Specification

Dewatering Equipment – Design Specification

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Revision details

Version No.	Clause	Description of revision
5	All	'SWC' replaced with 'Sydney Water'. Information from M34 (Rotary Drum Thickeners) and M35 (Centrifuges) removed from BMIS0209 and added as clauses 3.1-3.9 and 2.1-2.10, 2.15 respectively and amended. Clause 3.14 added. Amendments to clauses 2.11 Centrifuge sizing requirements, 2.12 Materials of Construction, 2.13 Centrifuge controls, 2.14 Electrical, 2.15 Testing and commissioning of centrifuges. Amendments to clauses 3.10 RDT sizing requirements, 3.11 Design criteria, 3.12 Materials of construction, 3.13 General control systems and electrical components. Addition of clause 3.14 Testing and Commissioning of RDT operation. Minor amendments to Appendices 1 and 2. Minor editorial changes elsewhere.
4	All	Document reformatted. Foreword, Copyright, General Terms and Definitions added. Changed 'shall' and 'should' to 'must' where relevant to SWC. 'Sydney Water' replaced with 'SWC'. Section 1.4 added. Minor amendments to sections 2.1.3, 2.1.4, 2.3, 3.1.1, 3.2.1, Appendices 1 and 2. Minor editorial changes elsewhere.
3	All	General update
2	All	General update
1	All	New Revision

Foreword

This Specification is for the design, supply and construction of dewatering equipment for Sydney Water assets.

Sydney Water makes no warranties, express or implied, that compliance with the contents of this Specification must be sufficient to ensure safe systems or work or operation.

It is the user's sole responsibility to ensure that the copy of the Specification is the current version as in use by Sydney Water.

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Acronyms

Acronym	Definition
AS	Australian Standards
DC	Direct Current
DIN	Digital Input
EN	European Standards
EPA	Environmental Protection Authority

Acronym	Definition
EPL	Environmental Protection License
HLR	Hydraulic Loading Rate
OTS	Sydney Water Operational Technology Services
I/O	Input / Output
IP	International (Ingress) Protection Marking
PLC	Programmable Logic Controller
PCA	Process Capability Assessment (Report)
PTC	Positive Temperature Coefficient
RDT	Rotary Drum Thickener
RSP	Rotary Screw Press
RTD	Resistance Temperature Detector
RPM	Revolutions Per Minute
SCA	Switchgear and Controlgear Assembly
SCADA	Supervisory Control and Data Acquisition
SLA	Service Level Agreement
SLR	Solids Loading Rate
SS316	Stainless Steel 316
SVI	Sludge Volume Index
UL	Underwriters Laboratories
VSD	Variable Speed Drive
WHS	Work, Health and Safety

General Terms and Definitions

Term	Definition
Sydney Water	The nominated person or organisation that has written authority to act on Sydney Water's behalf.
Contractor	The person or organisation responsible for the delivery, installation and commissioning of products, materials, equipment, and components described herein.
Supplier	The person or organisation responsible for the fabrication or manufacture and supply of products, materials, equipment, and components described herein.
Tenderer	The person or organisation responsible for the submission of the tender.

1. General

1.1 Scope

At Sydney Water's treatment facilities, there are several means to dewater digested sludges to biosolids and thicken waste activated and digested sludges for digester feed and recuperative thickening.

This Specification describes the general sizing and design requirements for dewatering equipment in Sydney Water's wastewater treatment and water recycling plants. This Specification applies to centrifuges and rotary drum thickeners (RDTs) that are due for renewals, or for new designs and installations.

1.2 Exclusions

Thickening and dewatering processes and equipment NOT described in this Specification are excluded from the scope of this Specification.

1.3 Objective

The objective of this Specification is to provide technical specifications and criteria for standardisation of dewatering equipment in Sydney Water's wastewater treatment plants. The intention is to ensure that a robust method for equipment selection and technical requirements are implemented to ensure the best possible quality and outputs are met for a reliable and capable 20-year life-cycle period.

This Specification will ensure reduced risk of undersized equipment being supplied, ensuring reliable and available redundancy.

This Specification will also provide a reduced risk of throughput constraints leading to higher operations and maintenance costs.

1.4 Standards

Equipment supplied and installed must be new and in accordance with the requirements of this Specification, Needs Specifications (if supplied), Drawings and job specific Technical Specification (where supplied) and the latest editions of the relevant Australian Standards and Sydney Water Technical Specifications, Water Services Association of Australia (WSAA) Codes of Practice, Water Industry Standards and Product Specifications.

Where there is no suitable Australian Standard available, an agreed international standard and/or industry current best practice must be adopted.

If an international standard is proposed in lieu of an Australian Standard, a detailed assessment to show that the proposed standard is equivalent or superior to the relevant Australian Standard must be provided to Sydney Water for acceptance.

The work must also comply with the requirements of all relevant bodies or codes, including but not limited to:

- SafeWork NSW
- NSW Environment Protection Authority (EPA)
- Power Supply Authorities
- Australian Communications and Media Authority
- Local Government Authority.

In the event of any ambiguity or discrepancy Sydney Water must be consulted as to the interpretation to be followed in carrying out the work.

2. Centrifuges

2.1 General

This section covers the general technical requirements for the dewatering/thickening centrifuge.

The centrifuge must:

- Be a horizontal decanter type unit comprising an outer rotating bowl and an inner scroll conveyor which must rotate in the same direction at a slightly different speed. The scroll must be arranged to thicken/dewater sludge to the conical end of the bowl to discharge through ports in the bowl periphery via a discharge chute. Centrate must be discharged through ports at the other end of the bowl for gravity discharge into the centrate chutes which are piped to the centrate pumping station.
- Be designed to produce at least 2500 G centrifugal acceleration when running at maximum speed.
- Meet the noise and vibration standards and requirements of this Specification at maximum G acceleration.
- Be fitted with a gearbox and a VSD drive to ensure a steady increasing load during start-up for both the bowl drive and the scroll drive. The torque of the scroll conveyor must be continuously monitored so that the optimum speed of the scroll conveyor, for a specific duty, can be maintained.
- Be supplied as a completely assembled unit on its base-frame and vibration take-up feet.
- The centrifuge must be supplied complete with ancillary equipment. Ancillary equipment must include logic controller, low harmonic frequency converters for both drives, push button stations, SS316 guarded sludge diversion gates (where needed and requested), central grease lubrication system, vibration isolators vibration take-up joiners for feed pipe connections, polymer dosing connections, cake discharge chutes and centrate discharge chutes.
- Be manufactured to DIN EN 12547 or equivalent standard.

All protective coatings for base-frames and non-wetted parts must comply with environments classed as “coastal corrosive” as per WSA 201, or equivalent, to withstand corrosive environments across sewage treatment plants for a design life of a minimum of 20 years.

Where centrifuges are to be installed on a steel mezzanine level, the centrifuge main supports must be isolated from the mezzanine floor and supported in isolation to surrounding access areas/structures to prevent harmonics, vibration and noise.

Special tools and lifting equipment must be provided to service the centrifuges and certified to AS 4991.

2.2 Centrifuge Installation and Design Requirements

The decanter design must incorporate, but must not be limited to the following:

- Facility for automatically regulating scroll drive must be provided. The differential speed must adapt automatically as a function of scroll torque and the solids content.
- Bearing design life must be a minimum of 8,000 hours or for the agreed period between machine overhauls.
- Conveyor bearings must be sealed to prevent contamination so additional lubrication is not required for the life of the bearings or between major overhaul intervals.

- Torque reducer unit and gearboxes must have a minimum design life of 40,000 hours before overhaul.
- Polymer injection points must be provided.
- Diverter gate (where requested) to divert solids discharge to drain during start up must be of 316 stainless steel and the gate including all moving parts to be guarded for safety upon opening and closing.
- Both the cake and the centrate chutes must have air vents at the same pressure and provisions for flushing of the vents and/or meet the specific vendor ventilation requirements.
- The differential speed must be adaptable automatically as a function of scroll torque and solids content in the bowl.
- Accessible safe sampling points for dewatered sludge and centrate must be provided.
- The centrifuge units must have flanged connections for feed and centrate and vibration take-up joiners for all fitted pipework as required by the manufacturer. These must be supplied with the centrifuge.
- Noise no greater than 85 dB at 1 m from the centrifuge at full speed

2.2.1 Centrifuge System Design Requirements

- Flow Transmitters and Flow Control Valves must be incorporated in the design for centrifuge flushing pipework to control the flow required by the supplier. This allows for the correct flow being supplied for the required flush flow rate required by the centrifuge supplier.
- Check Reclaimed Effluent or Flush Water Supply systems for adequacy in ensuring that a complete flush will be achieved without compromising other processes on site. If not, amplification of the flush water supply system must be included in the design. The designer shall determine the capacity based on the centrifuge supplier's reclaimed effluent requirements for flow, pressure, and quality to determine the total capacity. As flushing sequences differ from each supplier, the designer shall conservatively ensure that the reclaimed effluent requirements are met for the entirety of time needed to provide sufficient capacity.
- Sites that suffer from struvite in the dewatering process must consider RE demand to cater for a 1:1 ratio of RE for dilution of the ions causing the struvite. Example: If the feed rate is 7.0 L/s, an allowance of 7.0 L/s of RE needs to be added to the centrate line.
- Consideration shall be made for foaming of centrate receival tank. Spray bars may need to be added in the centrate receival tank.
- Consideration of reducing turbulence of the sludge feed and centrate streams must be incorporated. Such as, but not limited to, submerging feed sludge to any Feed Averaging Tanks upstream of the centrifuges, bottom fed FAT, along with centrate pipes entering the centrate tank being submerged. The turbulence avoidance is to ensure that CO_2 release and increase in pH is avoided in these streams.
- Dedicated density instruments must be incorporated into the design for the feed sludge concentration and installed on the pipework on the delivery side of the sludge feed pump. This ensures that the Centrifuge Feed Setpoint on SCADA can be set to a Solids Loading Rate setpoint, where the sludge density will govern the flow rate to achieve a constant solids load rate to the

centrifuge/s. This setpoint must be in kg/hr with the flow rate on a Flow Control Loop based on the Feed Solids Concentration.

The density transmitter shall be displayed on SCADA.

If the density instrument needs calibration or it has a fault, the PLC program shall operate a “forced mode” to a fixed density setpoint. The operator may choose Density Mode OR Fixed Mode as a selection on SCADA. Thus, either the density transmitter (when available) will vary the flow based on density to achieve the solids loading rate setpoint, or the “fixed density setpoint” will be used for the feed flow to achieve a kg/hr setpoint.

The solids loading rate setpoint regime will ensure that the polymer dosing system provides an accurate dose-rate based on actual solids in kg/DT.

- The Feed Macerators and Feed Pumps to the Centrifuges must be flushed at the end of each operation for a nominated time from SCADA setpoints provided by the designer. The time of flushing the feed line must ensure that the pipework from the Macerator through to the Centrifuge Inlet is clear of solids for readiness upon the next start request, then the “request to run” removed from the centrifuge controller by the plant PLC.
- The Centrifuge Flush sequence must occur after the feed system flush has completed.
- The polymer dosing point at the centrifuge inlet is to be the primary point of dosing.
- The designer must add a secondary polymer dosing point and be provided at 10 – 15 meters upstream of the centrifuge. Where the minimum of 10 meters cannot be provided based on the feed pumping system location, the designer must provide the secondary dosing point as far back as possible. **Note: The polymer dosing points must be installed downstream of the sludge feed flow meters.**

2.2.2 Centrifuge Mounting & Installation Requirements

If the centrifuges are to be installed on a steel structural frame mounted on the concrete floor, the centrifuge structural frame must not be connected to any walkways, steps or any other access means to prevent vibration transfer and noise from the centrifuge frame.

All structural steel must comply with the following Sydney Water Technical Specifications;

- Sydney Water Technical Specification – Civil (CPDMS0022)
- Sydney Water Technical Specification – Mechanical (BMIS0209)

The access platforms must be designed in a manner to allow maintenance and operating personnel to easily access lubricating points, bearings, inspection bowl drive, adjustment of weir plates, removal of centrifuge cover, access to instruments, access to manual and control valves of the centrifuge.

The centrate pipes installed must be the same diameter as the vendor outlet pipe (from the chute) to the destination receival centrate tank to ensure that the centrate flow is sized correctly without compromising the flow of drainage, avoid the risk of backflow and internal contamination of the centrifuge components.

Multiple rodding points must be provided for blockage removal along the length of the pipe.

All elbows on the centrate pipe must be of long radius bends.

Ventilation pipework must be sized as per the supplier’s recommendation and approved by the supplier prior to designing the pipework. Supplier’s installation instructions must be followed to ensure reliable operation

and ensuring that the supplier's warranty is not compromised. During the design phase for installation of new centrifuges, the above must be adopted, and any site-specific requirement adopted upon written approval from the supplier and Sydney Water.

The centrate pipe must be designed to reduce turbulence and, where possible, the discharge end must be submerged into the receival tank/channel of the centrate system, negating splashing and minimising turbulence.

There are many sites that suffer from "struvite build-up" in the centrate lines and complying with the requirements above, will minimise the potential of struvite build-up.

2.3 Centrifuge bowl

The bowl must be of the solid bowl decanter type and must be manufactured from Centrifugally Cast Stainless Steel (inland plants) or Duplex Stainless Steel (pitting corrosion resistant for ocean plants). The vendor to recommend based on location, confirming the needs specified here. The feed end of the bowl must be provided with circumferential discharge ports. The ports must be replaceable, or serviceable, and manufactured from high wear resistant material. Easily adjustable weir plates must be provided to vary the pond depth. The discharge port for the thickened/dewatered sludge and centrate must be designed to ensure free discharge and to avoid any build-up of material.

The complete assembly including drives, motor and lubrication system must be mounted and aligned on a sub frame. The frame must be a stainless steel or galvanised or painted steel frame. The steel base frame must be coated to WSA 201 or equivalent.

Heavy duty anti-vibration mountings must be located on the underside of the sub frame.

The equipment must be complete with all necessary items for efficient dewatering and thickening centrifuge operation.

2.4 Scroll conveyor

The scroll conveyor must be manufactured from material which can resist the wearing and corrosive effects of the sludge. The scroll flight tips must be designed to have a minimum design life of 15,000 hours. They must be protected by either ceramic or tungsten spray or carbide tiles to meet the sludge characteristics being fed. The supplier must be advised of the sludge characteristics prior to placement of the order to determine the right protection for the conveyor flights.

The scroll and bowl assembly must be statically and dynamically balanced before and after assembly.

2.5 Outer cover

The outer casing must be of minimum grade 316 stainless steel and must be designed to ensure segregation of cake and centrate into their respective discharge hoppers. The casing must be of two sections connected by a flanged joint with the upper half easily removable for inspection and servicing of the rotating assembly. The outer casing must have insulation under cover with acoustic material for noise reduction if noise doesn't meet ≤85 dB within 1 m proximity of the decanter at full speed.

2.6 Centrate discharge chute

The centrifuge assembly must be fitted with a grade 316 stainless steel centrate discharge chute which must collect all centrate without splashing. The centrate chute must be connected to the centrate pipe with a

vibration take-up joiner and allowing for free gravity of the liquid discharge without backing up into the machine (adequately vented).

2.7 Solids discharge chute

The centrifuge assembly must be fitted with a dewatered/thickened sludge chute which must direct all the dewatered /thickened sludge into the receiving conveyor/hopper.

The solids discharge chute must be connected to a diverter gate (where needed) manufactured from grade 316 stainless steel material with grade 316 stainless steel safety guards and separated by a vibration take-up piece supplied by the manufacturer.

The cake discharge outlet chute (post the diverter valve if fitted) must be sized to deliver dewatered/thickened sludge without spillage, to the receiving conveyor/hopper and must be of grade 316 stainless steel construction.

A flexible connection to the centrifuge discharge flange must be provided. The centrifuge discharge connection must not transmit any vibration or load from the centrifuge to the discharge chute to receiving chute.

The centrifuge centrate chute must terminate with a flange connection. The discharge pipe flange size must be of Table E with table D flange thickness to AS 2129 and vibration take-up joiners supplied as per supplier recommendations.

The vendor shall supply all details of the diverter gate to the designer.

The Designer will then be responsible to ensure that the diverter gate water supply is adequate, SCADA monitored, and as per all aspects of section 2.2.1 for demand and capacity of the required flow and demand of the flush water.

2.8 Feed tube

The feed tube must be manufactured from grade 316 stainless steel unless agreed to by Sydney Water.

2.9 Assembly

The complete assembly including drive motor and lubrication system must be mounted and aligned on a substantial steel sub-frame.

2.10 Lubrication system

A central grease lubrication system must be provided mounted on the centrifuge base assembly. Lubrication system details and bearings served are to be set by the manufacturer to ensure that the external bearings are greased correctly (grease volume and intervals) and specified in the O&M manuals.

2.11 Sizing standard – Note that this is how Sydney Water or Designers on behalf of Sydney Water must provide the information to the suppliers.

To ensure the best performance for both dewatering and thickening, the following principles must be applied.

A centrifuge operating at ½ (50 %) of its HLR and SLR capacity for dewatering digested sludge, produces the driest cake and the cleanest centrate. For WAS thickening operating at up to 75 % of its capacity produces the best thickening and centrate (also potentially negating the need for polymer addition).

There are three main values required for adequate sizing of the centrifuge. These are:

- Solids Loading Rate in kg/d (SLR).
- Hydraulic Loading Rate in kL/d (HLR).
- Desirable hours of operation per day.

The centrifuge specifications to the supplier are generally expressed purely as a duty required of Solids Loading Rate (SLR) in kg/hr, and a respective Hydraulic Loading Rate (HLR) in m3/hr.

NOTE: If the supplier has already factored in this sizing criteria from previous supply, the designer shall ensure that the sizing factors are not duplicated. It is crucial to ensure the right size centrifuge is being procured for duty.

The sludge characteristics must be provided to the supplier, such as:

- Sludge Type: Anaerobically Digested, Aerobically Digested or Waste Activated Sludge.
- %VS: Percentage of Volatile Solids (e.g. 84 %).
- High grit content, requiring extra abrasion protection. Details shall be accurately discussed and documented by the designer. The designer must provide this information to Sydney Water for approval to proceed with the agreed protection requirements.
- Temperature: 36 °C (for anaerobically digested sludge for example).
- Primary to WAS Ratio: For anaerobically digested sludges (e.g. 60:40).
- FOR WAS THICKENING: Provide the actual or expected SVI ml/g of the Waste Activated Sludge.

2.11.1 Steps for standard sizing method of digested sludges / sludge dewatering

a) The Designer must check the latest Process Capability Report or growth data and obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads.

b) Allow for a maximum of 20 hrs per day to treat the future daily required loads per centrifuge.

c) Apply the values from point a. above, to the following sizing formulae.

Solids Loading Rate kg/hr

= Future Solids Loading Rate (kg / day) / 20 hrs X 2

= Solids Loading Rate to be specified to the supplier in kg/hr

Hydraulic Loading Rate m^3/hr

= Future Hydraulic Loading Rate (kL / day) / 20 hrs X 2

= Hydraulic Loading Rate to be specified to the supplier in m^3 / hr

EXAMPLE: For Digested Sludge, if the future predicted peak Solids Load = 8,000 kg / day and the predicted peak Hydraulic Load = 520 kL /d

Specification to the supplier must be:

- Digested Sludge Characteristics (as mentioned above)
- SLR in kg/hr = 8,000 kg / d / 20 hrs X 2 **= 800 kg/hr (NOT the calculation, ONLY the kg/hr)**
- HLR in m3/hr = 520 kL / d / 20 hrs X 2 **= 52 m^3/hr (NOT the calculation, ONLY the m^3/hr)**

This ensures that the centrifuge offered will be operating at 50 % of the centrifuge capacity.

If the hours or operation are required to be less than the 20 hrs due to site specific needs, the equation will apply using the required hours of operation instead of the 20 hrs in the example above.

2.11.2 Step for standard sizing methods of waste activated sludge for thickening

a) Check the latest Process Capability Report and obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads.

b) Allow for a maximum of 23 hrs per day to treat the future daily required loads per centrifuge.

c) Apply the values from point a. above, to the following sizing formulae.

Solids Loading Rate kg/hr

= Future Solids Loading Rate (kg / day) / 23 hrs X 1.33

= Solids Loading Rate to be specified to supplier in kg/hr

Hydraulic Loading Rate m3/hr

= Future Hydraulic Loading Rate (kL / day) / 23 hrs X 1.33

= Hydraulic Loading Rate to be specified to supplier in m^3/hr

EXAMPLE: For Waste Activated Sludge, if the future predicted peak Solids Load = 5,500 kg / day and the predicted peak Hydraulic Load = 2520 kL / d, then the specification to the supplier must be:

SLR in kg / hr = 5,500 kg / d / 23 hrs X 1. 33 **= 318 kg / hr (NOT the calculation, ONLY the kg/hr)**
HLR in m^3 / hr = 2520 m^3 / d / 23 hrs X 1.33 **= 146 m^3 / hr (NOT the calculation, ONLY the m^3/hr)**

This ensures that the centrifuge offered will be operating at 75 % of the centrifuge capacity.

If the hours or operation are required to be less than the 23 hrs due to site specific needs, the equation will apply using the required hours or operation instead of the 23hrs in the example above.

2.12 Materials of construction

- Centrifuge bowl - Centrifugally Cast Stainless Steel (inland plants) or Duplex Stainless Steel (pitting corrosion resistant for ocean plants) and if highly abrasive sludge and/or exposed high chlorides, request details from the supplier as to options available in the grade of Stainless Steel required.
- Scroll - Centrifugally Cast Stainless Steel 316 or Duplex Stainless Steel.
- Scroll Flights - Stainless Steel 316 minimum.
- Scroll Flight Tip Protection - Tungsten Carbide Spray (minimum). For high abrasives in the sludge, request options from the supplier for Tungsten Carbide Tiles. Request any feedback from the Reliability Engineering team for a comparative duty from another site.
- Internal conveyor bearings to be sealed bearings and maintenance free between major overhauls.
- Feed Tube - Stainless Steel 316 minimum.
- Weir Plates - Stainless Steel 316 minimum.
- Frame - Coated Steel to withstand coastal corrosive environments and outdoor applications irrespective of the location classification for corrosion. Coating must meet WSA 201.

- Outer cover - Stainless Steel 316.
- Solids Discharge Ports - Tungsten Carbide, field replaceable Chilled White Cast Iron Alloy Bushes or equivalent.
- Chutes (solids and centrate chutes) - Stainless Steel 316.
- Solids Diverter Valve - Stainless Steel 316 with SS316 safety guards to be incorporated as per BMIS0209.
- Vibration Take-up Joins & all vibration compensators - NBR/Rubber Spring Type as per vendor's recommendation.
- Casing wear liner must be urethane or rubber based.
- Sample points integral with chutes to be made from Stainless Steel 316.

2.13 Centrifuge controls

All centrifuge and other related equipment operational functions must be arranged for fully automatic operation, governed by SCADA Control, to enable start-up and shutdown of the thickening/dewatering sequences.

The centrifuge controls/PLC must comply with D0000724 Sydney Water Treatment Plant SCADA Standards.

The control system must provide real data from all installed instruments as well as major alarms to the SCADA PLC system.

The Centrifuge motors must be provided as per the Sydney Water Electrical Specification CPDMS0022. The sensor must be connected to the control room to provide an alarm and trip function if the temperature exceeds the maximum temperature limit.

The supplier must provide a signal data map and wiring diagrams for Sydney Water's approval.

All alarms that are available to be signalled to the SCADA PLC, must be configured to the SCADA PLC via the communications protocol and addresses available.

The Centrifuge main bowl and scroll drives must be supplied with low harmonic variable speed drives.

The Centrifuge bowl speed must be capable of being set on SCADA via a setpoint write command to the centrifuge PLC in revolutions per minute (RPM).

The Centrifuge Starting/Base Differential Speed must be capable of being set on SCADA via a setpoint write command to the centrifuge PLC (this governs the scroll speed and differential speed of the bowl) in RPM.

The Centrifuge Flushing Differential Speed must be capable of being set on SCADA via a setpoint write command to the centrifuge PLC (this governs the scroll speed and differential speed of the bowl) in RPM.

The scroll drive must be automatically adjustable during operation to suit the varying characteristics and flow rate of the feed sludge to ensure optimum operating conditions.

The ability to vary weir levels by weir plate adjustment must be incorporated into the design of thickening centrifuges.

Once the plant is operating it must be capable of continuous unattended daily operation. The Contractor is responsible to arrange the equipment in the best engineering manner to fulfil the fully automatic operation.

The control system must control the main functions of the centrifuge from start-up to cake-production through to shut down. This system must communicate with the plant PLC control system to allow various auxiliary systems to start and stop and be varied.

The signal data map from the Centrifuge Controller, must send a command to the SCADA PLC for the following;

- Main Centrifuge Inlet Flushing Valve OPEN & CLOSE

- Diverter Gate Flushing Valve (if fitted with diverter gate) for OPEN/CLOSE
- Diverter Gate (if fitted) for OPEN/CLOSE

The SCADA PLC must be configured to read the requests from the Centrifuge Controller, and in AUTO mode, must be parallel rung code in the SCADA PLC to control the valves from the SCADA PLC digital output cards. Note: This is critical for unplugging a centrifuge in MANUAL mode, which will allow the operator to manually set the variables and control the flushing valves whilst the centrifuge has been given the “START” command, and “STOP” command from the SCADA.

If the centrifuge has an automated, SEPARATE, flushing sequence to unplug the centrifuge, the SCADA PLC will only need to request a “MANUAL FLUSH” and the assets mentioned above, must be either set in the Centrifuge Controller to ensure safe and adequate unplugging & flushing of the centrifuge by its own sequence. Note: If this sequence is NOT available, then the SCADA/PLC intervention must be applied.

The supplier must be informed of the needs and a signal data map & controller logic to enable the above feature (for manual flushing) and programmed to suit.

The centrifuge status must be relayed back to the SCADA PLC for transparency as to the step and state of the centrifuge sequence.

The required control system will allow the plant operator to adjust most of the centrifuge settings from the plant SCADA system without the need to attend the control panel provided with the centrifuge.

As a minimum, the following parameters must be adjustable from the plant SCADA system:

- Main Torque setpoint (kNm or % of drive).
- Divert to Outloading Torque setpoint (kNm or % of drive) if a diverter off-spec gate is required/recommended by the supplier.
- Divert to Centrate Torque setpoint on system Start-up (kNm or % of drive).
- Divert to Centrate Torque setpoint on system Shutdown (kNm or % of drive).
- Starting or “Base” differential speed (RPM).
- Flushing differential speed (RPM).
- Bowl speed (RPM).
- Flush/Shut-Down triggers such as high vibration, excessive torque or overloads of the drives, faults with machine drives and any other critical signals the manufacturer will request to shut-down the centrifuge. The centrifuge controller will send the output to the plant PLC input as to when the flush water valve must open and close. The plant PLC will send the output to the valve accordingly. Therefore, the centrifuge controller governs when to open and close the valve, not the plant PLC, though allows the operator to operate the centrifuge and manually open and close the flushing valve.
- Full control of each device individually in Local Mode (if selected from the controller, the plant PLC must interlock the centrifuge and the entire sequence from starting in this mode). The centrifuge must be in Remote Mode to allow for plant SCADA control and the automatic sequence.
- Defined Centrifuge logic provided for all sequences (centrifuge controller sequences/decanter status or step defined) to enable the plant PLC to schedule all surrounding assets and operate them as a system including centrifuge feed pumps, polymer dosing etc.

The minimum instrumentation to be supplied with each centrifuge must include but not necessarily be limited to the following:

- Vibration transmitters (signalled 4 - 20 mA signals back to plant PLC at all times) on main bearings - Both end bearings and signals for warning and shutdown alarms written from the Centrifuge PLC

to the SCADA plant PLC, predominantly for trending of each device, and for stopping/inhibiting the sludge feed and polymer dosing systems controlled by the SCADA PLC.

- Torque transducer with torque auxiliary contacts and other controls referenced in this Specification (or calculated drive torque as a %) - setpoint written to centrifuge PLC, though indicated to SCADA PLC.
- Bowl and scroll speed measurement signals for indication only to the plant PLC.
- Temperature for main bearings (signalled 4 - 20 mA signals back to plant PLC at all times) both end bearings and signals for warning and shutdown alarms written to plant PLC, though controlled as a safeguard by the centrifuge PLC. The signals to the SCADA PLC are for trending and visual online readings from SCADA.
- Interlocks for torque, motor amperage and vibration controlled by centrifuge PLC, though mapped for indication to the plant PLC.
- The scroll conveyor torque must be continuously monitored and controlled by the centrifuge PLC so that optimum relative speeds are maintained. If the solids loading exceeds the set limit of the scroll drive torque, the drive must raise an alarm signal sent to plant PLC.
- Speed Transmitters (if equipped) must be continuously monitored and controlled by the centrifuge PLC so that optimum relative speeds are maintained. The bowl speed reference must be mapped to the plant PLC for indication. If no speed sensors are installed, the supplier must calculate the speeds based on motor and VSD speed and pulley/gearbox ratios and provide the calculated speed signals back to the plant PLC.
- Total Instantaneous Power Consumption (module or calculated) signals back to the plant PLC in kW only if available by the supplier of the centrifuge.

2.14 Electrical

2.14.1 Local control panels

The local control panel must be mounted in an accessible location for its relevant centrifuge.

The control panel must be of IP65 rating or higher for wet-area applications, and as per CPDMS0022 Sydney Water Technical Specification - Electrical, for SCAs (inclusive of cable colour coding specifications)

The panel must not be bolted to the centrifuge base-frame as excessive vibrations can loosen terminals and circuit board components within the logic controller. It must be mounted on the skid base or beside the centrifuge on a stainless-steel base-frame and away from locations prone to damage by maintenance and inspection activities.

Any HMI or local interface displays must also be rated for wet-area applications and mounted on stainless steel frames at an accessible height to minimise bending or straining to reach and operate the local controls. Again, IP rated as specified for outdoors in the Sydney Water Technical Specification - Electrical CPDMS0022.

Centrifuge suppliers may decide to send all the hardware of the control system and VSDs loose, and to be installed by the Contractor to the Sydney Water Technical Specification - Electrical CPDMS0022.

2.14.2 General control systems and electrical components

The electrical components such as the controller module/PLC, communication protocols, VSDs and instrumentation must be accepted by Sydney Water Operational Technology division.

This will require Sydney Water's Operational Technology to approve of the control system and whether the hardware is easily accessible, maintainable, and compatible with Sydney Water's PLC and communications architecture.

- Electric Motors must be supplied as per Sydney Water Technical Specification - Electrical CPDMS0022.
- An Emergency E-stop or Latch Stop on the local control panel, must be wired as per the manufacturer's OEM instructions. This to ensure a safeguard of operation in case of an emergency, and generally will perform this function by activating a safety relay to the Bowl and Scroll VSDs upon pressing in the Emergency Stop or Latch Stop.
- The centrifuge cover must also have a switch which must trigger a safety relay to the Bowl and Scroll VSDs and act as per the E-Stop function. This switch must also be wired to the OEM manufacturer's requirements.
- VSDs are to be low harmonic VSDs and makes and models approved by Sydney Water if different to previously agreed makes and models.

2.15 Testing and commissioning of centrifuges

The Contractor must allow for commissioning and initial optimisation time to achieve the desired output of the site.

The Contractor will ensure that the point-to-point checks are commissioned and provide ITPs as per contract specifications including the D0001440 Technical Specification - Commissioning.

The supplier must provide a comprehensive optimisation report upon completion of the process optimisation and proving period after consistent operation of 30 days to Sydney Water's satisfaction.

Sydney Water's preference is to commence the wet commissioning with an 80 % deepest pond setting on the weir plates, at the safest, highest torque setting possible without compromising centrate.

The Contractor must allow for sampling and testing of the dewatering/thickening performance. The Contractor must conduct the sampling and testing over seven working days at the settings selected by the Contractor as per the supplier's manual.

The dewatering and thickening performance testing must be carried out in two phases. Two days initial testing must be carried out at the maximum capacity of the centrifuge. The second phase of testing must be carried out over five days at the design capacity.

During the testing of the centrifuge, the following parameters must be monitored, calculated and recorded:

a) Bowl speed (rpm)
b) Centrifugal force (g)
c) Pool depth (mm)
d) Differential speed (rpm)
e) Scroll torque (% or kNm) in the case of variable speed scroll drive
f) Sludge feed (m^3/hr)
g) Solids loading (kg/hr)
h) Feed solids concentration in sludge feed (%)
i) Solids concentration in dewatered/thickened sludge (%)
j) Polymer used (kg/dry ton – Active content for emulsions & 100% content for powder polymers to be tested based on the specific needs and polymer type – Powder or Emulsion)
k) Centrate solids concentration (NFR mg/L)

l) Solids Capture Rate (%: Target ≥ 95%)

The test will consist of four samples per day.

Samples, which will establish the solids concentrations of feed sludge, dewatered sludge and centrate, must be collected at the rate of one per every two hours for each centrifuge.

For dewatering centrifuge, the samples taken for each centrifuge must be tested for total solids concentration in the case of dewatered sludge cake and sludge feed, and suspended solids/Non-Filterable Residue (NFR mg/L) concentration for the centrate.

For thickening centrifuge, the samples taken for each centrifuge must be tested for total solids concentration in the case of thickened WAS and total suspended solids/NFR (mg/L) concentration in the case of the centrate and WAS feed.
It shall be noted that the driest cake for dewatering and cleanest centrate may be achievable at a lower RPM of the bowl speed anticipated.

The contractor and vendor will be responsible for achieving the highest dryness and best capture rates, and if lower bowl speeds can achieve this, then this can only be a credit to the supplier and contractor by saving bearing life as opposed to running at full speed and assuming that this is the best performance.
Any improvements of quality of sludge vs maximum speeds will be highly commendable.

2.16 See Appendix 1 for centrifuge datasheet

3. Rotary drum thickeners

3.1 General

RDTs are used within Sydney Water's facilities to either thicken waste activated sludge prior to digestion, or for recuperative thickening of the digestion processes.

The feed sludge enters the flocculation tank with the manufacturer's recommended polymer dosing point, or via a mixing device prior to the flocculation tank, where it is distributed for maximum flocculation and then introduced tangentially into the screen surface. Liquid gravitates downward through the screen slot openings passing through the screen, which retains the thickened sludge. Spiral pattern diverter flights and other manufacturer designed aids continuously move thickened sludge along the screen, into a discharge assembly and into a sludge hopper (as supplied by the manufacturer or custom built for the site and pumping needs (depending on target thickness and site layout).

This Specification must be adhered to as a baseline and innovations and advancements identified in the tender submissions.

Each RDT must:

- be designed to thicken sludge up to 8% (Dry Solids) and capture minimum 95% solids
- be designed to always have a clean screening surface to the oncoming wastewater stream while in operations. Spray piping must be arranged for external sparging, and for washing of the drum filter mesh. The drum thickener manufacturer must be ISO 9001 certified prior to drum thickener installation in Australia and units operating reliably at least 3 years at wastewater treatment applications.
- be manufactured for a 20-year design life and made from materials suited for coastal and high corrosive environments.
- consist of screening element/s, drum spray bar with accessible nozzles for effective intermittent cleaning cycles of the filter mesh, infeed mixing valves/mixing device (optional), flocculation tank with mixer (if mixer is integral to the flocculation tank proposed by the vendor) and polymer dosing port/s, full covers which are easily lifted by personnel, integrated solids discharge chute, sludge hopper (optional), base frame, filtrate outlet drain suited for maximum hydraulic loading rate via gravity, accessible sampling points for thickened sludge and filtrate, trunnions (if manufacturer design includes trunnions), central or accessible greasing points for bearings and drive unit appropriately geared to reliably thicken at maximum thickness at maximum hydraulic and solids loading rates.
- Have sample points integral to the design of the RDT which are safe to sample from without splashing onto staff.
- RDTs must be configured with a flocculation tank at the inlet of each Rotary Drum Thickener for maximum polymer mixing and flocculation efficiency.

If mixer is integral to the flocculation tank proposed by the vendor the mixers & motors must comply with the latest version of Sydney Water's Technical Specification Mechanical (BMIS0209), and the latest version Sydney Water's Technical Specification Electrical (CPDMS0022) respectively.

3.2 Drive system

A variable speed drive must be provided for controlling the speed of the drum. The cylindrical drum must be driven using a geared motor. The drive system must be designed to rotate the drum at maximum speed.

3.3 Cylindrical screen

The drum assembly must be constructed from 316 stainless steel unless accepted otherwise by Sydney Water. The drum filter mesh must be constructed from a minimum grade 316 stainless steel or polyester cloth. The manufacturer may recommend an alternative mesh to achieve the thickening requirements for specific applications, and approval for its use to be authorised by this specification's custodian.

3.4 RDT cover

The RDT cover must be designed to contain aerosol emissions from the rotating drum and the wash-water system. It must also serve to protect personnel from all the moving parts. The enclosure must be constructed of lightweight corrosion resistant material with structural integrity to withstand environmental conditions of the specific application and location of the site.

Easy lift drum covers to allow for staff to open the covers without lifting aids such as cranes etc. Lifting assisting devices must be integral to the cover or drum thickener design as supplied.

A suitable and permanent mechanism must be provided to retrieve the RDT cover handle when cover is fully opened. Inspection hatches for observation of the trunnions (if trunnion design is adopted), spray bars, discharge thickened sludge end must be provided with adequate open stays to prevent accidental cover closure.

Odour extraction ports of DN50 – DN100 mm must be provided from the enclosed unit.

3.5 Frame and access

The RDT must be installed with grade 316 stainless steel main body/frame, and the installation contractor must provide ladders, platforms and railings. All bolts, nuts, studs and washers must be grade 316 stainless steel and handrails and kick-plates made from aluminium.

The walkways around RDT to provide maintenance access must be as per Sydney Water Technical Specification – Civil (CPDMS0023).

Access platforms must be provided at a minimum of 800mm and no more than 1000 mm below the lip/access point to the RDTs (as required for nozzle and filter cloth maintenance) and any inspection hatches for ease of operations and maintenance.

3.6 Spray system

An Internal spray water system for periodic cleaning of the drum screen mesh must be provided. The spray headers must be grade 316 stainless steel with BSP connection. The headers must be furnished with vee jet nozzles or as recommended by the manufacturer for the most effective cleaning of the drum mesh.

The spray nozzles must be easily accessible for removal and cleaning.

Design Consideration for Sydney Water and Contractor Design: It is important to note that if reclaimed effluent (RE) is used then the RE supply must be designed to sustain 5 - 10 Bar of pressure at a quality of no greater than 200 microns whilst the sprays are either ON or OFF. This is to minimise spray nozzle blockages, and to ensure that the pressure is adequate for effective cleaning of the RDT drum mesh.

If the RDT is being used for "Primary/Raw Sludge Thickening", the designer shall provide an automated "hot water" flushing system for removing oils, grease, and fats to reduce the frequency of manual high pressure cleans.

The designer must ensure that the sizing and capacity of the reclaimed effluent system used for the RDT sprays, or alternate water system used for the RDT sprays, do not impact the needs, and demands across other areas of the treatment plant. To maintain water availability at the RDTs, a wholistic site water supply capacity and demand evaluation shall be carried out to ensure the quality and pressure required for the RDTs is constantly maintained without compromising other site process areas.

3.7 Thickened sludge pumping

The thickened sludge is recommended to be pumped directly out of the thickened sludge discharge hopper and directed by a stainless steel 316 chute into a progressive cavity “cake pump” to minimise friction losses and always ensure pumpability and at the thickest sludge concentration (%TSR).

3.8 Accessories

The following accessories must be provided for the operation and integration of the Rotary Drum Thickener specified in the above section.

3.8.1 Flocculation tank

The flocculation tank must be used to condition the sludge and chemicals and must be designed to give a minimum residence time of vendor recommended time within the tank. Alternatively, if recommended by the supplier, a mixing valve or mixing device at the inlet to the flocculation tank must be provided and be of 316 stainless steel construction with easily adapted polymer dosing points.

It must be made from not less than 2 mm thickness grade 316 stainless steel. It must include a single outlet that allows the conditioned sludge to flow by gravity into the inlet of the RDT.

Flanged feed inlet pipe, outlet pipe, overflow pipe and drainpipe must be provided. All flanges must comply with AS 4087 PN16.

If a mixer is required, it must have a motor installed suitable for a VSD for control of the mixer speed.

Flocculation Tanks are to have at least 2 x minimum DN50 ports on the lid to allow for Level Transmitters and High-Level Switches, along with an adequately sized odour extraction port. Flanged ends must be provided unless alternative connections are acceptable by Sydney Water. Note: The designer must specify the need to ensure that the penetrations & fittings are added to the manufacture, prior to site delivery.

The flocculation tank must have an accessible hinged lid for maintenance and product inspections.

3.8.2 Wash water system

If the site has limited service water for the spray system, then a wash water system must be installed and made up of a duty/standby pressure pump skid and tank with all interconnecting pipework, valves and electrical devices between the pump and tank.

An inlet and a single outlet must be provided with a control system to ensure the manufacturer recommended pressure is always maintained.

3.8.3 Chemical makeup and delivery system

Chemical dosing systems must be capable of automatically adjusting to changes in the treatment processes. Chemical makeup and delivery system must comply with the requirements stated in Clause M37 of Sydney Water’s Technical Specification Mechanical (BMIS0209).

3.9 Spare parts

Equipment must be provided with at least the following spare parts:

1. Trunnion Assemblies (Includes support blocks) if trunnion design
2. Set of nozzles (A set must include nozzles for both drum cleaning spray-bars if two are fitted)
3. Motor and gearbox assembly (optional)
4. Filter mesh for the drum.

3.10 RDT sizing standard

To ensure the best performance for thickening, the following principle must be applied.

There are five main values required for adequate sizing of the rotary drum thickener (RDT). These are:

- Solids Loading Rate in kg/d (SLR)
- Hydraulic Loading Rate in kL/d (HLR)
- Required hours of operation per day
- % Primary Sludge in RDT Feed.
- % Waste Activated Sludge in RDT Feed.

The RDT specifications to the supplier are generally expressed purely as a duty required of SLR in kg/hr, and a respective HLR in m^3/hr.

3.10.1 Steps for standard sizing method of thickening sludges

a) The Designer must check the latest Process Capability Reports and "Basis of Design" to obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads and use this value in the design, ensuring redundancy for the asset life of 20 years.

b) Provide Sludge Characteristics of the feed sludge

- Sludge Type: Anaerobically Digested, Aerobically Digested or Waste Activated Sludge
- Sludge Feed Concentration: %TSR of the feed sludge.
- %VS: Percentage of Volatile Solids (e.g. 84 %)
- Temperature: 36 °C (for anaerobically digested sludge for example)
- Primary to WAS Ratio: For anaerobically digested sludges (e.g. 60:40 based on mass ratio)

c) Allow for 23 hrs maximum per day to treat the future daily required loads per RDT or as per the design hours calculated to meet the current and future needs. This value is to enable the supplier to meet the maximum hydraulic load with the solids loading rate to determine the need of the duty and number of machines required.

d) Supply the information based on future peak loads to the supplier/manufacturer in the tender specification documents submitted.

e) The designer shall ensure 100% redundancy is utilised in the design to meet the above at the design asset life.

3.11 Design criteria

a) The sludge characteristics and duty need to be clearly defined. If aerobically digested sludge or waste activated sludge of concentrations of ≥1.0% TSR, then advise the supplier who may provide a modified version or internal baffle arrangement change as needed for the duty. Note: This is best discussed with the supplier early in the design and selection phase of a project.

b) Design Target Thickened Sludge Concentration must be submitted to the supplier.

c) Capture rate must be ≥95 % to ensure solids are separated adequately and minimising recycled solids back into the Treatment Plant.

d) Supply the information based on future peak loads to the supplier in the tender specification documents submitted.

e) Thickened Sludge Hoppers must be either provided by the supplier if available, or custom Thickened Sludge hoppers to be fabricated out of Stainless Steel 316 rigidly built to withstand any downstream potential pump cavitation.

f) The Thickened Sludge Hopper must have an inspection hatch, bottom and side mounted DN50 Stainless Steel Ports for an Analogue Level Transmitter (hydrostatic type) and Level Switch" Low" for installation of a capacitance level switch, as also advised by the supplier, or as per the design needs. The needs must be relayed to the supplier for any penetrations needed are manufactured and supplied with the RDT (if ordered from the supplier).

g) The designer must allow for an automated dilution control system for "Target Thickened Sludge Concentration" by means of a pipe sized adequately for the following
- Warm anaerobically digested feed sludge for recuperative thickening of anaerobic digesters.
- WAS feed sludge for WAS thickening.
- Aerobically digested sludge feed for recuperative thickening of aerobically digesters.
- Only for dilution flows of < 1 L/s may Reclaimed Effluent be used for WAS thickening and/or Recuperative Thickening of aerobic digesters to meet Target Thickened Sludge Concentrations.

h) To achieve the above, the designer shall ensure that a density meter is installed on the sludge feed pipework with a moving average calculated in the PLC, then using the feed flow setpoint and the feed density meter to determine the thickened sludge concentration from the thickened sludge flow.

i) The density transmitter shall be displayed on SCADA. *Note: This is only achievable if the thickened sludge pump operates to maintain a constant level in the thickened sludge hopper continuously*.

j) If the density instrument needs calibration or it has a fault, the PLC program shall operate a "forced mode" to a fixed density setpoint. The operator may choose Density Mode OR Fixed Mode as a selection on SCADA. This will allow for the Target Thickened Sludge concentration calculation to be always utilised via a virtual transmitter or calculated sludge concentration.

k) The use of the density and flow measurements in the sludge feed will ensure that the polymer dosing system shall provide an accurate dose-rate based on actual solids in kg/dT.

l) For WAS Thickening, the designer shall allow for item g) above, along with totalisation of dry solids & flow being wasted per day. The most desirable method is utilising the instrumentation to use previous day's wasting totalisers and incorporating a mass balance in an automated SRT mode for the secondary processes to meet the process requirement needs and Design Criteria of the specific site.

Where RDTs or Centrifuges are being used for Recuperative Thickening, the same as items g and h above shall be incorporated. The SRT being focused on the "Target Digester SRT", where the designer needs to incorporate a mass-balance calculation in the functional description to achieve a digester target sludge retention time.

m) It is strongly recommended that an wide throat cake progressive cavity pump is used for pumping high head and viscous Thickened Sludges. The Thickened Sludge Hopper base must match the perimeter of the auger/cake pump inlet chamber.

n) Check Reclaimed Effluent or Flush Water Supply systems for adequate capacity to ensure that a complete flushing sequence and RDT sprays will be achieved without compromising other processes on site. If so, amplification of the service water supply system shall be included in the design. The RDT supplier shall inform flow rates, pressure requirements and quality needs of the reclaimed effluent in their datasheets. The designer must ensure that these are always met.

o) For Anaerobically digested sludges, the designer must include Feed Macerators and Feed Pumps to the Rotary Drum Thickeners and shall be flushed at the end of each operation for a nominated time from SCADA setpoints that shall be provided by the designer. The time of flushing the feed line shall ensure that the pipework from the Macerator through to the RDT is clear of solids for readiness upon the next start request.

p) An RDT Flush sequence shall occur after the feed system flush has completed.

3.12 Materials of construction

The Rotary Drum Thickeners must comprise as a minimum the following components in the materials specified below:

- Drum Main Frame and Housing: Stainless Steel 316. If another grade of stainless steel is offered, it must be subject to approval by Sydney Water.
- Drum Rotating Element Frame: Stainless Steel 316. If another grade of stainless steel is offered, it must be subject to approval by Sydney Water.
- Drum Filter Mesh: Stainless steel 316 or polyester cloth. If an alternative mesh is recommended by the manufacturer, it must be subject to approval by Sydney Water.
- RDT Cover: Hinged UV stabilised Plastics/ABS with SS316 locking points and fasteners, hinges and struts (if equipped). Lightweight durable materials are required to withstand the elements of outdoor installations.
- RDT Spray Bars: SS316 Tube/Pipe and fittings with ease of access for angle adjustments to the spray pattern for drum mesh cleaning effectiveness.
- Spray Bar Water Spray Nozzles: SS316 or Equivalent in strength, rigidity and ability to withstand humid, coastal corrosive and odorous and acidic gases/environments. The spray-bar must withstand pressures of up to 10 Bar.
- Motors and gearboxes must be coated to withstand coastal corrosive environments and outdoor applications irrespective if indoors or not. Coating must meet WSA 201 and the RDT motors must be compliant with Sydney Water Technical Specification - Electrical CPDMS0022.
- Flocculation Tanks: Must be manufactured from minimum 2mm thick Stainless Steel 316.
- The flocculation tank must have an overflow port attached to the high-level point of the flocculation tank. This overflow port must also be made of Stainless Steel 316 minimum with a flanged end to allow for easy pipe connection.

3.13 General control systems and electrical components

Sydney Water will program the RDT sequence in the SCADA PLC to the functional specification that is recommended and provided by the RDT supplier.

The following electrical devices must be included as minimum to automate and enhance the operation of the screen.

1) Electric Motors must be supplied as per Sydney Water Technical Specification – Electrical (CPDMS0022) for electrical motor requirements.

2) 24VDC Valves for RDT spray systems, with digital limit switches must be used. The OPEN & CLOSE timing of the valve must be mechanically or electrically adjustable in the field. Angle seated valves may also be used. The time of opening and closing is crucial to ensure that the water pressure upstream is not affected, and that water hammer is negated. It is important that the spray supply control valves have OPEN & CLOSED feedback to SCADA with a discrepancy alarm for “Low Flow” when the valve is OPEN, and a “Flow Detected” alarm when the valve is CLOSED, this shall require adding a flow measuring device in the contractor’s design.

3) Rotary speed sensor, if recommended by the supplier.

4) A Level Transmitter and High-level switch (for flocculation tank). Reliable level indication is critical, thus hydrostatic type LTXs must be installed or other approved type by Sydney Water that is an inclusion by the RDT supplier.
5) 24VDC Flow Switches for spray system/s
6) 24VDC Pressure switches for spray headers.
7) The RDT cover must be provided with cover switches to stop the drive upon opening the lid, these switches must be latch stops and wired to the SCADA PLC so that the drive is stopped by the PLC in all modes, except for FIELD mode. A 24V local hand-station must be incorporated into the installation to allow for the RDT to be jogged (via a local jog button) and must have an Emergency Stop button (wired to the starter) and mounted close to the jog button. The Emergency Stop must be wired to the drive as a “hard-wired” emergency stop.

   This allows for rotating the drum for routine pressure washing of the drum mesh.
8) Wiring must be in accordance with the Sydney Water SCADA Standards and Sydney Water Technical Specification – Electrical CPDMS0022.
9) Close to each RDT skid or installation, the design must provide a single-phase and a three-phase power outlet to enable high-pressure cleaners & tools to be powered from within the close proximity of the RDT. The power outlets provided must be of close proximity, limiting the need for extension cables. Installation and design of these must be in accordance with Sydney Water Technical Specification – Electrical (CPDMS0022)

3.14 Testing and commissioning of Rotary Drum Thickener Operation

The Contractor must allow for commissioning and initial optimisation time to achieve the desired output of the site.

The Contractor will ensure that the point-to-point checks are commissioned and provide ITPs as per contract specifications including the D0001440 Technical Specification - Commissioning.

The supplier must provide a comprehensive optimisation report upon completion of the process optimisation and proving period after consistent operation of 30 days to Sydney Water’s satisfaction.

Noting that the control variables listed below of the drum thickener operation shall be optimised for the three individual functions in which they are used across Sydney Water.

1. WAS Thickening
2. Recuperative Thickening
3. Raw Sludge Thickening

The Contractor must allow for sampling and testing of the thickening performance. The Contractor must conduct the sampling and testing over seven working days at the settings selected by the Contractor as per the supplier's manual.

The thickening performance testing must be carried out in two phases. Two days initial testing must be carried out at the peak design capacity of the RDT. If the site process cannot risk any processes for this phase, it must be agreed to by Sydney Water to what capacity will be required.
The second phase of testing must be carried out over five days at the design capacity to cater for the site’s current process needs.

During the testing of the drum thickener, the following parameters must be monitored, calculated and recorded:

a) Drum speed (rpm)
b) Drum motor speed (%).
c) Spray ON time (secs)

d) Spray OFF time (secs)

e) Sludge feed flow (m^3/hr)

f) Solids loading rate (kg/hr)

g) Feed solids concentration in sludge feed (%TSR for Recuperative Thickening Function and Raw Sludge Thickening)

h) Feed solids concentration in sludge feed (NFR mg/L for WAS Thickening)

i) Solids concentration in thickened sludge (%TSR)

j) Polymer feed rate (L/h), Polymer concentration, Polymer dose rate (kg/dry tonne. Note: If emulsion polymer is used, the dose rate must be expressed as the active content of the polymer in kg/dry tonne)

k) Filtrate solids concentration (NFR mg/L)

l) Solids Capture Rate (%: Target ≥ 95%).

m) Target thickened sludge concentration Setpoint on SCADA vs Actual thickened sludge concentration (%TSR: Ensuring any dilution control loop is accurate and stable).

Note: Where dilution control is implemented to achieve desired thickened sludge control, the sample of thickened sludge must be taken from a representative location downstream of the thickened sludge pump.

The test will consist of four samples per day.

Samples, which will establish the solids concentrations of feed sludge, thickened sludge, and filtrate, must be collected at the rate of one sample every two hours for each rotary drum thickener.

For thickened sludge, the samples taken for each rotary drum thickener must be tested for total solids concentration in the case of thickened sludge and sludge feed for recuperative thickening and raw sludge thickening, and suspended solids/Non-Filterable Residue (NFR mg/L) concentration for the WAS feed sludge and filtrate.

3.15 See Appendix 2 for rotary drum thickener datasheet

Ownership

Ownership

Role	Title
Group	Engineering and Technical Solutions (ETS)
Owner	Engineering Manager, Engineering and Technical Solutions
Author	Jason Smith, ETS – Senior Mechanical Engineer

Change history

Version No.	Prepared by	Date	Approved by	Issue date
5	Mark Ziogas, Jason Smith	30 June 2024	Norbert Schaeper	30 June 2024
4	Mark Ziogas, Jason Smith	29 Oct 2021	Dinesh Dineshharan	29 Oct 2021
3	Mark Ziogas	18 Dec 2019	Tate Brammer	18 Dec 2019
2	Mark Ziogas	28 Mar 2019	Tate Brammer	28 Mar 2019
5	Mark Ziogas	28 Nov 2016	Iain McGregor	28 Nov 2016
0	Mark Ziogas	07 Nov 2016	Iain McGregor	07 Nov 2016

Appendices

Attachment	Title
1	Data sheet for vendor supply of centrifuges
2	Data sheet for vendor supply of RDTs

Appendix 1 Data sheet for vendor supply of centrifuges

Sydney WATER			Schedule of Rates and Technical Proposal	
Supply of Centrifuges			**Sydney Water Location**	
			OPERATING CONDITIONS	
			Duty/Standby (N+1 required)	
			Process Medium (Sludge Type)	
			Primary Sludge to WAS Mass Ratio (% / %)	
			Feed Sludge Dry Solids Concentration (%TSR)	
			Feed Sludge %Volatile Solids (%VS)	
			SVI (mL/g) – WAS Thickening Only	
			Feed Sludge Temperature (°C)	
			Fluid pH (pH)	
			Each Unit Duty Peak Requirement - HLR (m^3/hr)	
			Each Unit Duty Peak Requirement - SLR (kg/hr)	
2	Model Identification	-	Tenderer to advise	
3	Manufacturer	-	Tenderer to advise	
4	Country of Manufacture	-	Tenderer to advise	
5	Leadtime (from order to Site delivery)	Weeks	Tenderer to advise	
	Equipment Warranty Details			
6	Warranty period post commissioning	Years	Tenderer to advise	
	PERFORMANCE REQUIREMENTS			
7	Equipment Noise Assessment @ 1 m	dB	Tenderer to advise	
8	G-Force (maximum)	m/s^2/9.81	Tenderer to confirm '>3000 (i.e. 'High G')	
9	Hydraulic Load Rate Capacity Minimum	m^3/hr	Tenderer to advise	
10	Hydraulic Load Rate Capacity Maximum	m^3/hr	Tenderer to advise	
11	Solids Load Rates (Min)	kg/hr	Tenderer to advise	
12	Solids Load Rates (Max)	kg/hr	Tenderer to advise	
13	Sludge Inlet Pressure Required	kPa(g)	Tenderer to advise	
14	Overall Solids Capture Rate	%	Tenderer to confirm > 95 % (REQUIRED)	
15	Vibration level at Maximum Speed	mm/s	Tenderer to confirm ≤6	
16	B_{10} Bearing Life. Min design 8000 hrs	hours	Tenderer to confirm design	

Sydney WATER	Schedule of Rates and Technical Proposal			
	Supply of Centrifuges		**Sydney Water Location**	
17	Centrifuge failsafe mode in the event of Power loss		Tenderer to confirm design features	
	OTHER FEATURES (Optional or extra)			
18	Flow Configuration (Co Current or Counter current)	-	Tenderer to advise	
19	Weir Plate Design	-	Nb. Must allow for a full range of pond depth. Tenderer to confirm.	
20	Negative Pond Depth Maximum	mm	Tenderer to advise	
21	80 % Max Pond Depth (Of Min Radius)	Note	***Required to be set from Factory to Site. Tenderer to confirm.***	
22	Odour Control	-	Fully sealed unit.	
23	Scroll Conveyor Flight Wear Protection	-	Tenderer to confirm design	
24	Scroll Conveyor Flight Tips Minimum Design Life	hours	Tenderer to confirm design	
25	Feed Zone Wear Protection	-	Tenderer to confirm design	
26	Scroll/conveyor bearings - SEALED. Min design 8000 hrs.	hours	Tenderer to confirm design	
	SPEED REDUCTION / CONTROL			
27	Bowl Speed (maximum)	rpm	Tenderer to advise	
28	Scroll Speed (maximum)	rpm	Tenderer to advise	
29	Differential Speed (maximum range)	rpm	Tenderer to advise	
30	Drive Detail (Direct / Belt / Chain / Gearbox) VFD's per unit	-	Tenderer to advise	
31	Type and Number of Stages	-	Tenderer to advise	
32	Manufacturer	-	Tenderer to advise	
33	Service Factor	-	Tenderer to advise	
34	Final Drive Ratio	-	Tenderer to advise	
35	Torque Control (Torque Sensor OR %Torque OR Both)		Tenderer to advise	
36	Maximum Torque of Unit Offered	% / kNm	Tenderer to advise	
	SOLIDS DIVERTER VALVE - OPTIONAL ONLY		**Tenderer to provide detailed information, drawings, O&M**	
37	Description	-	Actuated sludge diverter valve to direct off-spec sludge to centrate outlet at start-up	
38	Valve actuation method	-	pneumatic	

Sydney WATER	Schedule of Rates and Technical Proposal			
	Supply of Centrifuges		**Sydney Water Location**	
39	Time to fully actuate	s	Tenderer to advise	
40	Valve limit switches	-	"Normally Open" 24 V DC required for both open and closed	
41	Vibration take-up joint/s	-	Required between solids diverter valve and centrifuge	
	SOLIDS DIVERTER VALVE FLUSHING			
42	Medium	-	Reclaimed Effluent (filtered to 500 µm)	
43	Required pressure	kPa	Tenderer to advise	
44	Flow (Instantaneous)	L/s	Tenderer to advise	
45	Number of connections	-	Tenderer to advise	
46	Connection size and type	-	Tenderer to advise	
	SCROLL MOTOR DETAILS			
47	Type	-	Electric squirrel cage induction motor	
48	Model	-	Tenderer to advise	
49	Manufacturer	-	Tenderer to advise	
50	IP Rating	-	56	
51	Frame	-	Tenderer to advise	
52	Maximum Starts	/h	Unlimited	
53	Power	kW	Tenderer to advise	
54	Speed (nominal)	rpm	Tenderer to advise	
55	Voltage	V	415 +10 % - 15 %	
56	Frequency (nominal)	Hz	50	
57	Suitable for VSD	Y/N	Tenderer to advise	
58	Method of Mechanical Overload Protection	-	Tenderer to advise	
59	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise	
60	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise	
61	Full load current	A	Tenderer to advise	
62	Windings temperature protection	-	Required for motors >=5.5 kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings	
63	Bearing temperature protection	-	Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings and/or bearings	

Sydney WATER	Schedule of Rates and Technical Proposal			
	Supply of Centrifuges		**Sydney Water Location**	
64	Anti-condensation heater	-	Required - 240 V AC	
	BOWL MOTOR			
65	Type	-	Electric squirrel cage induction motor	
66	Model	-	Tenderer to advise	
67	Manufacturer	-	Tenderer to advise	
68	IP Rating	-	56	
69	Frame	-	Tenderer to advise	
70	Maximum Starts	/h	Unlimited	
71	Power	kW	Tenderer to advise	
72	Speed (nominal)	rpm	Tenderer to advise	
73	Voltage	V	415 +10 % - 15 %	
74	Phase	No.	Three	
75	Frequency (nominal)	Hz	50	
76	Suitable for VSD	Y/N	Yes	
77	Method of Mechanical Overload Protection	-	Tenderer to advise	
78	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise	
79	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise	
80	Full load current	A	Tenderer to advise	
81	Windings temperature protection	-	Required for motors >=5.5 kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings	
82	Bearing temperature protection	-	Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings and/or bearings	
83	Anti-condensation heater	-	If Required - 240 V AC	
	INLET FLUSHING			
84	Medium	-	Reclaimed Effluent (filtered to 500 µm)	
85	Required pressure	kPa	Tenderer to advise	
86	Flow (Instantaneous)	L/s	Tenderer to advise	
87	Other – Compensator pipes and fittings	-	Connections provided by others in inlet pipework. Tenderer to advise on compensator pipes and fittings supplied.	

Sydney WATER			Schedule of Rates and Technical Proposal	
	Supply of Centrifuges		**Sydney Water Location**	
88	Machine must be capable of slow wash cycles of forward/reverse bowl sequence No. of forward and reverse cycles (Max)	No. Cycles	Tenderer to advise or manufacturer to advise on recommended flushing sequence	
89	Recommended forward and reverse low bowl speed RPM for water cycle.	RPM	Tenderer to advise or manufacturer to advise on recommended flushing sequence and Bowl Speed recommendation during flushing	
90	Recommended flush water flow during forward and reverse low bowl speed flushing cycles.	L/s	Tenderer to advise or manufacturer to advise on recommended flushing water flow requirements	
	CRITICAL DIMENSIONS			
91	Bowl Diameter	mm	Tenderer to advise	
92	Bowl Length	mm	Tenderer to advise	
93	Volume	L	Tenderer to advise	
94	G - Volume	m^3	Tenderer to advise	
95	Length to diameter ratio	-	Tenderer to advise	
96	Beach angle	degrees	Tenderer to advise	
97	Inlet Flange Size	mm	Tenderer to advise	
98	Inlet Flange Rating / Type	-	Tenderer to advise	
99	Centrate Flange Size	mm	Tenderer to advise	
100	Centrate Flange Rating / Type	-	Tenderer to advise	
101	Solids Discharge Connection	mm	Tenderer to advise	
102	Overall Length	mm	Tenderer to advise	
103	Overall Width	mm	Tenderer to advise	
104	Overall Height	mm	Tenderer to advise	
	MATERIALS			
105	Bowl	-	Tenderer to advise	
106	Scroll	-	Tenderer to advise	
107	Scroll Flights	-	Tenderer to advise	
108	Inlet Tube	-	Tenderer to advise	
109	Weir Plates	-	Tenderer to advise	
110	Frame	-	Tenderer to advise	
111	Cover	-	Tenderer to advise	
112	Solids Discharge Ports	-	Tungsten Carbide, Ceramic replaceable, Tenderer to confirm	
113	Chutes	-	Stainless steel 316	
114	Solids Diverter Valve	-	Stainless steel 316	
115	Vibrate take up joint	-	Tenderer to advise	
	WEIGHTS			
116	Overall - Dry	kg	Tenderer to advise	
117	Overall - Under full load	kg	Tenderer to advise	

Sydney WATER	Schedule of Rates and Technical Proposal			
	Supply of Centrifuges		**Sydney Water Location**	
118	Rotating Assembly	kg	Tenderer to advise	
119	Scroll Motor	kg	Tenderer to advise	
120	Bowl Motor	kg	Tenderer to advise	
121	Dynamic Loading	kN	Tenderer to advise	
	OPERATIONAL NOISE			
122	Sound Power Level at 1m	dB(A)	Tenderer to advise	
	EQUIPMENT PRICING			
123	Delivery DDP to site	Each	Tenderer to advise	
124	Installation Support	Hourly rate	Tenderer to advise	
125	Commissioning	Hourly rate	Tenderer to advise	
126	Lifting Frames or attachments required for installation	Unit	Tenderer to advise	
127	Training	Hourly rate	Tenderer to advise	
	Operation and Maintenance Manuals			
128	O&M manuals	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
129	Drawings including, General Arrangements, Exploded views, and detail dimensional drawings	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
130	Piping and instrumentation diagrams	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
131	Signal data Map for communication addressing of signals back to site PLC and STEP files for3D BIM use in design and lifecycle modelling	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
132	Installation standard specifications and check sheets	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
133	Documented operational training guides,	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
134	Lubrication specifications and schematics	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
135	A comprehensive catalogue of critical spare parts in the RFT response that is considered necessary for routine	Y/N	Tenderer to confirm documentation has been provided as part of their submission	

Sydney WATER	Schedule of Rates and Technical Proposal	
Supply of Centrifuges	**Sydney Water Location**	
maintenance and breakdowns usage		

Appendix 2 Data sheet for vendor supply of RDTs

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
			Process Duty - WAS Thickening and Recuperative Thickening - Municipal Wastewater	
			Units Required	
			OPERATING CONDITIONS	
			Duty/Standby (N+1 required)	
			Process Medium (Sludge Type)	
			Primary Sludge to WAS Mass Ratio (% / %)	
			Feed Sludge Dry Solids Concentration (%TSR)	
			Feed Sludge %Volatile Solids (%VS)	
			Feed Sludge Temperature (°C)	
			Fluid pH (pH)	
			Each Unit Duty Peak Requirement - HLR (m^3/hr)	
			Each Unit Duty Peak Requirement - SLR (kg/hr)	
			Operation hrs per day	
Item No:	**Item**	**Units**	**Sydney Water Requirement/Comment**	
	EQUIPMENT MANUFACTURING DETAILS			
1	Equipment Make	-	Tenderer to advise	
2	Model Identification		Tenderer to advise	
3	Manufacturer	-	Tenderer to advise	
4	Country of Manufacture	-	Tenderer to advise	
5	Leadtime (from order to Site delivery)	-	Tenderer to advise	
6	Equipment Warranty Details			
7	Warranty Period post commissioning	years	Tenderer to advise	
	EQUIPMENT CAPACITY			
8	Hydraulic Loading Rate - Maximum Capacity	m^3/hr	Tenderer to advise	
9	Solids Loading Rate - Maximum Capacity	kg/hr		
10	Flocculation Tank Make	-	Tenderer to advise	
11	Flocculation Tank Model	-	Tenderer to advise	
12	Flocculation Tank Type	-	Tenderer to advise	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
13	Flocculation Supporting Equipment	-	Tenderer to advise	
	AMBIENT CONDITIONS			
14	Temperature Range	°C	0 to 45	
15	Relative Humidity	%	40 to 80	
	WASHWATER (RDT)			
16	Fluid	-	Reclaimed effluent, filtered to 200 microns. Tenderer to confirm acceptance (Y/N)	
17	Fluid - Additional Filtration Requirement (if required)	micron	Tenderer to advise	
18	Consumption (per RDT)	L/hr	Tenderer to advise	
19	Instantaneous maximum flowrate (each unit)	L/s	Tenderer to advise	
20	Instantaneous minimum flowrate (each unit)	L/s	Tenderer to advise	
21	Required minimum pressure (for effective drum washing)	kPa	Tenderer to advise	
22	Typical duration wash water is on	minutes	Tenderer to advise	
23	Typical duration wash water is off	minutes	Tenderer to advise	
24	Number of solenoid valves	No off	Tenderer to advise	
	DIMENSIONS (RDT)			
25	Overall length	mm	Tenderer to advise	
26	Overall width	mm	Tenderer to advise	
27	Overall height	mm	Tenderer to advise	
28	Sludge inlet flange size	mm	Tenderer to advise	
29	Sludge inlet flange rating / type	-	Tenderer to advise	
30	Flush water inlet connection size	mm	Tenderer to advise	
31	Flush water inlet connection rating / type	-	Tenderer to advise	
32	Liquid discharge connection size	mm	Tenderer to advise	
33	Liquid discharge flange rating / type	-	Tenderer to advise	
34	Thickened sludge discharge connection type / details	-	Tenderer to advise	
35	Drum Diameter	mm	Tenderer to advise	
36	Drum Length	mm	Tenderer to advise	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
	ODOUR (FLOCCULATION TANK)			
37	Odour Connection	-	Tenderer to advise	
38	Odour Connection Size	NB / DN	Tenderer to advise	
39	Odour Connection Type	-	Tenderer to advise	
40	Odour Connection Standard	-	Tenderer to advise	
	MATERIALS (RDT)			
41	Covers	-	Tenderer to advise	
42	Casing - Grade 316 stainless steel (min)	-	Tenderer to advise	
43	Casing Thickness (minimum 2 mm)	mm	Tenderer to advise	
44	Frame - Grade 316 stainless steel (min)	-	Tenderer to advise	
45	Drum / Screen - Grade 316 stainless steel (min)	-	Tenderer to advise	
46	Spray nozzles; (No off and type)	-	Tenderer to advise	
47	Filter Type cloth or mesh	-	Tenderer to advise	
48	Bearings	-	Tenderer to advise	
	WEIGHTS (RDT)			
49	Overall (dry)	kg	Tenderer to advise	
50	Overall (wet/full)	kg	Tenderer to advise	
51	Drum assembly	kg	Tenderer to advise	
52	Motor and gearbox	kg	Tenderer to advise	
53	No. of supports	no.	Tenderer to advise	
54	Load per support (maximum)	kN	Tenderer to advise	
	DRUM DRIVE MOTOR			
55	Type	-	Electric squirrel cage induction motor	
56	Model	-	Tenderer to advise	
57	Manufacturer	-	Tenderer to advise	
58	IP Rating	-	56	
59	Frame	-	Tenderer to advise	
60	Maximum Starts	no./hr	6 (note: VSD driven) Tenderer to advise	
61	Power	kW	Tenderer to advise	
62	Speed	rpm	Tenderer to advise	
63	Voltage	V	415 +10 % - 15 %	
64	Phase	No.	Three	
65	Frequency (nominal)	Hz	50	
66	Suitable for VSD	Y/N	Tenderer to advise	
67	Method of Overload Protection	-	Tenderer to advise	
68	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
69	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise	
70	Full load current	A	Tenderer to advise	
71	Windings temperature protection	-	Required for motors >=5.5 kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings	
72	Bearing temperature protection	-	Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings or bearings	
	GEARBOX (RDT)			
73	Type	-	Tenderer to advise	
74	Manufacturer	-	Tenderer to advise	
75	Configuration	-	Tenderer to advise	
76	Ratio	-	Tenderer to advise	
77	Output Speed Range	rpm	Tenderer to advise	
78	Torque Range	Nm.	Tenderer to advise	
79	AGMA Service Factor	-	>1.25, Tenderer to advise	
80	Maintenance/Lubrication Requirements	-	Tenderer to advise	
	SPEED REDUCTION / CONTROL (RDT)			
81	Max drum speed	rpm	Tenderer to advise	
82	Min drum speed	rpm	Tenderer to advise	
	ACCESSORIES (RDT)			
83	Drum Inclination Adjustment / Control	-	Tenderer to advise	
84	Outlet adaptor	-	Sludge hopper and probes	
85	Inlet flexible connection	-	Tenderer to advise	
86	Drum lifting tool	-	Required to AS 4991	
87	Other lifting and support devices	-	Tenderer to advise in Spare Parts submission	
88	Drum speed/motion switch	-	Required	
89	Overwash sensor	-	Tenderer to advise	
90	Thickened sludge sample point with valve	-	Required	
91	Liquid discharge sample point with valve	-	Required	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
92	Other Flocculation Equipment Optional or Required (e.g. mixing valves etc)	-	Tenderer to advise details	
	DIMENSIONS (FLOCCULATION TANK)			
93	Flocculation tank required?	Y/N	Tenderer to advise	
94	Diameter	-	Tenderer to advise	
95	Height	mm	Tenderer to advise	
96	Volume	litres	Tenderer to advise	
97	Tank Dry Weight	kg	Tenderer to advise	
98	Sludge inlet connection size	mm	Tenderer to advise	
99	Sludge inlet flange rating / type	-	Tenderer to advise	
100	Sludge outlet connection size	mm	Tenderer to advise	
101	Sludge outlet flange rating / type	-	Tenderer to advise	
101a	Polymer Inlet			
101b	Ventilation connection			
102	Overflow connection size	mm	Tenderer to advise	
103	Overflow flange rating / type	-	Tenderer to advise	
104	High Level Switch Make / Model Details (24 V DC VEGA preferred by SW: model Vegaswing).		Tenderer to advise	
105	Analogue Hydrostatic Level Transmitter 24 V DC 4-20 mA (VegaWell or Vegabar preferred)		Tenderer to advise	
	PERFORMANCE (Flocculation Tank) - If required			
106	Mixing Velocity Gradient	s^{-1}	Tenderer to advise	
107	Flocculation detention time at average feed rate	sec	Tenderer to advise	
108	Flocculation detention time at peak feed rate	sec	Tenderer to advise	
	PERFORMANCE (MIXING VALVES or OTHER) - If Applicable			
109	Polymer injection and mixing valve minimum no. of pipe diameters upstream of RDT unit	No.	Tenderer to advise	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
110	Is the static mixer or mixing valve of non-clogging type?	Y/N	Tenderer to advise	
110	Typical valve pressure loss	kPa	Tenderer to advise	
111	Maximum valve pressure loss	kPa	Tenderer to advise	
112	Other Flocculation Devices		Tenderer to advise	
	MATERIALS (FLOCCULATION TANK)			
113	Main tank body. Grade 316 stainless steel	-	Tenderer to advise	
114	Main tank body thickness Minimum 2 mm	mm	Tenderer to advise	
115	Lid / cover	-	Tenderer to advise	
116	Mixer shaft and paddle	-	Tenderer to advise	
	ODOUR (FLOCCULATION TANK)			
117	Odour Connection (Required)	-	Tenderer to advise	
118	Odour Connection Size. DN50 (minimum)	NB / DN	Tenderer to advise	
119	Odour Connection Flange Type	-	Tenderer to advise	
120	Odour Connection Standard	-	Tenderer to advise	
	FLOCCULATOR DRIVE (Flocculation tank)			
119	Flocculator drive and mixer required?	Y/N	Tenderer to advise	
120	Type	-	Electric squirrel cage induction motor	
121	Model	-	Tenderer to advise	
122	Manufacturer	-	Tenderer to advise	
123	IP 56 Rating (Minimum)	-	Tenderer to advise	
124	Frame	-	Tenderer to advise	
125	Maximum Starts	no./hr	Tenderer to advise	
126	Power	kW	Tenderer to advise	
127	Speed	rpm	Tenderer to advise	
128	Voltage	V	415 +10 % - 15 %	
129	Phase	No.	Three	
130	Frequency (nominal)	Hz	50	
131	Suitable for VSD	Y/N	Yes - Required	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
132	Method of Overload Protection	-	Tenderer to advise	
133	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise	
134	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise	
135	Full load current	A	Tenderer to advise	
136	Windings temperature protection	-	Required for motors >=5.5 kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding or bearings	
137	Bearing temperature protection	-	Where required by Sydney Water, for motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings or bearings	
138	Anti-condensation heater	-	Tenderer to advise	
	FLOCCULATION TANK MIXER GEARBOX - If required			
140	Type	-	Tenderer to advise	
141	Manufacturer	-	Tenderer to advise	
142	Configuration	-	Tenderer to advise	
143	Ratio	-	Tenderer to advise	
144	Output Speed Range	rpm	Tenderer to advise	
145	Torque Range	Nm	Tenderer to advise	
146	AGMA Service Factor	-	>1.25, Tenderer to advise	
147	Maintenance/Lubrication Requirements	-	Tenderer to advise	
	THICKENED SLUDGE DISCHARGE HOPPER			
148	Length x Width	mm	Tenderer to advise	
149	Height	mm	Tenderer to advise	
150	Working Volume	m^3	Tenderer to advise	
151	Geometry	-	Sloped floor to discharge, Tenderer to advise	
152	Mass Empty	kg	Tenderer to advise	
153	Mass Full	kg	Tenderer to advise	
154	Sludge inlet connection size	mm	Tenderer to advise	
155	Sludge inlet flange rating / type	-	Tenderer to advise	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
156	Sludge outlet connection size	mm	Tenderer to advise	
157	Sludge outlet flange rating / type	-	Tenderer to advise	
158	Overflow connection size	mm	Tenderer to advise	
159	Overflow flange rating / type	-	Tenderer to advise	
160	Drain Valve Required	-	Tenderer to advise	
161	Tank body. Grade 316 stainless steel preferred	-	Tenderer to advise	
162	Tank body thickness Minimum 2 mm	mm	Tenderer to advise	
163	High Level Switch Make / Model Details (24 V DC VEGA preferred by SW).		Tenderer to advise	
164	Analogue Hydrostatic Level Transmitter 24 V DC 4-20 mA (VegaWell or Vegabar preferred)		Tenderer to advise	
165	Flushing Water Nozzle/Inlet (Min 50 mm)	DN	Tenderer to advise	
	EQUIPMENT PRICING			
166	Unit price DDP to site	No. of Units	Tenderer to advise	
167	Delivery DDP to site	Unit Price	Tenderer to advise	
167a	**Delivery DDP to site**	**TOTAL per site**	Tenderer to advise	
167b	Sludge Hopper price -	Unit	Tenderer to advise	
168	Installation Support	Hourly rate	Tenderer to advise	
169	Commissioning	Hourly rate	Tenderer to advise	
170	Lifting Frames or attachments required for installation as per AS 4991	Unit	Tenderer to advise	
171	Training	Hourly rate	Tenderer to advise	
	DOCUMENTATION: Operation and Maintenance Manuals and Other			
172	O&M manuals	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
173	Drawings including, General Arrangements, Exploded views, and detail dimensional drawings	Y/N	Tenderer to confirm documentation has been provided as part of their submission	

	Sydney WATER		Schedule of Rates and Technical Proposal	
	Supply of Rotary Drum Thickeners		**Sydney Water Location**	
174	Piping and instrumentation diagrams	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
175	Detailed Functional Description with reference to P&ID for native programming. All critical alarms identified and sequences in high detail.	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
176	STEP files for #D BIM use in design and lifecycle modelling	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
177	Installation standard specifications and check sheets	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
178	Documented operational training guides	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
179	Lubrication specifications and schematics	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
180	A comprehensive catalogue of critical spare parts in the RFT response that is considered necessary for routine maintenance and breakdowns usage	Y/N	Tenderer to confirm documentation has been provided as part of their submission	