

**RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:**

**Bid Receiving - PWGSC / Réception des
soumissions - TPSGC**
11 Laurier St. / 11, rue Laurier
Place du Portage, Phase III
Core 0B2 / Noyau 0B2
Gatineau, Québec K1A 0S5
Bid Fax: (819) 997-9776

**REQUEST FOR PROPOSAL
DEMANDE DE PROPOSITION**

**Proposal To: Public Works and Government
Services Canada**

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

**Proposition aux: Travaux Publics et Services
Gouvernementaux Canada**

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

Comments - Commentaires

Title - Sujet HEAT EXCHANGERS	
Solicitation No. - N° de l'invitation 23375-160262/A	Date 2015-08-13
Client Reference No. - N° de référence du client 23375-160262	
GETS Reference No. - N° de référence de SEAG PW-\$\$HL-657-67798	
File No. - N° de dossier hl657.23375-160262	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2015-09-23	Time Zone Fuseau horaire Eastern Daylight Saving Time EDT
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: Turner, Louie	Buyer Id - Id de l'acheteur hl657
Telephone No. - N° de téléphone (819) 956-3975 ()	FAX No. - N° de FAX (819) 956-5227
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: DEPARTMENT OF NATURAL RESOURCES 1 HAANEL DR. OTTAWA Ontario K1A1M1 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Vendor/Firm Name and Address

**Raison sociale et adresse du
fournisseur/de l'entrepreneur**

Issuing Office - Bureau de distribution

Fuel & Construction Products Division
11 Laurier St./11, rue Laurier
7A2, Place du Portage, Phase III
Gatineau, Québec K1A 0S5

Delivery Required - Livraison exigée 2015-12-31	Delivery Offered - Livraison proposée
Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur	
Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur	
Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)	
Signature	Date



Item Article	Description	Dest. Code Dest.	Inv. Code Fact.	Qty Qté	U. of I. U. de D.	Unit Price/Prix unitaire FOB/FAM Destination	Plant/Usine	Delivery Req. Livraison Req.	Del. Offered Liv. offerte
1	Helical Coil Heat Exchanger Helical Coil Heat Exchanger HX-3101 (0.5" tube @ 63" in 6" shell) • as per Specifications in Annex "A" and Design Sheets in Annex "B"	23375	I - 1	1	Each	\$	XXXXXXXXXXXX	2015-12-31	
2	Helical Coil Heat Exchanger Helical Coil Heat Exchanger HX-3201 (0.5" tube @ 47.25" in 6" shell) • as per Specifications in Annex "A" and Design Sheets in Annex "B"	23375	I - 1	1	Each	\$	XXXXXXXXXXXX	2015-12-31	
3	Helical Coil Heat Exchanger Helical Coil Heat Exchanger HX-4301 (0.5" tube @ 28.5" in 6" shell) • as per Specifications in Annex "A" and Design Sheets in Annex "B"	23375	I - 1	1	Each	\$	XXXXXXXXXXXX	2015-12-31	



Item Article	Description	Dest. Code Dest.	Inv. Code Fact.	Qty Qté	U. of I. U. de D.	Unit Price/Prix unitaire FOB/FAM Destination Plant/Usine	Delivery Req. Livraison Req.	Del. Offered Liv. offerte
4	Shell & Tube Heat Exchanger Vertical al Shell & Tube Heat Exchanger Vertical HX-4401 (547 x 0.5" tube @ 79" in 20" shell) • as per Specifications in Annex "A" and Design Sheets in Annex "B"	23375	I - 1	1	Each	\$XXXXXXXXXXXX	2015-12-31	

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Amd. No. - N° de la modif.

Buyer ID - Id de l'acheteur

hl657

Client Ref. No. - N° de réf. du client

23375-160262

File No. - N° du dossier

hl65723375-160262

CCC No./N° CCC - FMS No/ N° VME

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PART 1 - GENERAL INFORMATION

1.1 Security Requirements

There is no security requirement applicable to this Contract.

1.2 Requirement - Bid

The requirement is detailed under the "Line Item Detail".

1.3 Debriefings

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days from receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

1.4 Trade Agreements

The requirement is subject to the provisions of the North American Free Trade Agreement (NAFTA), and the Agreement on Internal Trade (AIT).

PART 2 - BIDDER INSTRUCTIONS

2.1 Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the [Standard Acquisition Clauses and Conditions Manual](https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The [2003](#) (2015-07-03) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of [2003](#), Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: 60 days
Insert: 90 days

2.2 SACC Manual Clauses

The following terms and conditions are incorporated herein

SACC Reference	Section	Date
B1000T	Condition of Material - Bid	2014-06-26

2.3 Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on page 1 of the bid solicitation.

2.4 Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than ten (10) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by Bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated, and the enquiry can be answered to all Bidders. Enquiries not submitted in a form that can be distributed to all Bidders may not be answered by Canada.

2.5 Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Ontario.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the Bidders.

2.6 Best Delivery Date - Bid

While delivery is requested by December 31, 2015, the best delivery that could be offered is

_____.

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

Section I: Technical Bid (2 hard copies)

Section II: Financial Bid (1 hard copy)

Section III: Certifications (1 hard copy)

Prices must appear in the line item detail only. No prices must be indicated in any other section of the bid.

Canada requests that Bidders follow the format instructions described below in the preparation of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper;
- (b) use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process [Policy on Green Procurement](http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html) (<http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html>). To assist Canada in reaching its objectives, Bidders should:

- 1) use 8.5 x 11 inch (216 mm x 279 mm) paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and
- 2) use an environmentally-preferable format including black and white printing instead of colour printing, printing double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical Bid

In their technical bid, Bidders should explain and demonstrate how they propose to meet the requirements and how they will carry out the Work.

When submitting their technical proposal, bidders are to ensure it is complete and indicates the bidder's understanding of the requirement and shows the approach they will take to meet all requirements of the SOR/Spec. Technical evaluation will be based solely on the information contained in the technical proposal.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with the Basis of Payment. The total amount of Applicable Taxes must be shown separately.

3.1.2 SACC Manual Clauses

The following terms and conditions are incorporated herein

SACC Reference	Section	Date
C3011T	Exchange Rate Fluctuation	2013-11-06

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3.1.3 Progress Payments

Progress payments will not be considered unless specifically offered by PWGSC in this document.

Section III: Certifications

Bidders must submit the certifications required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

4.1 Evaluation Procedures

- (a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the technical and financial evaluation criteria.
- (b) An evaluation team composed of representatives of Canada will evaluate the bids.

4.1.1 Technical Evaluation

All bids must be completed in full and provide all of the information requested in the bid solicitation to enable full and complete evaluation.

The technical bid should address clearly and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient.

4.1.1.1 Mandatory Technical Criteria

- a) The Bidder must provide documentation with their bid showing how they meet the technical requirements detailed in Annex "A" and Annex B design sheets. The bidder must also complete the "Compliant (Yes/No) section in Annex "A", Mandatory Requirements, items 1 – 14.

4.1.2 Financial Evaluation

4.1.2.1 Mandatory Financial Criteria

- a) The Bidder must bid a firm unit price in Canadian funds, Applicable Taxes excluded, DDP Delivered Duty Paid to destination Incoterms 2000, Customs Duties included for each item offered; and
- b) The Bidders' financial bid must be in accordance with the Basis of Payment.

4.2 Basis of Selection

The following terms and conditions are incorporated herein

SACC Reference	Section	Date
A0031T	Basis of Selection - Mandatory Technical Criteria	2010-08-16

PART 5 – CERTIFICATIONS AND ADDITIONAL INFORMATION

Bidders must provide the required certifications and additional information to be awarded a contract.

The certifications provided by Bidders to Canada are subject to verification by Canada at all times. Canada will declare a bid non-responsive, or will declare a contractor in default if any certification made by the Bidder is found to be untrue whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority will render the bid non-responsive or constitute a default under the Contract.

5.1 Certification Required with the Bid

Bidders must submit the following duly completed certifications as part of their bid.

5.1.1 Declaration of Convicted Offences

As applicable pursuant to subsection Declaration of Convicted Offences of section 01 of the Standard Instructions, the Bidder must provide its bid, a completed [Declaration Form](#), to be given further consideration in the procurement process

5.1.2.1 Product Certification

The Bidder certifies that all goods proposed conform to the specifications detailed under the "Line Item Detail".

Signature

Date

5.2 Certifications Precedent to Contract Award and Additional Information

The certifications and additional information listed below should be submitted with the bid, but may be submitted afterwards. If any of these required certifications or additional information is not completed and submitted as requested, the Contracting Authority will inform the Bidder of a time frame within which to provide the information. Failure to provide the certifications or the additional information listed below within the time frame provided will render the bid non-responsive.

5.2.1 Integrity Provisions – List of Names

Bidders who are incorporated, including those bidding as a joint venture, must provide a complete list of names of all individuals who are currently directors of the Bidder.

Bidders bidding as sole proprietorship, as well as those bidding as a joint venture, must provide the name of the owner(s).

Bidders bidding as societies, firms or partnerships do not need to provide lists of names.

5.2.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "[FCP Limited Eligibility to Bid](http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml)" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available [from Employment and Social Development Canada \(ESDC\) - Labour's](#) website.

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "[FCP Limited Eligibility to Bid](#)" list at the time of contract award.

PART 6 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

6.1 Security Requirements

6.1.1 There is no security requirement applicable to this Contract.

6.2 Requirement - Contract

The Contractor must provide the items detailed under the "Line Item Detail".

6.3 Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

6.3.1 General Conditions

2010A (2015-07-03) General Conditions - Goods (Medium Complexity), apply to and form part of the Contract.

6.4 Term of Contract

6.4.1 Delivery Date

All the deliverables must be received on or before _____.

6.4.2 Adherence to Delivery Schedule

The contractor will promptly give notice to the Department of Public Works and Government Services of its inability to meet the contract delivery schedule and will request therein an extension of time stating its proposed revised delivery schedule and offering consideration for such revisions. Until such notice is received and the revised delivery schedule agreed to by the Department of Public Works and Government Services, the Minister may, pursuant to the General Conditions, on the business day following the due date of delivery of any outstanding materials, **terminate the whole or part of the contract for default.**

6.5 Authorities

6.5.1 Contracting Authority

The Contracting Authority for the Contract is:

Louie Turner, Supply Specialist
Public Works and Government Services Canada
Acquisitions Branch, Commercial Acquisition & Supply Management Sector
Logistics, Electrical, Fuel & Transportation Directorate
Fuel & Construction Products Division (HL)
11 Laurier Street, 7A2, Place du Portage, Phase III
Gatineau, QC, K1A 0S5
Telephone: 819-956-3975 Facsimile: 819-956-5227
E-mail address: louie.turner@tpsgc-pwgsc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

6.5.2 Technical Authority

The Technical Authority for the Contract is:

Name: _____
Title: _____
Organization: _____
Address: _____
Telephone: ____-____-____
Facsimile: ____-____-____
E-mail: _____

The Technical Authority named above is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Technical Authority, however the Technical Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

6.5.2 Contractor's Representative

Name and telephone number of the person responsible for :

	General Enquiries	Delivery Follow-up
Name:	_____	_____
Telephone No.:	_____	_____
Facsimile No.:	_____	_____
E-mail address:	_____	_____

6.6 Payment

6.6.1 Basis of Payment - Firm Unit Price

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid a firm unit price, as specified in the contract for a cost of \$ _____ CAD. Customs duties are included, and Applicable Taxes are extra.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

6.6.2 Limitation of Price

SACC Manual clause C6000C (2011-05-16) Limitation of Price

6.6.3 Terms of Payment

SACC Manual clause H1000C (2008-05-12) Single Payment

6.7 Invoicing Instructions

The Contractor must submit invoices in accordance with the information required in Section 10 of 2010A, General Conditions - Goods (Medium Complexity). One (1) copy must be forwarded to the Contracting Authority identified under the section entitled "Authorities" of the Contract.

6.8 Certifications

6.8.1 Compliance

The continuous compliance with the certifications provided by the Contractor in its bid and the ongoing cooperation in providing additional information are conditions of the Contract. Certifications are subject to verification by Canada during the entire period of the Contract. If the Contractor does not comply with any certification, fails to provide the additional information, or if it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

6.9 Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____.

6.10 Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) the General Conditions 2010A (2015-07-03) Goods (Medium Complexity);
- (c) Requirement;
- (d) the Contractor's bid dated _____, as clarified on _____ " **or** ", as amended on _____.

6.11 SACC Manual Clauses

The following terms and conditions are incorporated herein

SACC Reference	Section	Date
B7500C	Excess Goods	2006-06-16
D9002C	Incomplete Assemblies	2007-11-30
G1005C	Insurance	2008-05-12

6.12 Inspection and Acceptance

The Technical Authority is the Inspection Authority. All reports, deliverable items, documents, goods and all services rendered under the Contract are subject to inspection by the Inspection Authority or representative. Should any report, document, good or service not be in accordance with the requirements of the Statement of Requirement and to the satisfaction of the Inspection Authority, as submitted, the Inspection Authority will have the right to reject it or require its correction at the sole expense of the Contractor before recommending payment.

6.13 Shipping Instructions

6.13.1 Shipping Instructions - Delivery Schedule Unknown

1. The Contractor must ship the goods prepaid DDP - Delivered Duty Paid Hannel Drive, Ottawa, Ontario. Unless otherwise directed, delivery must be made by the most economical means. The Contractor is responsible for all delivery charges, administration, costs and risks of transport and customs clearance, including the payment of customs duties and Applicable Taxes.
2. The Contractor must deliver the goods in conformance with item # 14 in Annex "A".

ANNEX "A"

STATEMENT OF REQUIREMENT

Heat Exchangers - General Requirements and Specifications

The contractor is to supply materials and labor to manufacture three helical coil heat exchangers and one shell and tube heat exchanger for the CanmetENERGY high pressure combustion system operating at the following specifications. See Annex "B" for design and mandatory configuration of the heat exchangers.

The contractor must meet the mandatory requirements stated below.

Item #	Requirement/Specification	Minimum	Maximum	Comments
1)	Temperature (shell side)	0 °C	150 °C	
2)	Design Pressure (shell side)	10 barg		
3)	Temperature (tube side)	0 °C	397 °C	
4)	Design Pressure (tube side)	100 barg		
Additional Mandatory Requirements				
5)	Contractor must perform full heat exchanger design calculations to verify heat exchanger dimensions, flow rates and temperatures for all 4 heat exchangers. Deviations from the calculations performed by CanmetENERGY will be reviewed and any proposed alternate arrangements will be considered by the technical authority at that time.			
6)	Contractor will be responsible for: I. Submission of drawings to Technical Standards Safety Authority (TSSA) as well as insuring completed vessels pass inspection. II. Contractor will be responsible for application for all required permits and registrations from TSSA and be responsible for the associated fees. III. Have a Quality Program for fabrications, installation and testing that is registered with the TSSA. IV. Perform all tests as described in this specification. V. Supply all necessary tools, equipment, instruments, and calibration reports to perform the tests.			
7)	Contractor must use 316/316L stainless steel for all tube side components and adhere to mandatory configuration provided in Annex B. Configuration deviations may be accepted upon review by Technical Authority, drawings must be submitted with bid package if deviations are to be considered. CRN number required			
8)	Contractor must use carbon steel for all shell side components and adhere to mandatory configuration provided in Annex B. Configuration deviations may be accepted upon review by Technical Authority, drawings must be submitted with bid package if deviations are to be considered. CRN number required			
9)	Contractor must supply fittings which adhere to the following specifications (tube side): - butt-welded, 316L Stainless steel ASTM A182, CRN number required			
10)	Contractor must supply fittings which adhere to the following specifications (shell side): - butt-welded, Carbon steel ASTM A105, CRN number required			
11)	Contractor must insure all flanged connections are ANSI class 150 with raised face and weld neck.			

12)	Contractor must provide a copy of the final documentation package as submitted to TSSA, specifically related to the work including, but not limited to: I. Applicable qualified welding procedure specifications (WPS); II. Welders certificates; III. Non-destructive examination (NDE) operator certificates; IV. Non-destructive examination (NDE) inspection reports; V. Material mill test certificates.	
13)	Contractor must supply documentation (1 hard copy & 1 electronic copy) including operation and maintenance manuals, maintenance procedures, as-built drawings, spare parts list and manufacturers data for components.	
14)	Contractor must deliver heat exchangers on shipping pallets that allows for unloading using a 5 ton capacity fork lift.	

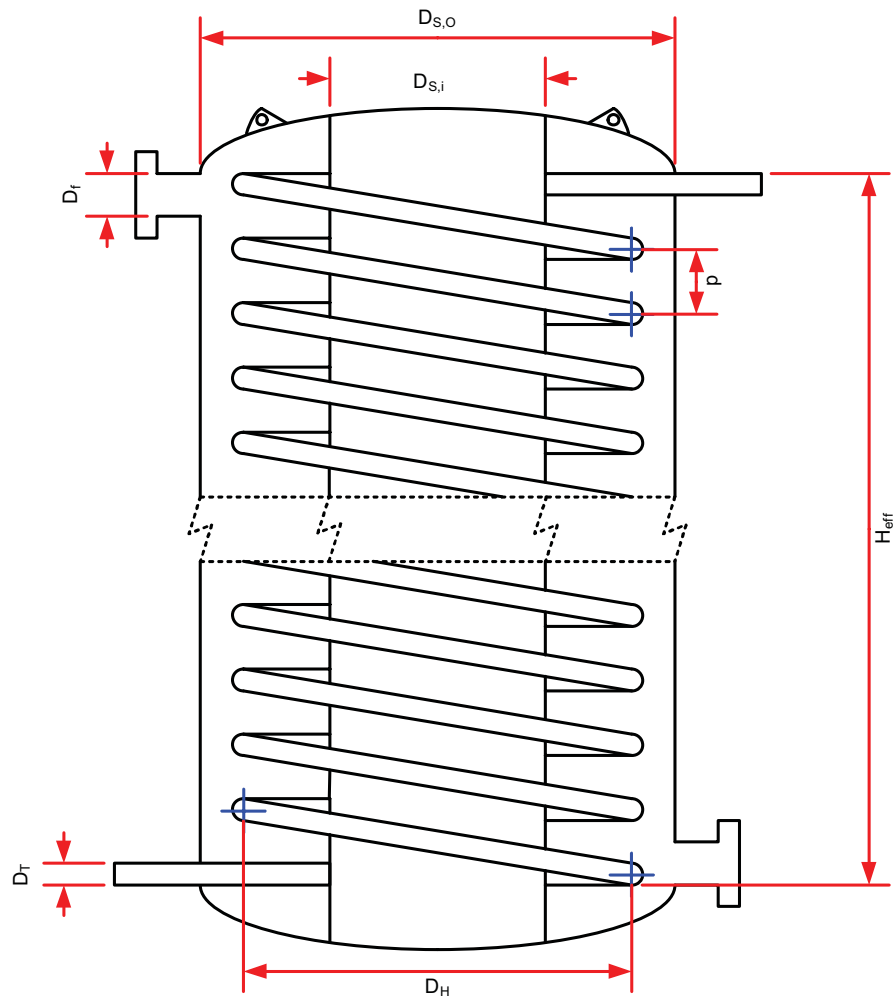
Notes to Contractor:**1.0 Background information**

Environmental

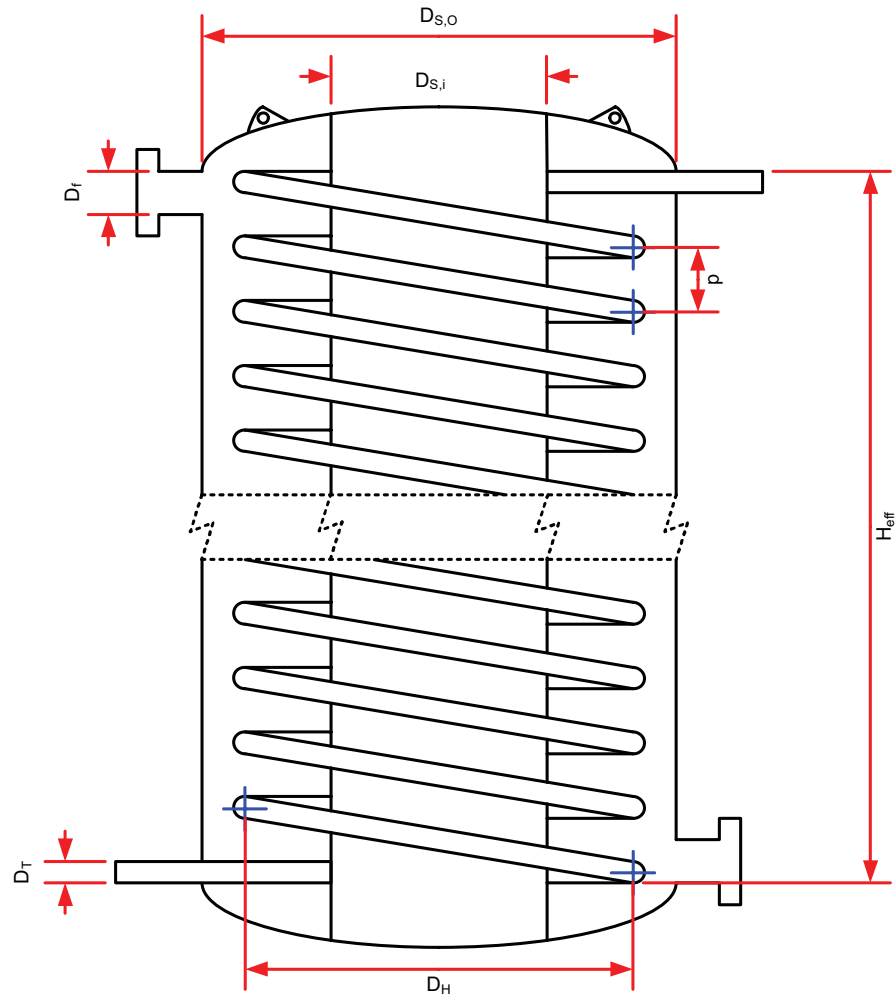
Elevation	0 ft
Ambient Outdoor Temperature	-30 °C to 40 °C, 100% relative humidity

2.0 CanmetENERGY responsibilities will include:

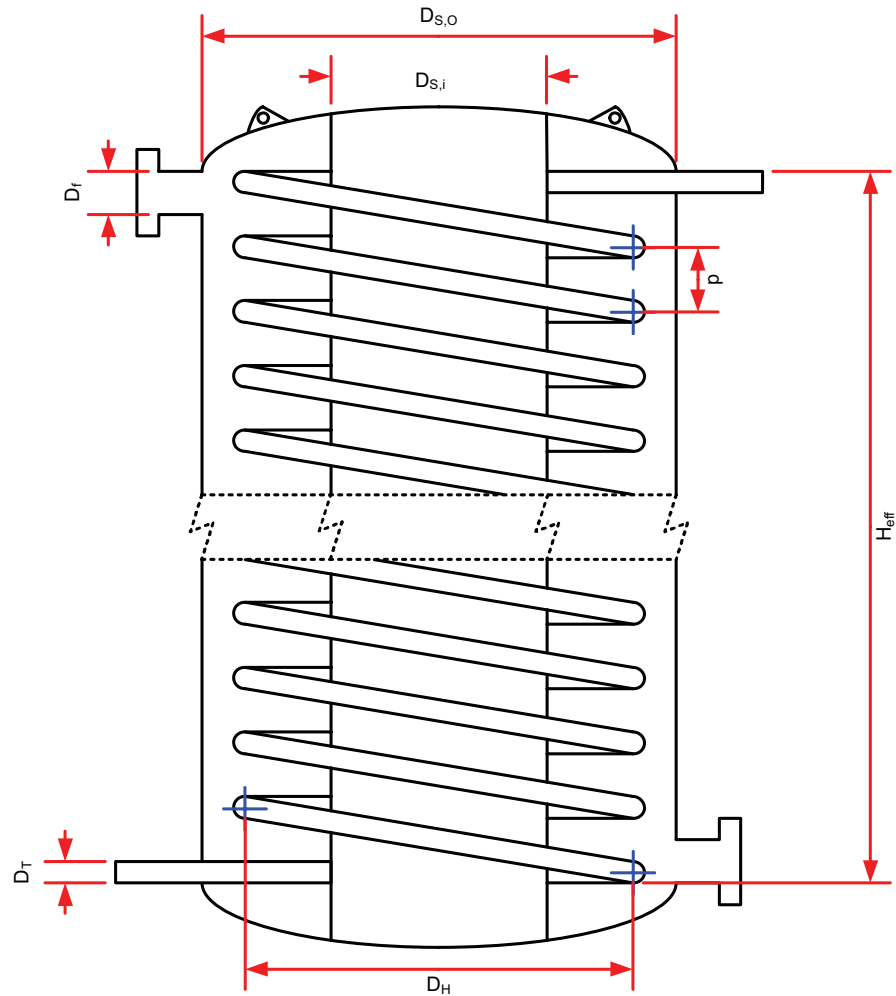
- a) Providing a suitable location for storage and installation of the heat exchangers, and structural supports for installation.
- b) Supply drawings for the mandatory configuration of the blowdown tanks to be delivered by the contractor.
- c) Unloading of heat exchangers off of delivery vehicle.



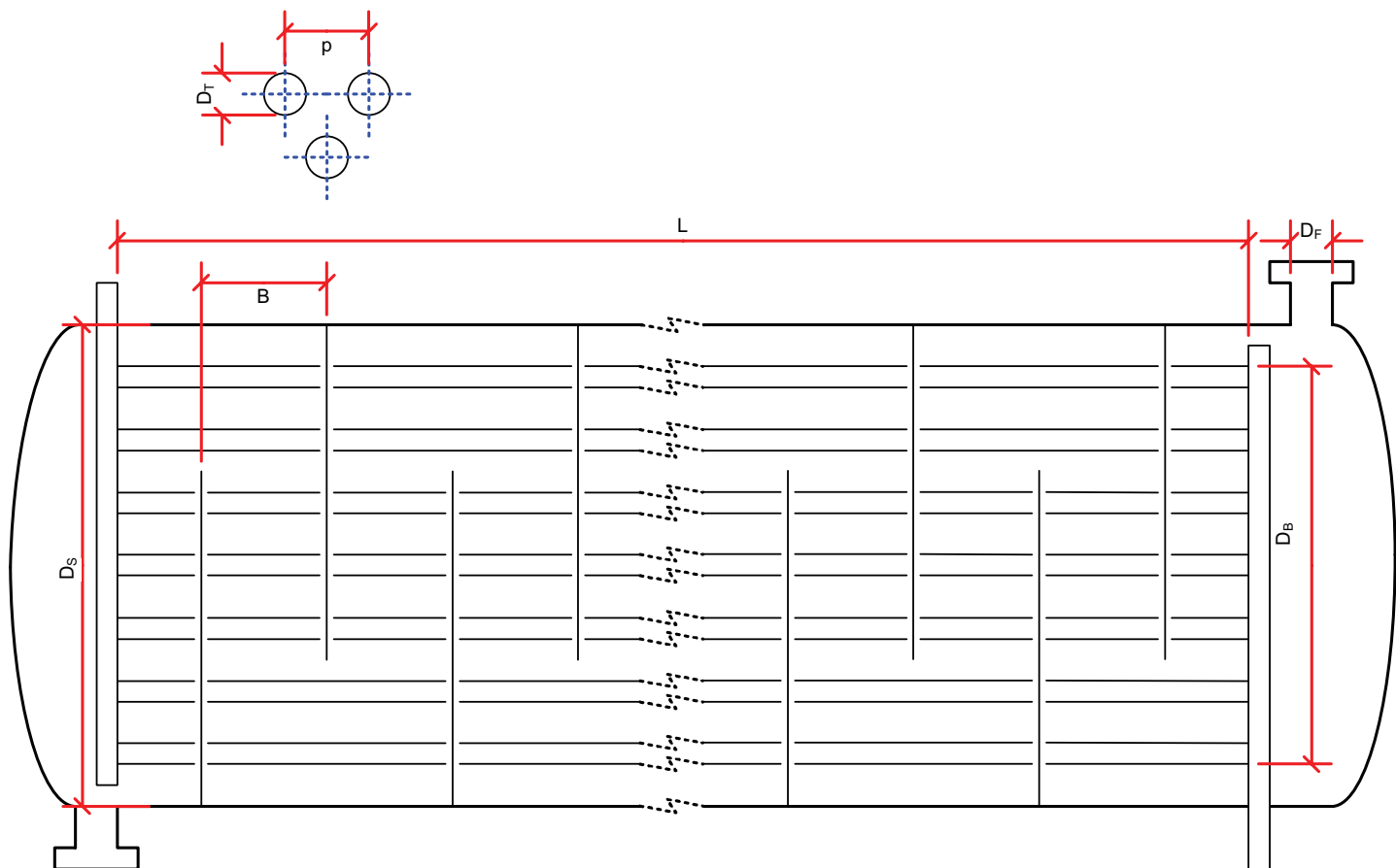
Heat Exchanger: HX-3101				
Parameter	Symbol	Units	Estimated Value	Comments
Diameter of helical coil (center to center)	D_H	m	0.134	
Inner diameter of outer shell	$D_{s,o}$	m	0.154	6" Sch. 40 pipe, I.D.
Outer diameter of inner shell	$D_{s,i}$	m	0.114	4" Sch. 40 pipe, O.D.
Outer diameter of tube	D_T	m	0.0127	1/2 Tube 0.049" wall thickness
Diameter of shell connections	D_F	m	0.0267	1" Sch. 40 pipe, threaded or flanged
Effective height of helical coil	H_{eff}	m	1.6	
Coil Pitch (center to center)	p	m	0.01905	$1.5 * D_T$
Number of turns in coil	N		84	
Shell side fluid	H_2O			
Shell side flow rate	\dot{m}_s	kg/h	1200	
Shell side inlet temperature	$T_{s,i}$	°C	20	
Shell side outlet temperature	$T_{s,o}$	°C	40	
Shell side pressure	P_s	barg	10	
Tube side fluid	H_2O			
Tube side flow rate	\dot{m}_T	kg/h	255	
Tube side inlet temperature	$T_{T,i}$	°C	275	
Tube side outlet temperature	$T_{T,o}$	°C	75	
Tube side pressure	P_T	barg	100	
Heat exchanger duty	Q	kW	61.8	
Estimated heat transfer area	A	m^2	1.41	
Estimated overall heat transfer coefficient	U	$W/m^2 \cdot ^\circ C$	398.9	



Heat Exchanger: HX-3201				
Parameter	Symbol	Units	Estimated Value	Comments
Diameter of helical coil (center to center)	D_H	m	0.134	
Inner diameter of outer shell	$D_{S,o}$	m	0.154	6" Sch. 40 pipe, I.D.
Outer diameter of inner shell	$D_{S,i}$	m	0.114	4" Sch. 40 pipe, O.D.
Outer diameter of tube	D_T	m	0.0127	1/2 Tube 0.049" wall thickness
Diameter of shell flanged connections	D_F	m	0.0267	1" Sch. 40 pipe, threaded or flanged
Effective height of helical coil	H_{eff}	m	1.2	
Coil Pitch (center to center)	p	m	0.01905	$1.5 * D_T$
Number of turns in coil	N		63	
Shell side fluid	H_2O			
Shell side flow rate	\dot{m}_s	kg/h	600	
Shell side inlet temperature	$T_{S,i}$	°C	20	
Shell side outlet temperature	$T_{S,o}$	°C	40	
Shell side pressure	P_s	barg	10	
Tube side fluid	H_2O			
Tube side flow rate	\dot{m}_T	kg/h	130	
Tube side inlet temperature	$T_{T,i}$	°C	275	
Tube side outlet temperature	$T_{T,o}$	°C	75	
Tube side pressure	P_T	barg	100	
Heat exchanger duty	Q	kW	31.5	
Estimated heat transfer area	A	m^2	1.05	
Estimated overall heat transfer coefficient	U	$W/m^2 \cdot ^\circ C$	274.2	



Heat Exchanger: HX-4301				
Parameter	Symbol	Units	Estimated Value	Comments
Diameter of helical coil (center to center)	D_H	m	0.134	
Inner diameter of outer shell	$D_{S,o}$	m	0.154	6" Sch. 40 pipe, I.D.
Outer diameter of inner shell	$D_{S,i}$	m	0.114	4" Sch. 40 pipe, O.D.
Outer diameter of tube	D_T	m	0.0127	1/2 Tube 0.049" wall thickness
Diameter of shell flanged connections	D_F	m	0.0267	1" Sch. 40 pipe, threaded or flanged
Effective height of helical coil	H_{eff}	m	0.724	
Coil Pitch (center to center)	p	m	0.01905	$1.5 * D_T$
Number of turns in coil	N		38	
Shell side fluid	H_2O			
Shell side flow rate	\dot{m}_s	kg/h	1200	
Shell side inlet temperature	$T_{S,i}$	°C	20	
Shell side outlet temperature	$T_{S,o}$	°C	40	
Shell side pressure	P_s	barg	10	
Tube side fluid	H_2O			
Tube side flow rate	\dot{m}_T	kg/h	960	
Tube side inlet temperature	$T_{T,i}$	°C	185	
Tube side outlet temperature	$T_{T,o}$	°C	135	
Tube side pressure	P_T	barg	125	
Heat exchanger duty	Q	kW	34.9	
Estimated heat transfer area	A	m^2	0.64	
Estimated overall heat transfer coefficient	U	$W/m^2 \cdot ^\circ C$	397.8	



Heat Exchanger: HX-4401				
Parameter	Symbol	Units	Estimated Value	Comments
Inner diameter of shell	D_s	m	0.4778	20" Sch. 40 pipe
Outer diameter of tube	D_T	m	0.0127	1/2 Tube 0.049" wall thickness
Diameter of tube bundle	D_B	m	0.4108	
Diameter of shell flanged connections	D_F	m	0.0267	1" Sch. 40 pipe, threaded or flanged
Coil Pitch (center to center)	p	m	0.0159	$1.25 * D_T$ (Triangular arrangement)
Number of tubes in bundle	N		547	
Baffle Spacing	B	m	0.2	
Length of tubes	L	m	2	
Shell side fluid	$H_2O/E\text{-}Glyc$			50:50 by volume
Shell side flow rate	\dot{m}_s	kg/h	8381	
Shell side inlet temperature	$T_{s,i}$	°C	20	
Shell side outlet temperature	$T_{s,o}$	°C	40	
Shell side pressure	P_s	barg	10	
Tube side fluid	H_2O			
Tube side flow rate	\dot{m}_T	kg/h	7600	
Tube side inlet temperature	$T_{T,i}$	°C	50	
Tube side outlet temperature	$T_{T,o}$	°C	25	
Tube side pressure	P_T	barg	10	
Heat exchanger duty	Q	kW	230	
Estimated heat transfer area	A	m^2	43.6	
Estimated overall heat transfer coefficient	U	$W/m^2 \cdot ^\circ C$	739.5	