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DIVISION 11000 – CLARIFIER MECHANISMS

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CLARIFIER MECHANISMS

PART 1 - GENERAL

1.1 General

.1 Contract scope includes the design, supply, delivery, installation assistance and commissioning of all equipment and appurtenances required for the complete replacement of 3 clarifier equipment systems inside existing concrete clarifier basins as shown on Drawings included with this Bid Opportunity.

.2 Scope of Supply consists of the following major items:

.1 Provide installation instructions and equipment shop drawings.

.2 Fabricate and supply the equipment.

.3 Store and protect equipment in a manner that prevents damage or premature aging.

.4 Deliver the equipment;

.5 Inspect delivered equipment;

.6 Provide installation training;

.7 Inspect and accept each installed clarifier system;

.8 Supervise equipment performance testing and commissioning;

.9 Provide as-constructed Drawings;

.10 Provide technical support and remedy defects during the Warranty Period as detailed in GC 10.

.3 Include all accessories required to ensure the new clarifier systems operate safely and satisfactorily.

.4 Provide any appurtenances or services not specifically mentioned or included in the Contract Documents but which are necessary as part of the Work to ensure that the equipment is fully operational when installed.

1.2 Coordination

.1 Co-operate and liaise with the Install Contractor to facilitate smooth transition from supply to installation and commissioning.

1.3 Installation Instructions

.1 No later then eight (8) weeks following contract award, provide detailed installation instructions suitable for use in assisting the Install Contractor to assess the level of effort required to install the clarifiers. This submission shall include:

- Installation instructions
- List of parts
- Overview and detail drawings describing the size of components to be shipped, and weights of major sections or components.
- Provide handling instructions indicating specific requirements to ensure there is no uneven wear or distortion of components.

1.4 Shop Drawings

.1 Refer to GC 4.04 - General Conditions.

.2 Submit complete shop drawings within 8 weeks of notification of Contract Award.

.3 Furnish as a minimum the following design and description information to establish compliance with these specifications:

1. Certified general arrangement and tank dimensional drawings.
2. Certificate of design stamped by a Professional Engineer registered and in good standing in the jurisdiction of design stating that the equipment to be provided for this project meets or exceeds all design requirements of these specifications. The certificate shall state the respective loads and design criteria.
3. Drive mechanism rating calculations, stamped by a Professional Engineer registered and in good standing in the jurisdiction of design, verifying the compliance of the drive gears and bearings with the specified continuous torque rating and bearing life rating.
4. Motor data and catalogue information. Electrical drawings as applicable to the supply of the clarifier equipment manufacturer.
5. Catalog cut sheets marked to indicate specific model and size, for purchased sub-components.

1.5 Operating and Maintenance Manuals

.1 Not less than four (4) weeks prior to commissioning the first of three clarifiers, submit to the Contract Administrator for review two (2) draft copies of Operating and Maintenance (O&M) manuals containing information required by the Specifications.

.2 Submit O & M manuals in paper & electronic format.

.3 Furnish four (4) complete operations and maintenance manuals. Provide information as specified in this Section for installation check-out, operation, maintenance, and lubrication requirements for each unit of mechanical, electrical, and instrumentation equipment.

.4 Customize the O&M manuals to describe the equipment actually furnished. Do not include extraneous data for models, options, or sizes not furnished. When more than one (1) model or size of equipment type is furnished, show the information pertaining to each model, option or size.

.5 Each manual shall be a bound, indexed binder with drawings and parts lists prepared specifically for this project.

.6 In addition to information called for in the Specifications, include the following:

.1 Title sheet, labeled "Operating and Maintenance Instructions", and containing project name and date.

.2 List of contents.

.3 Certified as-constructed record drawings of all systems supplied. Include overview, general arrangement and detail drawings.

.4 All accepted shop drawings.

.5 Full description of entire mechanical and electrical system and operation.

.6 Address and telephone number of the Contractor and the nearest Contractor's Representative, including distributors for parts, servicing, and repairs.

.7 Detailed Specification and O&M instructions for all items of equipment provided including a preventative maintenance program.

.8 Process control/operating instructions for each component and the entire system as a whole. This shall include, but not necessarily be limited to:

.1 The Contractor's recommended step-by-step procedures for starting and stopping under normal and emergency operation. Include all specified modes of operation including recommended operation after the assembly or equipment has been in long-term storage.

.2 Control diagrams with data and information to explain operation and control of systems and specific equipment.

.3 Technical information on all alarms and monitoring devices provided with the equipment.

.4 Routine maintenance requirements including procedures and specific description of consumable items such as lubricants, filter, seals, etc. and listing Canadian sources of supply.

.5 Complete disassembly, inspection, repair and reassembly instructions including required tolerances, fastener preloads, specialty tools and any other information necessary to restore equipment to correct operation.

.7 List of spare and replacement parts and consumables, specifically noting wear items, long delivery items, and other items convenient for stocking as optional replacement items.

.8 List of special tools.

.9 Nameplate information including equipment number, make, size, capacity, model number, serial number and equipment tag.

.10 Submit separately originals of all warranties and guarantees.

1.6 Equipment Delivery

.1 The schedule shall allow for a two (2) week period for the Contract Administrator to review and comment on the Contractor’s Shop Drawings.

.2 Ten (10) days before delivery, give notice to the Contract Administrator.

.3 Goods shall be delivered to the project site at 2230 Main Street, Winnipeg, Manitoba in accordance with D13. Goods shall be delivered F.O.B destination, freight prepaid.

.4 Pack and crate each component to provide protection during storage, handling, and transport. The Contractor shall identify each component with durable labels or tags securely attached to each piece of equipment, crate or container.

.5 Protect polished and machined metal surfaces from corrosion and damage during shipment and storage. Protect threaded connections with threaded plugs or caps. Pack electrical equipment and control panels to prevent scratching, access by dirt, moisture, or dust or damage to insulation. Cover equipment having exposed bearings and glands so as to exclude foreign matter. All openings in the

equipment shall be covered before placement in storage. Sufficient lifting hooks shall be supplied for handling all crates or boxes and heavy pieces.

.6 There is little room on-site for material storage. Therefore store clarifier systems until delivery is requested by the Install Contractor. As necessary meet with the Install Contractor and co-ordinate the sequence and timing of material deliveries with him. Material lists and installation drawings provided by the Contractor would be used as guidelines to assist in planning the delivery schedule.

.7 Once all material for one clarifier system has been completed and placed in storage by the supplier, payment will be processed as per the Supplementary Conditions section D17.

.8 Once authorized by the Contract Administrator, material can be shipped. The Contractor shall make available all details of shipment pickup and delivery dates, including information that will permit the Install Contractor to track the delivery's progress to the site.

.9 The Install Contractor will be responsible for unloading material delivered under this contract.

.10 The Install Contractor will inspect material delivered as it is unloaded against packing slips and the Supplier's detailed material lists. The Contractor's representative may wish to be present for unloading. The Install Contractor will then sign for and accept responsibility for the material delivered.

1.7 Installation Support

.1 Provide detailed, illustrated instructions regarding equipment installation. If it is found necessary, or if so directed by the Contract Administrator, the Contractor's Representative may be asked to visit the site to provide assistance during installation.

.2 Prior to completing installation, the Contract Administrator will inform the Contractor and arrange for his attendance at the Site to verify successful installation.

.3 Then conduct a detailed inspection of the installation including wiring, electrical connections, controls and instrumentation, rotation direction, running clearances, lubrication, workmanship, and all other items as required to ensure successful operation of the equipment.

.4 Identify any outstanding deficiencies in the installation and provide a written report to the Contract Administrator describing such deficiencies.

.5 The Contract Administrator will make arrangements to resolve deficiencies and the Contractor shall then re-inspect and provide written confirmation each clarifier has been correctly installed and is ready for commissioning. This final inspection would include running the clarifier dry and performing dry torque tests.

PART 2 - PRODUCT

2.1 Description

.1 Provide three (3) primary clarifier mechanisms suitable for installation in the City's existing concrete basins as shown on the contract drawings. Two clarifiers are nominally 35 m and one of 44 m diameter.

.2 Each mechanism shall be a center column supported, center feed unit with peripheral effluent collection. Provide a center drive mechanism for rotation of the rake arms and scum skimming mechanism.

.3 Design the equipment to effectively settle suspended solids and scrape the settled solids from the basin floor to the sludge withdrawal sump as shown on the drawings. The clarified effluent shall be collected uniformly by the peripheral launder. Surface scum shall be collected by the scum skimming equipment and discharged through the scum withdrawal pipe.

.4 The equipment furnished for each clarifier mechanism shall include but not be limited to:

- walkway,
- center drive assembly,
- center drive platform,
- center support column with inlet openings,
- energy dissipating inlet (EDI),
- feedwell
- center cage,
- sludge collection arms with rake blades,
- surface scum skimming equipment,
- effluent weir plates and scum baffle,
- anchorage parts
- anchorage parts, anchor bolts, gaskets and assembly fasteners.

.5 Design systems to avoid or mesh with obstructions left behind by removal of existing clarifier systems, including bolts, steel plates and similar items.

2.2 Materials

.1 Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 6 mm (1/4") with:

- All structural steel conforming to ASTM A-36 requirements; and
- steel plate conforming to ASTM A283C requirements.

.2 All aluminum fabrication shall conform to:

.1 CSA/CAN 3-S157 Strength Design in Aluminum
.2 CSA W59.2, Welded Aluminum Construction
.3 CSA S244, Welded Aluminum Design and Workmanship
.4 CSA W47.2 Certification of Companies for Fusion Welding of Aluminum

.3 Unless noted otherwise all anchor bolts and other fasteners including handrail, skimmer, and rake blade squeegee fasteners shall be 316 stainless steel. Temporary bolts used for assembly only shall be high tensile steel. Apply an NSF approved anti-seize compound to all threads in mechanical connections.

.4 The centre cage and submerged rotating trusses for the support of scrapers, sludge collection devices, skimmers, etc., shall be all-welded steel construction.

.5 Design the drive main bearing for the total rotating weight with a minimum AFBMA B10 bearing life of 200,000 hours, suitable for 24 hour continuous operation.

.6 Design all main drive components to provide a minimum wear life of 20 years.

.7 Design all bearings other than the drive main bearing for a minimum AFBMA B10 bearing life of 100,000 hours, suitable for 24-hour continuous operation.

2.3 Clarifier Operating Parameters

		35 M (115 ft)	44M (145ft)
.1	Winter Design Average Flow	29.4 ML/d	46.2 ML/d
.2	Summer Design Average Flow	35 ML/d	55 ML/d
.3	Design Peak Flow	115.5 ML/d	181.5 ML/d
.4	Wastewater Temperature	5 to 20C	
.5	Average Ambient Temperature	-24 to +26C	
.6	Extreme Ambient Temperatures	-45 to +40C	

2.4 Design Requirements

.1 Minimum design torques are listed below. Alarm, shut-off and ultimate torque shall be 120, 140 and 200% of the design AGMA continuous running torque listed respectively. No portion of the mechanism shall be damaged if operated for a few seconds at the ultimate torque value.

		35 M (115 ft)	44 m (145 ft)
.1	Drive continuous running torque	81,150 N-m	128,260 N-m
.2	Mechanism rotation	Clockwise	Clockwise
.3	Rake arm tip speed, approximately	3 m/min	3 m/min

2.5 References

.1 American Society of Testing Materials (ASTM):
1. A36 Structural Steel Specifications
2. A992 Structural Steel Specifications
3. 304 Bolt Specifications
4. A123 Hot-Dip Galvanized Coatings
5. A153 Hot-Dip Galvanized Bolts
6. A48 Cast Iron Specifications
7. A536 Ductile Iron Specifications
8. A283C Steel Plate Specifications

.2 American Iron and Steel Institute (AISI), Heat Treated Steel Specifications
.3 American Gear Manufacturers' Association (AGMA), Gear Ratings
.4 American Welding Society (AWS), Current Standards
.5 Anti-friction Bearing Manufacturers' Association (AFBMA), Bearing Life Specifications
.6 National Electrical Manufacturer's Association (NEMA), Motor Design Standards and Standards for Control Enclosures

2.6 Center Drive Assembly

.1 Provide a center drive assembly with an integral motor and primary speed reducer coupled through roller chain and sprockets to a secondary worm gear reducer driving the main gear through a pinion. Provide an integral overload protection system. A cycloidal reducer directly coupled to the motor without the use of chains and sprockets and keyed to the pinion shaft is also acceptable.

.2 The intermediate worm gear reduction unit and the final gear reduction unit shall be the product of the Contractor. Units purchased from a third party manufacturer will not be acceptable.

.3 The complete package shall be of sufficient strength to sweep in changes 50mm grout on the tank bottom under its own power if required.

.4 The continuous output torque rating of the spur and pinion gearing shall be based on the smaller of the rating values determined from the ANSI/AGMA standard and a design life of 20 years. The drive shall be designed and rated to develop the torque values listed in Section 2.4.

Submit for both sizes of clarifiers, calculations stamped by a Professional Engineer substantiating that the continuous output torque rating and design life conform to the specified values. Calculations shall include the spur gear, pinion, worm gear set, and all bearings used in the intermediate worm gear reduction unit and the final gear reduction unit.

The spur gear and pinion calculations shall specify the values used for the following design parameters for surface durability and strength ratings:

Number of Pinions	Pinion Pitch Diameter
Actual Face Width	Tooth Diametrical Pitch
Tooth Geometry Factors (I and J Factors)	Hardness Ratio Factor
Load Distribution Factor	Elastic Coefficient
Aspect Ratio	Life Factor
Allowable Contact Stress	Application Factor
Allowable Bending Stress	Rim Thickness Factor

Design the center drive unit for the continuous torque rating as specified in Section 2.5. The continuous torque shall be defined as the minimum torque at which the drive mechanism may operate continuously 24 hours per day, 365 days per year, for 20 years, at the specified sludge collector arm speed. Main gear and pinion calculations shall be based on Spur and Pinion Gearing: ANSI/AGMA 2001-C95, "Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth." standard for rating the pitting resistance and bending strength of involute spur and helical gear teeth. Calculations shall clearly present the values used for the design parameters. Specifically, the load distribution factor shall be determined by the empirical method. For parameters which are material dependent, such as allowable contact stress, the calculations shall include a complete description of material and heat treatment used.

Size drive units such that the worm gear, spur gear and pinion meet Design Running Torque requirements in accordance with AGMA 2001-D21 and 6034-B92.

The continuous torque rating for the drive unit shall be the lowest value determined for the gearing.

.5 All gears and bearings shall be oil bath lubricated with the main bearing totally submerged in oil. Oil pumps are not permitted.

The oil reservoir for the main bearing and gear shall have a section of minimum depth 50 mm (2”) below the main bearing to positively prevent contamination of the main bearing and gears with condensate or

other contaminants. Gear and bearing housings must also be fitted with oil level sight glasses and condensate drains. Condensate must be allowed to drain from a low point of the housing. Condensate and contaminants shall not drain through the lower pinion bearing.

.6 Drive components will be located via a machined, registered fit to preserve the alignment of key drive components under all load conditions. Inspection of the completed drive unit shall be accomplished at the clarifier manufacturer's shop, with reports of all tests and certifications of material hardness being made available for review at the Contract Administrator's request prior to shipment to the job site.

.7 No underwater bearings shall carry any part of the vertical thrust load and all gearing must be completely enclosed and oil lubricated.

.8 Major drive components, main gears and bearings must be designed to allow for separate and individual replacement by plant personnel to facilitate quick and economical repairs.

.9 The primary gear reducer shall be of either worm/worm gear, helical or cycloidal design and shall be C-face or integrally mounted to the electric motor. The motor shall be minimum 1.0 HP (1.5 HP for 44 m diameter clarifier).

.10 The full voltage non reversing starter for the rake drive motor will be located remotely in the City's motor control centre.

.11 Supply all electrical devices on the rake drive, factory mounted and wired to the extent it is practical to ship.

.12 The motor shall be TEFC and suitable for Class 1 Division 1 environment. It shall be rated 575V, 3ph, 3W.

.13 Control devices, heat tracing, etc shall be NEMA 4X and again suitable for a Class 1 Division 1 environment.

.14 Submit a recommended motor control diagram for the City's use, as well as a control narrative providing a description of operation and the settings for all control and protection devices.

.15 Gearmotors shall conform to ANSI/AGMA 60009-A00, and shall have a service factor of 1.4, based on the specified continuous running torque. Gear reducers with a C-face mounted drive motor shall conform to ANSI/AGMA 6010-F97 and shall have a service factor of 1.25. All gearbox bearings shall be of the anti-friction type and running in oil in a ductile iron or fabricated steel housing.

.16 The motor and primary speed reducer shall drive a secondary worm gear reducer through a #60 roller chain and steel sprockets enclosed in a fibreglass, molded polyethylene, or galvanized 22 gauge steel guard. Sprockets and chain shall be designed for the connected horsepower of the drive with a minimum service factor of 4.0. Provision shall be made for adjustment of chain tension.

.17 The main drive unit shall consist of a worm gear secondary reduction unit, pinion and main spur gear assembly. The secondary reducer shall be a worm gear reducer specifically designed for this application. The worm gear shall be ductile iron or centrifugally cast high strength manganese bronze. The worm shall be hardened alloy steel. A pinion and shaft shall be keyed to the worm gear to transmit power from the worm gear to the spur gear. In order to maintain proper alignment between the pinion and the spur gear, the pinion shall be supported by bearings both above and below the spur gear. The bearings shall be fitted into precision machined bearing pilots to positively insure bearing and gear alignment.

.18 Minimum ball raceway diameter: 1.8m (72”). Load carrying balls: Minimum diameter 13mm (1/2”), chrome alloy hardened to 60-65 Rockwell C.

.19 The main gear shall rotate and be supported on a ball bearing assembly provided with four replaceable liner strips fitted into the main gear and turntable base. Liner strips shall be special vacuum degassed, carbon corrected, alloy steel hardened to a Rockwell hardness of at least 43 to 46 Rc. The turntable base shall be a minimum 25mm (1”) thick to insure adequate structural rigidity to properly support the drive bearing and gear. Forged alloy raceway fully contoured precision bearing sets are also acceptable.

.20 The main gear and bearing shall be completely enclosed in a ductile iron or fabricated steel housing provided with neoprene dust seals. In order to ensure the maximum possible base rigidity and vibration dampening the gear housing shall be of full sidewall construction, integral with the base. If requested, shop inspection reports shall be made available for review.

.21 The ductile iron housings shall be cast as a single piece to provide a leak proof enclosure. Seals or gaskets located below the oil level will not be acceptable. The base of the housing shall be mounted on the top flange of the stationary center column and designed to support the internal spur gear, the rotating clarifier mechanism, one end of the access bridge and bridge cover system. The housing shall be complete with seals, oil level dipstick, oil fill, and valved oil and condensation drains. A positive means of removing condensation and contaminant from the lower pinion-bearing pocket shall be provided.

.22 The condensate removal system shall drain condensate from the lowest points of the housing as the condensate accumulates without operator attendance. The system shall accommodate changes of lubricant specific gravity through a slip coupling in the discharge portion of the system in order to maintain the system in equilibrium. The system shall not be adversely affected by evaporation of water from the system and shall have a positive means to prevent loss of water from the system due to evaporation of condensate from the system discharge by positive sealing of the system discharge when condensate is not being drained.

Provide heat trace tape and insulation for the exposed portions of the condensate system. The operation of the heat trace tape shall be controlled by a thermostatic switch set to energize the heat trace tape when the ambient temperature falls below 5°C. Provide heat trace tape to prevent freezing of the condensate removal pipe and a space heater for condensate control in the overload housing.

Condensate removal systems that are affected by evaporation or differences in lubricant specific gravities, are not acceptable.

Lubrication of the gear teeth shall be accomplished by means of an oil dam and the meshing action of the pinion and the internal gear teeth that shall force lubricant up the face of the teeth. Designs that require auxiliary oil pumps or circulating systems for lubrication will not be acceptable.

.23 Overload Protection: Equip the drive unit with an electro-mechanical overload control device actuated by thrust from the worm shaft, or a device which directly measures torque from the main pinion. The control device shall activate an alarm for warning of overload, a motor cutout for overload protection and a back-up safety motor cutout for back up overload protection. The respective switches in the overload control device shall be factory calibrated and set to the following settings:

1. Alarm - 120% of Design Running Torque
2. Motor cutout – 140% of Design Running Torque
3. Back-up motor cutout - 140% of Design Running Torque.

All drive control components shall be mounted in a waterproof enclosure of cast iron, epoxy coated aluminium, or stainless steel with a gasket sealed, removable cover. Cover the pointer with a clear plastic enclosure and install above the platform surface for visibility from the platform.

2.7 Walkway Access Bridge and Enclosure

2.7.1 Walkway

.1 Provide a 1.0m (39") clear, open width walkway extending from the tank wall to the center drive platform. Support the walkway at the center by the drive unit and on the opposite end by the tank wall. As a minimum the walkway shall be designed to safely withstand all dead loads plus a live load of 4.8 kN/m^2 (100 psf) with a maximum deflection of 1/360 of the entire span. The walkway shall consist of two (2) trusses, sufficiently braced to resist the specified design loads. Truss height shall be 1070mm (42") and be provided with a midrail.

.2 The walkway shall fit into the existing clarifier concrete wall ledge that currently supports the existing walkway.

.3 The walkway decking shall be 32mm(1-1/4") aluminium I-Bar grating.

.4 Provide a center drive operations platform a minimum of 3.8 x 3.8 metres to provide clearance around the center assembly and drive control for maintenance and service.

.5 The drive platform shall be decked with minimum 6 mm slip resistant aluminium checkered floor plate and have sufficient structural steel supports to meet the specified design load conditions.

.6 Provide handrails around the center drive platform where the walkway truss does not act as a handrail. The top rail shall be at 1070 mm height.

Provide toe plate along both sides of the walkway and around the center drive platform. The toe plate shall be a 100 mm x 6 mm plate or a 100 mm tall aluminium plate or extruded channel.

The handrailing shall be 38mm (1-1/2") diameter aluminium pipe, 2-rail design, with fittings factory assembled to posts. Ship railings in stock lengths for cutting and fitting.

.7 Provide isolation between dissimilar metals and concrete at the connection points to prevent corrosion.

.8 Provide allowance for mounting City supplied sludge blanket sampling hand pump on walkway.

.9 Provide lifebuoy mounted on walkway.

.10 Provide safety davit with minimum design davit live load 18.0 kN applied in any direction. Mount the safety davit to one side of the walkway.

.11 Safety davit: model number PNUS101-SS complete with sleeve cap model number PNUS106-SS as manufactured by Pelsue. Use 316 stainless steel bolts, nuts, plates and washers for mounted sleeves in accordance with manufacturer's instructions. Provide stainless steel cable to secure sleeve cap to bridge.

2.7.2 Enclosure

.1 The walkway shall be protected by a metal clad insulated enclosure. The width and height of the enclosure shall match the dimensional requirements of the existing enclosure as shown on the existing enclosure drawings attached. The roof and wall construction of the enclosure shall include: 22 Ga

prefinished exterior metal cladding, 24 Ga interior galvanized metal liner; R20 insulation. Provide a flexible rubber shirt at the base of the wall to function as a seal to the water surface. The walkway shall be offset within the enclosure. The enclosure shall be supported at the center by the drive unit and on the opposite end by the tank wall. The enclosure shall be designed to support all dead and live loads as per the requirements of the 2005 NBC. The enclosure and walkway shall be supported independent of each other to facilitate removing the enclosure separate from the walkway. The enclosure shall be designed to be removed as a unit.

2.8 Center Cage and Rake Arms

.1 Provide a center cage of steel truss construction and connections for the two (2) sludge removal arms and feedwell supports. Bolt the top of the cage to the main gear which shall rotate the cage with the attached arms and feedwell. The minimum angle size used for construction of the cage and rake arms shall be 50 x 50 x 6 mm members.

.2 Design to hold the sludge collection devices in a horizontal and vertical plane when subjected to momentary ultimate torque.

.3 Connection to the internal spur gear shall be adjustable for proper alignment and allowance for structural tolerances.

.4 The clarifier mechanism shall include two (2) sludge removal arms of steel truss construction with steel raking blades and adjustable 20 gauge, 316 stainless steel squeegees. The rake blades shall be properly spaced to insure complete raking of the basin floor twice per revolution.

.5 Arms shall require no tie-bars for supports and should be an all shop welded construction.

.6 The cage and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at twice the drive design rating.

2.9 Center Column

.1 Provide a stationary center column with minimum 6 mm thick steel and suitably reinforced and designed to withstand the stalled torque of the drive mechanism. One end shall have a suitable support flange for bolting to the foundation with a minimum of twelve (12) 32 mm (1-1/4") diameter anchor bolts as shown on the plans. Provide a similar flange at the top of the column for supporting and securing the center drive assembly.

.2 Openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the feedwell. Size and location of outlet port shall be determined by the manufacturer based on limiting the velocity to 0.50 metres per second at peak flow.

2.10 Feedwell [and Energy Dissipating Inlet]

.1 Support the feedwell with structural members attached to the center rotating cage. Fabricate the feedwell from 4.7 mm (3/16") steel plate with upper and lower reinforcing rim angles and stiffeners as required. Minimum feedwell diameters shall be 6.0 m and 7.5 m for the 35 m and 44 m diameter clarifiers respectively.

.2 Install the feedwell top at the average daily liquid level.

.3 Equip the clarifier with an energy dissipating inlet located inside the rotating feedwell. The dissipating inlet shall be designed to dissipate the energy of the incoming flow thereby inducing flocculation of the feed solids. The energy dissipating inlet shall have a bottom plate extending to within 25 mm (1") of the

center column. The well shall be constructed of 4.7 mm plate. Baffled openings equally spaced around the periphery shall be provided for 1) energy dissipation, 2) directing exit flow direction tangential to the inlet wall and 3) prevention of downward flow.

.4 Alternately, the energy dissipating baffle system shall consist of a secession of three (3) overlapping vertical target baffles with a series of four (4) increasing port areas designed to provide a "Gt" (t in seconds) value in the well not exceeding 5,000 with a velocity gradient "G" within the flocculation well not exceeding 65 fps/ft at a minimum water temperature of 10^{o} C at maximum influent flow. Horizontal shelf baffles shall prevent downward movement in the flocculation zone. Baffles shall bolt to the center cage and well support beams.

.5 Provide a system of flushing water spray nozzles that can be manually initiated to direct scum over the feedwell rim. Provide easily accessible water shut-off valve on walkway. When water is shut-off, piping downstream of shut-off valve shall drain by gravity. Provide air vent as required. Provide piping on walkway to edge of clarifier. System shall be all 316ss.

2.11 Ducking Skimmer/Scum Trough

.1 Provide a floating scum collection system that discharges into a rotating scum pipe for removal. The skimming system shall consist of skimmer assemblies, a rotating scum pipe assembly and additional devices specified and required for proper operation. The sludge collector arms shall support the skimmer assemblies. Designs that rely on the scum baffle for support will not be acceptable. The scum pipe shall be supported from the walkway. Each skimmer assembly shall be furnished with 316 SS pivot supports that allow the skimmer blade to pass under the scum pipe without interfering with the operation of the scum pipe. The scum pipe dipping cycle shall begin as a skimmer assembly approaches the scum pipe, by rotating the scum pipe to receive scum and flushing water and shall be completed by returning the scum pipe to the closed position as the skimmer assembly passes. The scum pipe shall discharge scum by gravity flow into a drop box attached to the scum pipe and located near the clarifier perimeter. The skimmer blade shall effectively move scum past the walkway enclosure rubber skirt.

.2 Each clarifier shall be equipped with two skimmer assemblies. Each skimmer assembly shall collect floating scum the full distance between the scum baffle and the influent well. Each skimmer assembly shall consist of a skimmer blade, blade supports, support pivot bearings, wiper and return mechanism. The skimmer blade shall be 10 gauge 316 SS. The skimmer blade sections shall not exceed 3 m (10') in length and shall be approximately 300 mm (12") high with 100 mm (4") extending above the maximum water elevation for the basin. The skimmer blade shall be sealed between sections and shall have adequate supports attached to the sludge collector arms. The pivot bearings shall be suitable for underwater service and shall be of the water lubricated or self-lubricating type not requiring additional lubrication. Provide a neoprene or equal wiper on the outer skimmer blade to collect scum between the end of the skimmer blade and the scum baffle. A positive return mechanism actuated by a counterweight shall be provided to rotate the skimmer blade to the vertical position after it passes under the scum pipe.

Each skimmer assembly shall be provided with additional supports or stops as required to prevent damage to the equipment when the basin is dewatered or when the collector is operated in a dry clarifier.

.3 The rotating scum pipe assembly shall be a 316 SS pipe with rectangular weir openings, and support bearings and a push-button electrically operated pipe rotation system, to operate the scum pipe. The scum pipe shall have a nominal diameter of 400 mm (16") and a wall thickness of not less than 6mm (0.25").

Line rotating scum pipe supports with nylon or equal material to provide a low friction contact surface to prevent wear between the scum pipe and supports. Provide each support with a skimmer blade guide to provide a gradual return of the blade to the water surface after ducking under the scum pipe. To facilitate this, a bearing/guide support shall be located and centered on each skimmer blade section. Supports (attached to the bridge) shall be fully adjustable for levelling the scum pipe. Blades shall be provided with replaceable wearing shoes where they contact the guides.

Overall support shall be such that a slight vertical or horizontal misalignment shall not interfere with smooth operation of the pipe.

.4 Provide a suitable watertight seal for the open end of the pipe. This seal shall be so constructed that it shall remain effective even with a slight misalignment of the pipe. The seal shall not be affected by grease, mild acids, and alkalies. The seal shall be readily renewable without removing the pipe from the supporting brackets and shall not bind or impede the smooth action of the revolving pipe.

.5 Provide a motorized drive on the scum pipe. The motor starter for this drive shall be provided by the City in a remote MCC room. Provide two “maintained contact” (dead man) pushbuttons at the trough location to control the position of the trough. The pushbutton and motor and all related electrical devices shall be rated Class 1 Division 1 environment.

2.12 Effluent Weir and Scum Baffle

.1 Effluent weir plates shall consist of 225mm (9”) deep x 6 mm thick, 316ss sections with 63 mm (2-1/2”) deep 90 degree V-notches at 150mm (6”) intervals. The weir sections shall be fastened to the tank wall using 316 stainless steel cinch anchor bolts, hex nuts, and stainless steel clamps, allowing for vertical adjustment.

.2 The scum baffle plates shall consist of 300 mm deep x 6 mm thick 316ss sections supported from the tank wall by 316ss clamps and adhesive anchor rods and hex nuts, allowing for vertical and radial adjustment. In the area of the scum pipe the baffle shall extend 600 mm deep starting approximately 1.8 m preceding and ending 1.8m following the scum pipe.

2.13 Painting and Surface Preparation

2.13.1 Paint System

.1 All non-submerged steel shall be sandblasted to SSPC-SP-6 specifications and all submerged or partially submerged steel shall be sandblasted to SSPC-SP-10. Then apply one coat of Bar Rust 235 epoxy grey primer 150 – 200 microns and one coat of Bar Rust 235 epoxy 150-200 microns.

.2 Prior to assembly of the drive unit, castings shall have been sandblasted and thoroughly cleaned to remove any foreign particles in the drive base. After assembly, the drive mechanism shall be solvent cleaned and power wire brushed as needed prior to application of primer.

.3 .All items such as motors, reducers and equipment completely shop assembled and ready for installation shall be given one (1) shop coat of the manufacturer's standard enamel.

.4 All constituents of each coating system shall be supplied by the same manufacturer.

2.13.2 Reference Standards

.1 Reference to the SSPC Good Painting Practice and the National Association of Corrosion Engineers specifications refers to the latest edition of these specifications.

.2 Apply all coatings in accordance with paint manufacturers' recommendations, and to SSPC Standards.

.3 Strictly observe all safety rules and regulations of the City, applicable governing bodies, and insurance underwriters in the storage, handling, use and application of coating system material, solvents, and cleaning agents.

.4 Employ qualified and competent personnel to perform the Work in a neat and workmanlike manner, conforming to all City and Government Safety Standards and Regulations.

2.13.3 Shipment, Protection, and Storage

.1 Deliver all materials to the site in sealed containers properly labeled as to the manufacturer's name, type, and colour of contents, date of manufacture, batch number, storage requirements, and shelf-life.

.2 Provide adequately ventilated storage for all materials and ensure compliance with fire prevention regulations.

2.13.4 Warranty

.1 Provide a one-year paint system warranty.

2.13.5 Coating Application

.1 Provide traps or separators to remove oil and water from the air, so that the air from the spray gun impinging onto the steel substrata shows no condensed water or oil.

.2 Hand brush all welded and hard-to-spray areas prior to the first spray coat application, with coating mixed to manufacturer's recommended procedures.

.3 Coat by brush, roller, sheepskin dauber, or other suitable method, all areas inaccessible to the spray gun.

.4 Do not apply coatings to a surface at a temperature that will cause blistering, separation or otherwise be detrimental to the life of the coating.

.5 Only thinners specified by the paint manufacturer are acceptable.

.6 Materials that exceed manufacturer's published shelf life are not acceptable.

.7 Immediately brush out all runs, sags, blisters, etc, or remove and repair the area prior to the next application.

.8 Apply the coating using a 3-coat, 2-colour system.

.9 Apply the coating holiday free.

2.13.6 Drying and Curing

.1 Accommodate all drying and re-coat times in accordance with the manufacturer's specifications.

.2 Cure in accordance with the manufacturer's recommended specifications. Force curing specifications are available from manufacturer if required.

.3 Maintain required curing temperatures.

.4 Ensure the finished coating is free of obvious defects such as runs, sags, blisters or pinholes, air entrapment, fish-eyes and foreign matter.

.5 Provide film thickness, as determined by a calibrated Mikrotest gauge or equivalent, in accordance with SSPC Good Painting Practice.

.6 Repair or replace at the Contractor's expense any coating not meeting the requirements of this Specification.

.7 Employ qualified and competent personnel to perform the Work in a neat and workmanlike manner, conforming to all City and Government Safety Standards and Regulations.

2.14 Spare Parts

.1 The intent of this specification is to provide uninterrupted operation for a minimum period of two (2) years. To meet this objective the clarifier manufacturer shall supply any spare parts, excluding lubricants that are required to meet this time frame. As a minimum, provide the following spare parts, per clarifier:

1. One (1) sight glass for each main drive housing containing oil.
2. One (1) set of skimmer wipers.
3. One (1) set of sludge scraper arm wipers.

PART 3 - EXECUTION

3.1 Technical Support Services

.1 Provide a service representative properly trained in inspection and operation of the mechanism to inspect and certify proper installation, that the torque settings of the drive overload protection device are correct, perform the torque test, and instruct the City's personnel on maintenance and operation.

.2 Provide the services of a field service representative as required to suit the project installation schedule. This time will be for installer instruction, assisting and inspecting the Install Contractor's work, checkout and acceptance of completed installation, test monitoring, commissioning, and to instruct the Install Contractor and City's personnel in the start-up and proper operation of the equipment.

.3 Estimated time and number of trips required by the Contractor's service representative is presented in the Bid Submission, Form B: Prices.

3.2 Torque Test

.1 The clarifier mechanism shall be field torque tested. The purpose of the torque test is to verify the structural integrity of the mechanism structural steel design and center drive unit. The testing shall be carried out by the Install Contractor, under the supervision of the Contractor's Representative and as approved by the Contract Administrator before the mechanism is accepted and placed into operation.

.2 The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the contractor in the tank floor at locations specified by the equipment manufacturer. A load shall be applied to the scraper arm in small increments by means of a ratchet lever connected to the cable assembly. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the center line of the mechanism. A reading shall be taken at the drive design torque.

.3 Verify that the alarm, motor cut-out, and back up safety motor cut-out switches are properly set and are in proper operation to protect the clarifier mechanism as specified.

3.3 Equipment and Performance Verification

.1 After the installation has been verified, torque test completed, and any identified deficiencies have been remedied, equipment will be subjected to a demonstration test, running test, and equipment performance tests.

.2 The Install Contractor will inform Contractor at least seven (7) days in advance of conducting the tests and arrange for the attendance of the Contractor. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contract Administrator.

.3 Test Operation – Each clarifier will be filled with wastewater and placed in operation for up to 3 days. At any time during this period, the Contract Administrator will accept the performance test. The next clarifier will then be shut-down to permit installation of the next new clarifier system. Operating problems noted during this performance test shall be resolved and the system retested before the performance test can be accepted.

3.4 Welding

.1 Shop welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "WELDING IN BUILDING CONSTRUCTION" of the American Welding Society.

.2 Shop drawings shall clearly show complete information regarding location, type, size, and length of all welds in accordance with "STANDARD WELDING SYMBOLS" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes or details.

.3 Welding shall conform to CSA W59.1 and ASTM E109.

.4 All shop and field welding shall be seal welding.

DRAWINGS