Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 51 00 - Temporary Utilities.

.2 Section 01 52 00 - Construction Facilities.

1.2 REFERENCES

.1 Association of Iron and Steel Engineers (AISE)

.1 Standard No. 7.

.2 American Institute of Steel Construction (AISC)

.1 ASIC 360-2005, Specification for Structural Steel Buildings – Allowable Stress Design.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM A276-2010, type 304L, Stainless Steel Bars and Shapes.

.2 ASTM A240/A240M -12a, type 304L, Stainless Steel Plate, Sheet and Strip.

.3 ASTM A325-2010, Bolts.

.4 ASTM A449-2010, Standard Specification for Hex Cap Screws, Bolts and Studs.

.5 ASTM B209-2010, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.6 ASTM B584-2012a, Bronze Bearings.

.7 ASTM F593-2002(2008)e1, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

.8 ASTM F594-2009e1, Standard Specification for Stainless Steel Nuts.

.9 ASTM HST-4-1999, Performance Standard for Overhead Electric Wire Rope Hoists.

.4 Crane Manufacturers Association of America (CMAA)

.1 Specification 70-2010, Specification for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes.

.5 Canadian Standards Association (CSA)

.1 CSA A23.3-2004, Standard for Design of Concrete Structures.

.2 CSA S16-2009, Standard for Design of Steel Structures.

.3 CSA W47.1-2009, Certification of Companies for Fusion Welding of Steel.

.4 CSA W47.2-2011, Certification of Companies for Fusion Welding of Aluminum.

.5 CSA W55.3-2008, Certification of Companies for Resistance Welding of Steel and Aluminum.

.6 CSA W59-2003, Welded Steel Construction.

.7 CSA W59.2-M1991, Welded Aluminum Construction.

.8 CSA/CAN3-Z299.3, Quality Assurance Program.

.9 CSA/CAN3 G40.20/G20.21, General Requirement for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.6 Steel Structure Painting Council (SSPC)

.1 The Society for Protective Coatings (SP-1 and SP-10).

.7 United States Army Corp of Engineers (USACE)

.1 EM 1110-2-2105, Design of Hydraulic Steel Structures.

.2 EM 1110-2-2701, Engineering and Design: Vertical Lift Gates.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop drawings for gates bearing the seal and signature of a professional engineer licensed to provide services in the Province of Ontario.

.1 Design calculations for gates clearly describing all loads and load combinations included.

.2 Heating calculation

.3 Product data.

.3 Shop drawings for guide heaters bearing the seal and signature of a Professional Engineer licensed to provide services in the Province of Ontario.

.1 Wattage calculations associated with guide heaters.

.2 Heating calculation.

.3 Product data.

.4 Wheel and wheel path material data and post-fabrication hardness testing.

Part 2 Products

2.1 GATE EQUIPMENT - DESCRIPTION

.1 There is one spillway gate at the South Control Dam and two spillway gates at the North Control Dam.

.2 Provide fixed-wheel vertical-lift type spillway gates with an upstream sealing skin plate, appropriate seals, embedded parts suitable for dedicated hoists mounted on the deck without superstructure.

.3 Control the gates from electrical panel to be located in the on-site control booth and provide a provision for remote control inputs for normal raise and lower signals from the station remote terminal unit (RTU).

.4 The gates will be used for reservoir water level control and must be capable of being raised under inflow design flood (IDF) water level.

.5 The gate sill beams and guides erection tolerance as follows:

.1 Adjust sill beams and gain sealing faces to within a maximum gap of 0.2 mm from true straight using a 3-m straightedge.

.2 Adjust rolling part of gate wheels in the same manner, allowing a maximum gap of 0.2 mm.

.3 Roller path deviation from plumb to be maximum 3 mm over full length.

.4 Sill beam surface deviation from horizontal to be maximum 3 mm across opening.

.5 With gate in closed position, gap between sill and gate lip must reject a 0.2-mm feeler gauge.

.6 Tolerances not specified here or on contract drawings must be established by the manufacturer and be consistent with industry practices in this type of work.

.6 For normal operation, the gates will be in closed position or in crack open position to allow for a minimal flow downstream. The gates will open to release excess water from the reservoir. The gates to be designed in a manner to prevent vibration when spilling water.

.7 Provide a gate design suitable for a deck-mounted hoist that permits the complete removal of gate from gate pocket with mobile crane for maintenance.

.8 The gates will be provided with cladding and internal heating to ensure build up of ice does not occur.

.9 Gate guides will be provided with guides heater ducts located behind the seal path.

.10 Heater elements will be provided in the guide heater ducts. The heaters will be capable of operating in the dry, partially or completed immersed, and will be constructed so that they may be energized, without injury, after a prolonged period of de-energization.

2.2 DESIGN PARAMETERS

.1 The table below decribes the design parameters.

Description	**North Dam**	**South Dam**
Water Level		
- Normal (m)	194.6	194.6
- Normal Maximum (m)	195.9	195.9
- Inflow Design Flood (m)	196.8	196.8
Sill Elevation (m)	192.7	191.1
Number of Bays	2	1
Clear Width of Opening (m)	5.5	5.5
Clear Height of Opening (m)	4.2	5.8
Top of Deck Elevation (m)	199.0	199.0
Normal Lifting/Lowering Speed (minimum) (cm/min)	45	45

2.3 DESIGN LOADS

.1 Load, load combination, and load factors to conform to USACE EM 1110-2-2701 VERTICAL LIFT GATES requirements for Spillway Crest Gates (Chapter 4).

.2 The gates will be designed for the hydrostatic forces caused by the water at maximum water elevation and flows, for a floating ice load on the upstream side of 36 kN/m of gate width (ice sheet is considered to be 60 cm thick and acting at the expected range of winter water levels) and for wind pressure of 1.5 hPa on all external parts of the mechanical lifting devices.

2.4 DESIGN REQUIREMENTS

.1 Design gate assemblies with the skin plate integral with the main horizontal and vertical members.

.2 Design the gate assemblies such that the self-weight of the gate assembly will exceed the forces resisting closure, including friction assuming static friction coefficients and buoyancy, by a minimum of 25%.

.3 The following minimum friction coefficients will be used in calculations of vertical loads acting on the gate:

.1 Self-lubricated bushings: Static = 0.15; Dynamic = 0.10.

.2 Anti-friction bearing: Static = 0.02, Dynamic = 0.01.

.3 Rubber seals on steel: Static = 1.50; Dynamic = 0.80.

.4 Rubber seals with fluorocarbon sealing surfaces on steel: Static = 0.20; Dynamic = 0.10.

.5 Steel on steel (unlubricated): Static = 0.50; Dynamic = 0.25.

.6 Bronze on steel (unlubricated): Static = 0.30; Dynamic = 0.18.

.4 Design the gates to withstand full hydrostatic force at IDF level acting on the upstream side and no force (dewatered) acting on downstream side.

.5 Design the gate guides as beams on an elastic foundation.

.6 Include a corrosion allowance of 1.6 mm minimum in the design of the gates and guides.

.7 For normal loading conditions, the allowable stresses in mechanical components will not exceed those permitted by CMAA Specification No. 70. For extreme loading conditions, stresses will not exceed 80% of the elastic limit of the material.

.8 Stresses on self-lubricated bronze bearings will not exceed 30 MPa for normal loading and 50 MPa for extreme loading conditions or that required by the bushing manufacturer, whichever is less.

.9 AISE Standard No. 7 will be used for determination of allowable stresses for hooks with no additional safety factors applied. Stresses may be increased by 33% for extreme loading conditions.

.10 Calculate the compressive strength in crowned wheels using the following specifications:

.1 The maximum hardness of the wheel path will be at least 20 MHN points greater than the minimum wheel hardness.

.2 The maximum shear stress of the wheel and of the wheel path will not exceed the lesser of the following two values: 2.4 times the minimum BHN hardness of the softer material or 620 MPa.

.3 The maximum compressive stress of the wheel and of the wheel path will not exceed the lesser of the following two values: 6.8 times the minimum BHN harness of the softer material or 1720 MPa.

.11 Backing members of embedded parts will be proportioned such that the bearing stress transmitted to the concrete does not exceed 7 MPa.

.12 All bolted connections will use bolts, washers and nuts. Tapped holes are not permitted.

.13 Design an adequate de-icing system to be provided for all gates on both North Channel Dam and South Channel Dam spillway structures to ensure that the gates are operational in winter times.

Part 3 Execution

3.1 MATERIALS AND FABRICATION

.1 Gates:

.1 The gates will be fabricated from plate steel and structural materials. Major structural members and plate steel will be CSA G40.21 Grade 300 WT or 350 WT. Secondary structural shapes will be CSA G40.21 Grade 300 W or ASTM A36. All gate steel components will have a minimum thickness of 12.7 mm.

.2 Gate Wheels:

.1 Wheels will be of forged stainless steel construction with tread hardened to at least 255 BHN. Wheel and roller axles will be stainless steel and bushings will be self-lubricated bronze, or an alternative proposed and acceptable to Departmental Representative's requirements.

.2 The gates will have spring-loaded guide rollers (wheels) to limit lateral movement.

.3 Gate Seals:

.1 Rubber seals will be of the moulded type only. The material used for rubber seals will be compounded of natural rubber, a copolymer of butadiene and styrene, or a blend of both, and will contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers. The construction will provide a seal with adequate impact, abrasion, scuff, weather, water, temperature and age-resistant properties which will provide, in the moulded form, suitable sealing properties.

.2 The gate seals at the top and side will be J-type rubber seals, double stem and single stem respectively, as acceptable to Departmental Representative. The bottom seal will be rubber of rectangular cross section.

.3 Provided machined mounting bars for the seals, and stainless steel fasteners to be used for bolting the seals to the gate.

.4 Vulcanize all seal corners to avoid undue leakage. Mitred joints should not be used.

.5 Protect gate seals from damage during handling, transporting and testing of the gate.

.6 Upon installation, demonstrate that the seals meet the contract requirements in that they are properly installed and that the gates are free from leakage to an extent acceptable to Departmental Representative.

.4 Gate Guides:

.1 Provide gate guides of rigid steel construction with suitable anchors for embedding in concrete. The sealing surfaces will be ASTM A276 Type 304 stainless steel. The wheel path may be standard rail or a stainless steel bar to ASTM A276 Type 410. Accurately align the wheel path during guide installation to avoid overloading of the gate wheels. Ensure the minimum hardness of the wheel path is at least 50 BHN points greater than the minimum wheel hardness.

.5 Gate Guide Heaters:

.1 The heaters will be of the tubular type with a maximum diameter of 70 mm. The heaters will extend approximately the full length of the guides and will have an element rated to operate at 240 V, single-phase. The heaters will have watertight junction boxes and metallic-sheathed lead-in cables of a nonhygroscopic type. The heater element will be removable, and the casing will be spliced as required to facilitate shipping, installation and maintenance.

.6 Gate Bolting:

.1 All bolts for assembly of structural joints and assemblies will be ASTM A325M-09, and all other bolts and studs will be ASTM A449-07b except as otherwise noted on the drawings or specified herein.

.2 Provide stainless steel bolts for seal attachment.

.3 Unthreaded body through seal.

.4 Retain all fasteners with suitable lock washers.

.5 Tapped threads cut into gate for seal fastening will not be acceptable.

.6 Use only new materials that conform to the applicable CSA and ASTM standards.

.7 Protective Coating:

.1 In accordance with Section 09 90 00 - Painting and Coating.

3.2 SPARE PARTS

.1 Provide a price list for any spare parts considered necessary for maintenance of supplied equipment.

.2 All spare parts will be interchangeable with and of the same materials and workmanship as the original parts of the equipment furnished.

.3 Supply all spare parts packed and treated for long-term storage at site, and each part will be clearly marked with its description and purpose on the outside of the packing.

3.3 ATTENDANCE DURING GATES AND GUIDES INSTALLATION

.1 Ensure gates and guides are installed in accordance with the drawings and procedures.

.2 Arrange for gate manufacturer's Factory Authorized Representative (FAR) to inspect the completed installation and witness commissioning. Submit to Departmental Representative a written certificate of FAR's approval of installation. FAR will submit a report for each site visit made.

3.4 COMMISSIONING

.1 Perform checks and test of individual components and completed works, including recording of alignment dimensions, to demonstrate that the Work has been correctly installed, meets the design requirements, and is adjusted to operate correctly and safely.

.2 Demonstrate installation and removal of the gate in the dry. Clearances will be checked and recorded.

.3 Demonstrate operation of the gate in the wet.

.4 Following installation of the gate in the wet, the volume of the water leaking past will be measured. Total leakage will not exceed 1.0 L/min per linear metre of seal length. Leakage measurements will be based on normal water level and a leakage volume averaged over 30 minutes.

.5 Any defects related to equipment design, manufacture, assembly, and installation that become evident during the design tests will be immediately corrected.

.6 Correct promptly, at own expense, any defects or deficiencies in the work provided under this contract which appear during the period of one year from the date of delivery.

.7 Prepare a detailed commissioning procedure, which describes the sequence of operations and methods to be used for commissioning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 The work of this section includes supply of products and placing the impervious glacial till material, filter material, and rock-fill material at the upstream cofferdam at the South Channel at the Big Chaudière Dam.

.2 Glacial till consists of a mixture of gravel, sand, silt, and clay-size particles found in natural deposits.

.3 The filter material will form the upstream of the cofferdam between the rock fill and impervious material.

.4 The rock fill will form the downstream shell of the cofferdam.

.5 The rock fill will be the first material dumped into the South Channel.

.6 Common Excavation: excavation of materials that are not rock excavation or stripping.

.7 Unclassified Excavation: excavation of whatever character other than stripping encountered in the Work.

.8 Stripping: excavation of organic material covering original ground.

.9 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.

.10 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.

.11 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.

.12 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Reference Standards:

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM D422-07, Standard Method for Particle Size Analysis of Soils.

.2 ASTM D1140-06, Standard Method of Test for Amount of Material in Soils Finer than the 75 µm (No. 200) Sieve.

.3 ASTM D2216-10, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Four weeks prior to placement of fill, the Contractor shall provide the Departmental Representative with samples of the impervious fill proposed for the Works. The Contractor will arrange for laboratory testing of these samples to confirm their suitability. Copies of the test reports will be supplied to the Departmental Representative before the material can be placed. No additional payment will be made for these tests.

1.3 QUALITY ASSURANCE

.1 Direct and continuous quality control shall be maintained throughout the period of construction. The Contractor shall perform its Work in every way to facilitate all field testing and sampling by the Departmental Representative.

.2 The Contractor shall vary the method of placing in order to meet the requirements of the Departmental Representative as shown on design drawings.

Part 2 Products

2.1 MATERIALS

.1 Upstream Impervious Blanket Fill (Zone 1):

.1 Upstream impervious blanket fill requires approval by Departmental Representative.

.2 Impervious material used for cofferdam not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.

.3 Borrow Material:

.1 Obtain from sources such as quarry, or borrow pit as approved or as designated by Departmental Representative.

.2 Upstream impervious blanket materials to consist of acceptable earth material (glacial till).

.3 Cofferdam upstream impervious blanket material to conform to gradation as follows:

Sieve Designation	**Percent Passing by Weight**
75 mm	100
19 mm	65 - 100
4.75 mm	45 - 75
2 mm	35 - 60
0.425 mm	25 - 45
No. 200	15 - 35

.2 Filter Material (Zone 2):

.1 Filter materials require approval by Departmental Representative.

.2 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.

.3 Borrow Material:

.1 Obtain from sources such as quarry or borrow pit as approved or as designated by Departmental Representative.

.2 Cofferdam materials to consist of acceptable well-graded granular material.

.3 Cofferdam filter to conform to gradation of Granular B Type II as shown below:

Sieve Designation	Percent Passing by Weight
100 mm	100
25 mm	50 - 100
4.75 mm	20 - 55
1.2 mm	10 - 40
0.3 mm	5 - 22
No. 200	0 - 10

.3 Rock-Fill Material (Zone 3):

.1 Rock-fill materials require approval by Departmental Representative.

.2 Material used for cofferdam not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.

.3 Rock-fill material, forming the downstream shell of cofferdam, shall be preferably processed from clean, hard, strong, durable, and high-quality quarried rock, free from roots, topsoil or other debris. Materials containing quantities of organic matter, flat or elongated particles, dirt, and/or clay and rock fines are unacceptable. Care shall be taken to prevent the rock fill from being contaminated by mixing with the subgrade, in some areas. All material shall be cubic in shape with the largest dimension less than 2 times the smallest. The rock-fill material shall be well graded with a maximum size of 300 mm and not more than 28% by weight smaller than 4.75 mm (#4 sieve). The blasted rock shall be exploited selectively if necessary to ensure compliance with the grading.

.4 Borrow Material:

.1 Obtain from sources such as quarry or as designated by Departmental Representative.

.2 Cofferdam rock-fill materials to consist of acceptable processed rock material.

.3 Cofferdam rock-fill material to consist of fragmented rock produced by drilling and blasting operations, and boulders which will be mainly dumped/pushed into water.

.1 Cofferdam rock-fill material to conform to gradation as follows:

Sieve Designation	Percent Passing by Weight
300 mm	100
100 mm	65 - 100
50 mm	45 - 70
19 mm	30 - 50
9.5 mm	18 - 38
4.75 mm	10 - 28
2 mm	0 - 18
0.425 mm	0 - 5

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that condition of substrate is acceptable for embankment Work:

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 COMPACTION EQUIPMENT

.1 No specific compaction equipment is required for the purpose of construction of the South Channel Upstream Cofferdam since all materials will be dumped in wet.

3.3 STRIPPING

.1 No stripping is required for the purpose of construction of the South Channel Upstream Cofferdam since all work will be done underwater.

3.4 EXCAVATING

.1 General:

.1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.

.2 In the locations where the upstream fill foundation is not bedrock, excavate a minimum of 2000 mm (2 m). It is only required below the locations where the impervious blanket fill and filter material will be dumped into the South Channel as shown on drawings. The excavation can be carried out using a long stick backhoe, dragline, or any other appropriate equipment from the banks or the cofferdam crest.

.3 No excavation is required beneath the cofferdam rock-fill material.

.2 Rock Excavation:

.1 Notify Departmental Representative when material appearing to conform to classification for rock is encountered.

.2 No rock excavation is required below the cofferdam impervious material, filter material, or rock-fill material.

.3 Borrow Excavation:

.1 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.

.1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.

.2 Remove waste and stripping material from borrow pits to designated locations.

.2 Slope edges of borrow areas to minimum 2:1 and provide drainage as directed.

.3 Develop drainage ditches, sumps and the like around the borrow area prior to beginning excavation of the impervious fill. Clear and grub an area only sufficiently large so as to avoid any possibility of contaminating the impervious material with near-surface unsuitable materials, but not to jeopardize the integrity of remaining materials as a result of premature exposure.

3.5 EMBANKMENTS (COFFERDAMS)

.1 Construction method used to be pre-approved in writing by Departmental Representative.

.2 Do not place material which is frozen nor place material on frozen surfaces or water except in areas authorized by Departmental Representative.

.3 The construction of impervious material comprises the following steps:

.1 Dump the impervious material on the cofferdam crest.

.2 Using a dozer, push the impervious material at small angle relative to the dam axis.

.3 Check the repose angle underwater with drawings; correct the procedure if the repose angle is flatter than shown on drawings.

.4 The construction of filter material comprises of the following steps:

.1 Dump the filter material on the dam crest.

.2 Using a dozer, push the filter material downward in a way that materials fall instead of being dumped into water.

.3 Check the repose angle underwater with drawings; correct the procedure if the repose angle is flatter or steeper than shown on drawings.

.5 The construction of rock-fill material comprises of the following steps:

.1 Dump the rock-fill material on the dam crest.

.2 Using a dozer, push the rock-fill material downward in a way that materials fail instead of being dumped into water.

.3 Check the repose angle underwater with drawings; correct the procedure if the repose angle is flatter or steeper than shown on drawings. The acceptable angle of repose for rock-fill material is 1.70H:1V to 1.80H:1V slopes.

.4 Rock-fill materials can be partly placed using other haulage equipment provided that the end results be similar to the method described above.

3.6 COMPACTION

.1 In the cofferdam, compact impervious fill, filter material, and rock fill by random movements of haulage and spreading equipment.

3.7 FINISHING

.1 Finish slopes to lines, grades and drawings where applicable; however, there is no need to scale slope by removing slopes in bedrock steeper.

.2 Do not allow the impervious material to lean against the South Channel gate as the pressure will open the gate.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

.1 Maintain finished surfaces in condition conforming to this section until approval by Departmental Representative.

.2 Maintain the cofferdam structures throughout the unwatering period. Should the Contractor notice a sudden increase in seepage through a cofferdam, or significant damage or deterioration of the cofferdam, notify the Departmental Representative immediately and take immediate action to correct the condition.

.3 Provide silt fences and erosion protection as required to mitigate and prevent impacts to adjacent properties.

3.10 REMOVAL OF COFFERDAM

.1 Remove all cofferdams and dispose of cofferdam materials.

.2 Remove the cofferdams in such a manner that will result in acceptable water discharges free of suspended sediment to the extent possible and in accordance with all the requirements.

END OF SECTION