

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

**Bid Receiving
PWGSC
33 City Centre Drive
Suite 480C
Mississauga
Ontario
L5B 2N5
Bid Fax: (905) 615-2095**

**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 Environmental Control Chambers	
Solicitation No. - N° de l'invitation 01686-160103/A	Date 2015-06-24
Client Reference No. - N° de référence du client 01686-160103	
GETS Reference No. - N° de référence de SEAG PW-\$TOR-016-6879	
File No. - N° de dossier TOR-5-38039 (016)	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2015-08-04	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: Yari, Helen	Buyer Id - Id de l'acheteur tor016
Telephone No. - N° de téléphone (905) 615-2081 ()	FAX No. - N° de FAX (905) 615-2060
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: DEPARTMENT OF AGRICULTURE AND AGRI-FOOD Greenhouse & Processing Crops 2585 County Road 20 Harrow Ontario N0R1G0 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Vendor/Firm Name and Address

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

Delivery Required - Livraison exigée See Herein	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

Solicitation No. - N° de l'invitation

01686-160103/A

Amd. No. - N° de la modif.

Buyer ID - Id de l'acheteur

tor016

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

01686-160103

File No. - N° du dossier

TOR-5-38039

CCC No./N° CCC - FMS No/ N° VME

SEE ATTACHED

TABLE OF CONTENTS

PART 1 - GENERAL INFORMATION	2
1.1 SECURITY REQUIREMENTS.....	2
1.2 REQUIREMENT - BID	2
1.3 DEBRIEFINGS	2
PART 2 - BIDDER INSTRUCTIONS.....	2
2.1 STANDARD INSTRUCTIONS, CLAUSES AND CONDITIONS	2
2.2 SUBMISSION OF BIDS.....	2
2.3 ENQUIRIES - BID SOLICITATION	2
2.4 APPLICABLE LAWS	3
PART 3 - BID PREPARATION INSTRUCTIONS	3
3.1 BID PREPARATION INSTRUCTIONS	3
PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION	3
4.1 EVALUATION PROCEDURES.....	3
4.2 BASIS OF SELECTION.....	4
PART 5 - CERTIFICATIONS.....	4
5.1 CERTIFICATIONS PRECEDENT TO CONTRACT AWARD.....	4
PART 6 - RESULTING CONTRACT CLAUSES	5
6.1 SECURITY REQUIREMENTS.....	5
6.2 REQUIREMENT - CONTRACT	5
6.3 STANDARD CLAUSES AND CONDITIONS	5
6.4 TERM OF CONTRACT	5
6.5 AUTHORITIES	5
6.6 PAYMENT	6
6.8 CERTIFICATIONS	7
6.9 APPLICABLE LAWS	7
6.10 PRIORITY OF DOCUMENTS.....	7
6.12 INSURANCE	7
6.13 SACC MANUAL CLAUSES	7
ANNEX "A"	8
REQUIREMENT 1.....	8
REQUIREMENT 2.....	13
ANNEX "B"	19
BASIS OF PAYMENT	19
ANNEX "C"	20
EVALUATION CRITERIA.....	20

PART 1 - GENERAL INFORMATION

1.1 Security Requirements

There is no security requirement.

1.2 Requirement - Bid

The requirement is detailed under Article 2 of the resulting contract clauses.

1.2.1 Delivery - All the deliverables (delivery, installation, start-up and commissioning) must be received on or before 15 February 2016.

Please state your best delivery in terms of calendar days after receipt of order. _____ Days.

Please state your best completion date for installation, start-up and commissioning of units after delivery of units to site. _____ Days.

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.

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>) 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 (2014-09-25) 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 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.

2.3 Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than 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.

2.4 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.

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

3.1.1 Financial

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

3.1.1.1 Exchange Rate Fluctuation

C3011T (2013-11-06), Exchange Rate Fluctuation

3.1.2 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 financial evaluation criteria.
- (b) An evaluation team composed of representatives of Canada will evaluate the bids. (taken from previous)

4.1.1 Technical Evaluation

4.1.1.1 Mandatory Technical Criteria

Mandatory technical criteria are included in Annex "C".

4.1.2 Financial Evaluation

- 4.1.2.1 The Bidder must complete and submit with its bid, Annex B - Basis of Payment.

4.1.2.2 *SACC Manual* Clause A0220T (2014-06-26), Evaluation of Price

4.1.2.3 Evaluated Price will be the Aggregate of the Extended Prices on Annex B, Basis of Payment.

4.2 Basis of Selection

4.2.1 Basis of Selection – Mandatory Technical Criteria

A bid must comply with the requirements of the bid solicitation and meet all mandatory technical evaluation criteria to be declared responsive. The responsive bid with the lowest evaluated price will be recommended for award of a contract.

PART 5 - CERTIFICATIONS

Bidders must provide the required certifications and associated 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 in carrying out any of its obligations under the Contract, 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 may render the bid non-responsive or constitute a default under the Contract.

5.1 Certifications Precedent to Contract Award

The certifications listed below should be completed and submitted with the bid, but may be submitted afterwards. If any of these required certifications 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 comply with the request of the Contracting Authority and to provide the certifications within the time frame provided will render the bid non-responsive.

5.1.1 Integrity Provisions - Associated Information

By submitting a bid, the Bidder certifies that the Bidder and its Affiliates are in compliance with the provisions as stated in Section 01 Integrity Provisions - Bid of Standard Instructions 2003. The associated information required within the Integrity Provisions will assist Canada in confirming that the certifications are true.

5.1.2 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" 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 Controlled Environment Growth Chambers in accordance with the Requirement 1 and 2 at Annex "A" and the Contractor's technical bid entitled _____, dated _____.

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 (2014-11-27), 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 (excluding installation, start-up and commissioning) must be received on or before _____.

Installation, start-up and commissioning must be completed within _____ days from date of delivery.

All the deliverables (delivery, installation, start-up and commissioning) must be received on or before 15 February 2016.

6.5 Authorities

6.5.1 Contracting Authority

The Contracting Authority for the Contract is:

Helen Yari
Supply Specialist
Public Works and Government Services Canada
Acquisitions Branch, Ontario Region
33 City Centre Drive, Suite 480
Mississauga, Ontario L5B 2N5
Telephone: 905-615-2081 Facsimile: 905-615-2060
E-mail address: helen.yari@pwgsc-tpsgc.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.

Solicitation No. - N° de l'invitation
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tor016
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6.5.2 Project Authority (To be filled in at contract award)

The Project Authority for the Contract is:

Name: _____
Title: _____
Organization: _____
Address: _____

Telephone : _____
Facsimile: _____
E-mail address: _____

The Project Authority 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 Project Authority, however the Project 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.

6.5.3 Contractor's Representative

Name: _____
Title: _____

Telephone : _____
Facsimile: _____
E-mail address: _____

6.6 Payment

6.6.1 Basis of Payment

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid a firm unit prices, as specified in Annex B for a cost of \$ _____. 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 Single Payment

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

6.7 Invoicing Instructions

1. The Contractor must submit invoices in accordance with the section entitled "Invoice Submission" of the general conditions. Invoices cannot be submitted until all work identified in the invoice is completed.

2. Invoices must be distributed as follows:

- a. The original and one (1) copy must be forwarded to the address shown on page 1 of the Contract for certification and payment.
- b. 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 associated 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 associated 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 Ontario.

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 (2014-11-27) General Conditions – Goods (Medium Complexity);
- (c) Annex A, Requirement 1 and Requirement 2;
- (d) the Contractor's bid dated _____, as clarified on _____ **or**, as amended on _____.

6.12 Insurance

SACC Manual Clauses G1005C (2008-05-12) Insurance

6.13 SACC Manual Clauses

SACC Manual Clauses A9068C (2010-01-11) Government Site Regulations

ANNEX "A"

REQUIREMENT 1

1.0 General Requirements:

To supply, deliver, install, start-up and commission three (3), standard production model Commercially Available Controlled Environment Plant Growth Chambers having an internal growth floor area of 19 to 20 square feet and performance features for optimum conditions suitable for plant growth, carbon dioxide enrichment studies and other related similar research projects to Agriculture and Agri-Food Canada (AAFC), Greenhouse and Processing Crops Research Centre, 2585 County Road 20, Harrow, ON, CANADA, N0R 1G0, in accordance with the specifications detailed herein.

Prototype or one of a kind controlled environment growth chambers are not acceptable.

2.0 General Mandatory Requirements:

2.1 Electrical Certification: Growth chambers must be provided with product certification to CSA (Canadian Safety Association) and/or ULC (United Laboratories of Canada) Standards. Contractor must provide proof of certification covering the entire product certificates must be provided.

2.2 Electrical Configuration: Each Growth chamber must be configured for 120/208 volt, three phase, 60 cycle, four wire plus ground electrical service.

2.3 Warranty: Contractor must ensure equipment and labor includes a warranty for a minimum of 2 years (24 months) from date of onsite installation, startup and commissioning. Proof and details of warranty must be provided to Agriculture and Agri-Food Canada (AAFC) Response to service calls must be within 8 hours of call placement, 7 days per week. A qualified, factory trained and certified service technician must be on site within 24 hours during regular business day (7h00 – 17h00) to address any reported problem. Manufacturer must guarantee the availability of parts and components for a minimum of 10 years.

2.4 Light Intensity: Contractor must provide light scans that verify specified micromoles/m²/sec measure at 6" (150mm), from the lamps, verified at 25°C with 100 hour old lamps.

3.0 Mandatory Construction Technical Requirements:

3.1 Wall panel construction must be woodless with CFC-free insulation. Exterior panels must be aluminium, finished with baked on enamel paint having either a smooth or pebbled finish or high polished stainless steel. Interior panels and doors must be finished with high reflective white enamel baked on smooth aluminium sheets or high polished stainless steel. End walls must have a reflective specular aluminium finish or polished stainless steel. The chamber must be equipped with mechanical fastening devices which will allow the chamber to be secured to the floor with concrete anchors.

3.2 Each growth chamber must be equipped with two front mounted access doors complete with thermal gasket, keyed magnetic locks and stainless steel hinges. Each door must be supplied with one (1) dual pane observation window with a minimum glass size of 10"x 14" (254mm x 355mm) complete with a light tight cover, pull handle and latching hardware.

3.3 Each growth chamber must be equipped with two (2), internally mounted 120 Volt AC duplex receptacles, rated for damp locations and wired with overload protection.

- 3.4 Outside dimensions must be 100"W x 35½"D x 116"H (2540mmW x 900mmD x 2945mmH) ± 2" (50mm).
- 3.5 Inside dimensions must be 97" W x 30½"D (2465mmW x 775mmD) ± 2" (50mm).
- 3.6 Interior growth area must be no less than 19 to 20 ft² (1.9m²).
- 3.7 Growth height must be no less than 67" (1700mm) from growth floor to light canopy in the UP position.
- 3.8 Each growth chamber must be equipped with one hose bib and connected to the local control system for timed control of automatic watering.
- 3.9 Each growth chamber must be equipped with a central control panel located between the access doors.
- 3.10 Each growth chamber must be equipped two (2) instrumentation ports with a minimum diameter of 1.5 inches (38mm) and complete with light tight caps.
- 3.11 Each growth chamber must be supplied with a factory installed removable aluminium or stainless steel perforated growth floor which allows conditioned air movement in a vertical direction through the crop and then through the light canopy.
- 3.12 Each growth chamber drain pan must be corrosion resistant and must be waterproofed in order to avoid water leakage through the side panels. Agriculture and Agri-Food Canada (AAFC) will connect all chamber drains to existing floor drain systems in the complex. All drain openings and drain lines installed as part of the chamber by the manufacturer must be capable of evacuating evaporator defrost cycle condensation and excess plant watering.
- 3.13 Each growth chamber must be set up for single tier operation with vertical air flow.
- 3.14 Each growth chamber must be assembled and tested at the manufacturing facility prior to shipment and delivery to ensure chamber performance meets all factory performance objectives.

4.0 Mandatory Lighting Requirements – High Light Intensity:

- 4.1 In the single tier vertical air flow configuration mode, the Contractor must ensure light intensity at a minimum of 1100 to 1125 micromoles/m²/s measured at 6" (150mm) from lamps, verified at 25°C with 100 hour old lamps.
- 4.2 Each growth chamber must be equipped with an adjustable light canopy that will ensure a balance spectrum for research plant materials using T5 fluorescent and Halogen incandescent lamps.
- 4.3 Each growth chamber must have a counterbalanced light bank system, adjustable to a minimum of 67" (1700mm) from the floor.
- 4.4 Contractor must ensure that fluorescent and incandescent lamps are controlled independently with a minimum of 4 or 5 programming levels for each lamp type.
- 4.5 Contractor must ensure energy efficient electronic ballasts are easily accessible for servicing and that cooling will be provided by adequate air circulating fan motors.
- 4.6 Each growth chamber must be provided with a factory installed quantum light meter for display purposes and recording of light output of each new growth chamber.

5.0 Mandatory Temperature Requirements Standard and Low Temperature Operation:

- 5.1 Standard temperature operation range: Must ensure full operation with a minimum temperature range of +4°C to +40°C lights OFF; +10°C to +40°C lights ON (full fresh air) is provided.
- 5.2 Low temperature operation range: Must ensure full operation with a minimum temperature range of +2°C to +40°C lights OFF/ON (Full fresh air above +4°C) is provided.

When operating in low temperature range: Must provide a multi-circuit evaporator coil that is designed to continuously control temperature with no temperature spike during defrost and that is accomplished by staging the operation of the evaporator circuits, cycling one through defrost while the active circuits maintain temperature control within the chamber.

- 5.3 Must ensure a temperature control within $\pm 0.5^{\circ}\text{C}$, from control temperature set point.
- 5.4 Must ensure primary temperature safety limits are provided for programmable high and low temperature alarm limit that automatically follows the programmed set point.
- 5.5 Must provide secondary temperature safety limits to provide independent high and low temperature limit.
- 5.6 Must ensure an audible alarm is provided for both limits and that activation of safety limit set points turns off power to the chamber.
- 5.7 Must provide a vertically adjustable sensing device located in the growth area to ensure a continuous sample of growth room air is drawn over the sensors for accurate controlling, measuring and recording at plant location and ensuring to mitigate lamp radiation.

6.0 Mandatory Relative Humidity Requirements:

- 6.1 Must provide additive humidity to achieve a minimum of 90% Relative Humidity (RH) lights OFF and 80% (RH) lights ON, limited by a +25°C maximum dew point through the incorporation of spray nozzles, requiring 60 psi (4.2 bar) pressure, that are programmed with the control system.
- 6.2 Must ensure humidity control is within $\pm 3\%$ (RH) and system must incorporate a dry humidity sensor located in a device for sensing, measuring and controlling. Must provide misting programming through the microprocessor controller.
- 6.3 Must provide a separate dehumidification coil to allow reduction in humidity to at least 40% (RH) at +25°C.

7.0 Mandatory Refrigeration System and Components:

- 7.1 Must provide a water-cooled, hermetically sealed condensing unit mounted on top of growth chamber. Must ensure valves provide continuous flow and variable temperature returns to cooling water. All growth chambers will be connected to a Central Cooling Tower supply and return system.
- 7.2 Must provide a hot-gas refrigeration system incorporating a 3-way proportional valve to ensure a steady-state system without the use of individual solenoids on separate heating and cooling circuits. Must ensure unit is capable of switching from cooling tower operations to domestic city water, includes a thermostatic 3-way water valve, and is equipped with a hand operated bypass shut off valve and a water condenser

sized for maximum inlet water temperature of +29°C. Maximum pressure drop across condenser and water valve shall not exceed 10 psi (0.7 bar).

- 7.3 Must ensure evaporator coil be copper-tube construction.
- 7.4 Must ensure condensing unit is charged with CFC-free refrigerant.
- 7.5 In the single tier configuration mode, must ensure air in the chamber is directed uniformly upward (vertical) through the floor at less than 50 ft/min (15.2 m/min).
- 7.6 Must ensure the refrigeration system is capable of removing radiant lamp heat.
- 7.7 Must ensure conditioning unit has sufficient fans, heaters and valves necessary to meet the specified parameters.
- 7.8 Fresh air control must have individual manual adjustment of positively sealed inlet and outlet from open 20 ft³/min (0.57 m³/min) to close.
- 7.9 Monitoring: a) Refrigeration system operation must be monitored by the control system, including visual and audible alarm. b) Pressure transducers must be installed to allow for real-time diagnostics for preventative maintenance and repair.

8.0 Mandatory Control System:

- 8.1 Contractor must provide a touch screen controller with a back lit high resolution display monitor at each unit. Must ensure daily programs can be linked to simulate multi day or seasonal programs. Must ensure up to eight programs may be sequenced together. Must provide an on screen help manual for programming. Must provide a status screen to display set point conditions, unit ID number and operating indicators of various components.
- 8.2 Contractor must ensure all controlled parameters at each unit can be recorded to provide a log of actual experimental results. Must ensure that stored data can be transferred to a desktop via a portable storage device and local area network. Must ensure graphing of both set points and actual performance values is provided. Pan and zoom functions to increase resolution must be incorporated. Must provide graphing program to view historical data in graph form to compare with actual performance. Must ensure a continuous on-screen graphical display of the last 24 hours of room performance and next 8 hours of unit set point program. Inputs and controlled parameters must be automatically logged to provide a historical record of performance.
- 8.3 Growth chamber controllers must have multi-level security password protection capability.
- 8.4 Each growth chamber controller must be equipped with an on screen diagnostic display of optional inputs and outputs such as refrigeration valves, damper motors, etc., that allows service personnel access to the service life of the components including lamp burning hours, valve cycles etc.
- 8.5 Must ensure each unit is equipped with a start-up delay to stagger activation of units.
- 8.6 Must ensure each unit controller is shipped communications-ready for connection to a Central Management System or local area network.
- 8.7 Each growth chamber must be equipped with dry contact relays to allow operator to track and receive high and low temperature alarms, humidity, lighting and other controlled parameters from the unit. The

unit must allow the integration with existing Building Alarm System, Central Management and local network. Must ensure that alarms can be logged to a portable storage device and the network.

9.0 Site Utility Services Provided by (AAFC):

- 9.1 AAFC will connect each growth chamber to existing electrical services on site with an external disconnect switch, all wiring and conduits and overload protection.
- 9.2 AAFC will connect drain lines from growth chambers to facility drains.
- 9.3 AAFC will connect the supply and return condenser cooling water lines from central cooling tower system to each growth chamber.
- 9.4 AAFC will supply Reverse Osmosis supply water to each growth chamber additive humidification system.

10.0 Mandatory Carbon Dioxide Enrichment System:

- 10.1 Each new controlled environment chamber must be equipped with a factory installed carbon dioxide enrichment monitoring and control system.
- 10.2 Carbon dioxide control requirements ambient to 3000 parts per million.
- 10.3 The Contractor must supply all components, carbon dioxide regulator, carbon dioxide control valve, carbon dioxide injection system and carbon dioxide gas analyzer.
- 10.4 AAFC will supply and hook up bulk liquid carbon dioxide supply system to the new controlled environment chambers.

11.0 Off-Loading, Installation, Start-up and Commissioning:

- 11.1 AAFC will off-load the equipment at the delivery site with appropriate unloading devices.
- 11.2 AAFC will transport the equipment from the off-loading or storage area to the assembly area.
- 11.3 The Contractor must un-crate equipment and dispose of crating material in customer supplied disposal bins.
- 11.4 The Contractor must assemble and make work the supplied equipment using qualified personnel.
- 11.5 The Contractor must provide start-up and commissioning services to ensure that each growth chamber performs to factory specifications.
- 11.6 The Contractor must provide two hours of instruction on use and maintenance of the equipment.
- 11.7 The Contractor must provide for each unit one complete set of user documentation, technical specifications, maintenance manuals, drawings and list of spare parts in English.

ANNEX "A"

REQUIREMENT 2

1.0 General Requirements:

To supply, deliver, install, start-up and commission four (4), standard production model commercially available, Controlled Environment Plant Growth Chambers having an internal growth floor area of 14 to 15 square feet and performance features for optimum conditions suitable for plant growth and other related similar research projects to Agriculture and Agri-Food Canada (AAFC), Greenhouse and Processing Crops Research Centre, 2585 County Road 20, Harrow, ON, CANADA, N0R 1G0, in accordance with the specifications detailed herein.

Prototype or one of a kind controlled environment growth chambers are not acceptable.

2.0 General Mandatory Requirements:

2.1 Electrical Certification: Growth chambers must be provided with product certification to CSA (Canadian Safety Association) and/or ULC (United Laboratories of Canada) Standards. Proof of certification for entire product must be provided.

2.2 Electrical Configuration: Each Growth chamber must be configured for 120/208 volt, three phase, 60 cycle, four wire plus ground electrical service.

2.3 Warranty: Contractor must ensure equipment and labor includes a warranty for a minimum of 2 years (24 months) from date of onsite installation, startup and commissioning. Proof and details of warranty must be provided to Agriculture and Agri- Food Canada. Response to service calls must be within 8 hours of call placement, 7 days per week. A qualified, factory trained and certified service technician must be on site within 24 hours during regular business day (7h00 – 17h00) to address any reported problem. Manufacturer must guarantee the availability of parts and components for a minimum of 10 years.

2.4 Light Intensity: Contractor must provide light scans that verify specified micromoles/m²/sec measure at 6" (150mm), from the lamps, verified at 25°C with 100 hour old lamps.

3.0 Mandatory Construction Technical Requirements:

3.1 Wall panel construction must be woodless with CFC-free insulation. Exterior panels must be aluminium, finished with baked on enamel paint having either a smooth or pebbled finish or high polished stainless steel. Interior panels and doors must be finished with high reflective white enamel baked on smooth aluminium sheets or high polished stainless steel. End walls must have a reflective specular aluminium finish or polished stainless steel. The chamber must be equipped with mechanical fastening devices which will allow the chamber to be secured to the floor with concrete anchors.

3.2 Each growth chamber must be equipped with two front mounted access doors complete with thermal gasket, keyed magnetic locks and stainless steel hinges. Each door must be supplied

with one (1) dual pane observation window with a minimum glass size of 10"x 14" (254mm x 355mm) complete with a light tight cover, pull handle and latching hardware.

- 3.3 Each growth chamber must be equipped with two (2), internally mounted 120 Volt AC duplex receptacles, rated for damp locations and wired with overload protection.
- 3.4 Outside dimensions shall be 104"W x 35½"D x 78"H (2640mmW x 901mmD x 1980mmH) ± 2" (50mm).
- 3.5 Inside dimensions shall be 73" W x 31½"D (1854mmW x 800mmD) ± 2" (50mm).
- 3.6 Interior growth area must be no less than 15 to 16 ft² (1.4m²) to (1.5m²).
- 3.7 Growth height must be no less than 57" (1448mm) from growth floor to light canopy in the UP position.
- 3.8 Each growth chamber must be equipped with one (1), hose bib and connected to the local control system for timed control of automatic watering.
- 3.9 Each growth chamber must be equipped with a central control panel located at the left or right end of the growth chamber depending on the machine area location.
- 3.10 Each growth chamber must be equipped with two (2) instrumentation ports with a minimum diameter of 1 inch (25.4mm) and sealing caps.
- 3.11 Each growth chamber must be supplied with a factory installed removable aluminium or stainless steel perforated growth floor which allows conditioned air movement in a vertical direction through the crop and then through the light canopy.
- 3.12 Each growth chamber drain pan must be corrosion resistant and must be waterproofed in order to avoid water leakage through the side panels. Agriculture and Agri-Food Canada (AAFC) will connect all chamber drains to existing floor drain systems in the complex. All drain openings and drain lines installed as part of the chamber by the manufacturer must be capable of evacuating evaporator defrost cycle condensation and excess plant watering.
- 3.13 Each growth chamber must be set up for single tier operation with vertical air flow.
- 3.14 Each growth chamber must be assembled and tested at the manufacturing facility prior to shipment and delivery to ensure chamber performance meets all factory performance objectives.

4.0 Mandatory Lighting Requirements – Light Intensity:

- 4.1 In the single tier vertical air flow configuration mode, contractor must ensure light intensity at a minimum of 875 to 925 micromoles/m²/s measured at 6" (150mm) from lamps, verified at 25°C with 100 hour old lamps.

- 4.2 Each growth chamber must be equipped with an adjustable light canopy that will ensure a balanced spectrum for research plant materials using T5 fluorescent and Halogen incandescent lamps.
- 4.3 Each growth chamber must have a counterbalanced light bank system, adjustable to a minimum of 57" (1448mm) from the floor.
- 4.4 Contractor must ensure that fluorescent and incandescent lamps are controlled independently with a minimum of 4 or 5 programming levels for each lamp type.
- 4.5 Contractor must ensure energy efficient electronic ballasts are easily accessible for servicing and that cooling will be provided by adequate air circulating fan motors.
- 4.6 Each growth chamber must be provided with a factory installed quantum light meter for display purposes and recording of light output supplied in each new chamber.

5.0 Mandatory Temperature Requirements - Standard Temperature Operation

- 5.1 Standard temperature operation range: Must ensure full operation with a minimum temperature range of +4°C to +45°C lights OFF; +10°C to +45°C lights ON (full fresh air) is provided.
- 5.2 Must ensure temperature control within $\pm 0.5^{\circ}\text{C}$, from control temperature set point.
- 5.3 Must ensure primary temperature safety limits are provided for programmable high and low temperature alarm limit that automatically follows the programmed set point.
- 5.4 Must provide secondary temperature safety limits to provide independent high and low temperature limit.
- 5.5 Must ensure an audible alarm is provided for both limits and that activation of safety limit set points turns off power to the chamber.
- 5.6 Must provide a vertically adjustable sensing device located in the growth area to ensure a continuous sample of growth room air is drawn over the sensors for accurate controlling, measuring and recording at plant location and ensuring to mitigate lamp radiation.

6.0 Mandatory Relative Humidity Requirements:

- 6.1 Must provide additive humidity to achieve a minimum of 90% RH lights OFF and 80% RH lights ON, limited by a +25°C maximum dew point through the incorporation of spray nozzles, requiring 60 psi (4.2 bar) pressure, that are programmed with the control system.
- 6.2 Must ensure humidity control is within $\pm 3\%$ RH and system must incorporate a dry humidity sensor located in a device for sensing, measuring and controlling. Must provide misting programming through the microprocessor controller.
- 6.3 Must provide a separate coil dehumidification to allow reduction in humidity to at least 40% RH at +25°C.

7.0 Mandatory Refrigeration System and Components:

- 7.1 Must provide a water-cooled, hermetically sealed condensing unit for each growth chamber that is easily accessible. Must ensure valves provide continuous flow and variable temperature returns to cooling water. All growth chamber will be connected to a Central Cooling Tower supply and return system.
- 7.2 Must provide a hot-gas refrigeration system incorporating a 3-way proportional valve to ensure a steady-state system without the use of individual solenoids on separate heating and cooling circuits. Must ensure unit is capable of switching from cooling tower operations to domestic city water, includes a thermostatic 3-way water valve, and is equipped with a hand operated bypass shut off valve and a water condenser sized for maximum inlet water temperature of +29°C. Maximum pressure drop across condenser and water valve shall not exceed 10 psi (0.7 bar).
- 7.3 Must ensure evaporator coil be copper-tube construction.
- 7.4 Must ensure condensing unit is charged with CFC-free refrigerant.
- 7.5 In the single tier configuration mode, must ensure air in the chamber is directed uniformly upward (vertical) through the floor at less than 50 ft/min (15.2 m/min).
- 7.6 Must ensure the refrigeration system is capable of removing radiant lamp heat.
- 7.7 Must ensure conditioning unit has sufficient fans, heaters and valves necessary to meet the specified parameters.
- 7.8 Fresh air control must have individual manual adjustment of positively sealed inlet and outlet from open 20 ft³/min (0.57 m³/min) to close.
- 7.9 Monitoring: a) Refrigeration system operation must be monitored by the control system, including visual and audible alarm. b) Pressure transducers must be installed to allow for real-time diagnostics for preventative maintenance and repair. c) Proportional refrigeration control valve must have feedback for monitoring the valves position by Building Management System.

8.0 Mandatory Control System:

- 8.1 Contractor must provide a touch screen controller with a back lit high resolution display monitor at each unit. Must ensure daily programs can be linked to simulate multi day or seasonal programs. Must ensure up to eight programs may be sequenced together. Must provide an on screen help manual for programming. Must provide a status screen to display set point conditions, unit ID number and operating indicators of various components.
- 8.2 Contractor must ensure all controlled parameters at each unit can be recorded to provide a log of actual experimental results. Must ensure that stored data can be transferred to a desktop via a portable storage device and local area network. Must ensure graphing of both set points and actual performance values is provided. Pan and zoom functions to increase resolution must be incorporated. Must provide graphing program to view historical data in graph form to compare

with actual performance. Must ensure a continuous on-screen graphical display of the last 24 hours of room performance and next 8 hours of unit set point program. Inputs and controlled parameters must be automatically logged to provide a historical record of performance.

- 8.3 Growth chamber controllers must have a multi-level security password protection capability.
- 8.4 Each growth chamber controller must be equipped with an on screen diagnostic display of optional inputs and outputs such as refrigeration valves, damper motors, etc., that allows service personnel access to the service life of the components including lamp burning hours, valve cycles etc.
- 8.5 Must ensure each unit is equipped with a start-up delay to stagger activation of units.
- 8.6 Must ensure each unit controller is shipped communications-ready for connection to a Central Management System and the local area network.
- 8.7 Each growth chamber must be equipped with dry contact relays to allow operator to track and receive high and low temperature alarms, humidity, lighting and other controlled parameters from the unit. The unit must allow the integration with existing Building Alarm System, Central Management and local network. Must ensure that alarms can be logged to a portable storage device and the network.

9.0 Site Utility Services Provided by (AAFC):

- 9.1 AAFC will connect each growth chamber to existing electrical services on the site with an external disconnect switch, all wiring and conduits and overload protection.
- 9.2 AAFC will connect drain lines from growth chambers to facility drains.
- 9.3 AAFC will connect the supply and return condenser cooling water lines from central cooling tower system to each growth chamber.
- 9.4 AAFC will supply Reverse Osmosis supply water to each growth chamber additive humidification system.

10. Off-Loading, Installation, Start-up and Commissioning:

- 10.1 AAFC will off-load the equipment at the delivery site with appropriate unloading devices.
- 10.2 AAFC will transport the equipment from the off-loading or storage area to the assembly area.
- 10.3 The Contractor must un-crate equipment and dispose of crating material in customer supplied disposal bins.
- 10.4 The Contractor must assemble and make work the supplied equipment using qualified personnel.

Solicitation No. - N° de l'invitation
01686-160103/A
Client Ref. No. - N° de réf. du client
01686-160103

Amd. No. - N° de la modif.
File No. - N° du dossier
TOR-5-38039

Buyer ID - Id de l'acheteur
tor016
CCC No./N° CCC - FMS No./N° VME

- 10.5 The Contractor must provide start-up and commissioning services to ensure that each growth chamber perform to factory specifications.
- 10.6 The Contractor must provide two hours of instruction on use and maintenance of the equipment.
- 10.7 The Contractor must provide for each unit one (1), complete set of user documentation, technical specifications, maintenance manuals, drawings and list of spare parts in English.

Solicitation No. - N° de l'invitation
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TOR-5-38039

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tor016
CCC No./N° CCC - FMS No./N° VME

ANNEX "B"

BASIS OF PAYMENT

Firm unit prices in Canadian dollars including Canadian customs duties, excise taxes, F.O.B dock at Agriculture and Agri-Food Canada, 2585 County Road, Harrow, Ontario, including all delivery charges. Applicable Taxes (Goods and Services Tax or Harmonized Sales Tax) are extra, if applicable.

Item No.	Description	Quantity	Firm Unit Price	Extended Price
1.0	Controlled Environment Plant Growth Chambers, 19-20 square feet growth area, with Carbon Dioxide Enrichment System, in accordance with Annex A, Requirement 1. Model and Part Number: _____	3	\$ _____	\$ _____
2.0	Installation, start-up, and commissioning of Item 1.0 in accordance with Annex A, Requirement 1.	3	\$ _____	\$ _____
3.0	Controlled Environment Plant Growth Chambers, 14-15 square feet growth area, in accordance with Annex A, Requirement 2. Model and Part Number: _____	4	\$ _____	\$ _____
4.0	Installation, start-up, and commissioning of Item 3.0 in accordance with Annex A, Requirement 2.	4	\$ _____	\$ _____
		Aggregate of Extended Prices		\$ _____

Solicitation No. - N° de l'invitation
01686-160103/A
Client Ref. No. - N° de réf. du client
01686-160103

Amd. No. - N° de la modif.
File No. - N° du dossier
TOR-5-38039

Buyer ID - Id de l'acheteur
tor016
CCC No./N° CCC - FMS No./N° VME

ANNEX "C"

EVALUATION CRITERIA

(to follow)

ANNEX C

EVALUATION CRITERIA

1. Technical Evaluation

1.1 Mandatory Technical Criteria

Each bid will be reviewed for compliance with the mandatory requirements of the bid solicitation. Bids that do not meet each and every Mandatory Technical Criteria will be considered nonresponsive and will receive no further consideration.

1.1.1 The Bidder must propose products that meet the mandatory requirements at Annex "A" for Requirement 1 and Requirement 2.

1.1.2 The Bidder must submit, *documentation to demonstrate that their proposed products meets the mandatory requirements at Annex "A".

*Documentation may include specification sheets or descriptive literature that demonstrates that the chambers offered meets the minimum requirements at Annex A. If the specification sheets or literature DO NOT address a required specification the Bidder must submit a compliance statement for those items stating how the requirement is being met. .

It is recommended that Bidders provide a cross reference for each Mandatory Requirement by completing a table similar to the one below at 2.0 Cross-reference Table for Annex A, Requirement 1 and Annex A, Requirement 2.

1.1.3 The manufacturer of the proposed equipment must have successfully completed at least 3 projects for supply and installation of similar equipment. The supply and installation of similar equipment can be for 15 or 20 square foot models or a combination of both. The Bidder must provide reference details of these projects: Model and quantity of chambers, Client Name and Address, Contact Name and phone number or e-mail address. These references will be contacted to confirm supply and installation success.

1.1.4 The manufacturer of the proposed equipment must be ISO9001 registered. The Bidder must submit a copy of the Manufacturer's ISO Registration Certificate, with their bid. If not submitted with the bid, the Bidders will have 3 days to submit upon request from the Contracting Officer or the bid will be deemed noncompliant.

2.0 Cross-reference Table

	Mandatory Requirement as per Annex A – Requirement 1.	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
2.0	General Mandatory Requirements	
2.1	Growth chambers must be provided with product certification to CSA (Canadian Safety Association) and/or ULC (United Laboratories of Canada) Standards. Contractor must provide proof of certification covering the entire product certificates must be provided.	
2.2	Each Growth chamber must be configured for 120/208 volt, three phase, 60 cycle, four wire plus ground electrical service.	
2.3	Contractor must ensure equipment and labor includes a warranty for a minimum of 2 years (24 months) from date of onsite installation, startup and commissioning. Proof and details of warranty must be provided to Agriculture and Agri-Food Canada (AAFC) Response to service calls must be within 8 hours of call placement, 7 days per week. A qualified, factory trained and certified service technician must be on site within 24 hours during regular business day (7h00 – 17h00) to address any reported problem. Manufacturer must guarantee the availability of parts and components for a minimum of 10 years.	
2.4	Contractor must provide light scans that verify specified micromoles/m ² /sec measure at 6" (150mm), from the lamps, verified at 25°C with 100 hour old lamps.	
3.0	Mandatory Construction Technical Requirements (Requirement 1)	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
3.1	Wall panel construction must be woodless with CFC-free insulation. Exterior panels must be aluminium, finished with baked on enamel paint having either a smooth or pebbled finish or high polished stainless steel. Interior panels and doors must be finished with high reflective white enamel baked on smooth aluminium sheets or high polished stainless steel. End walls must have a reflective specular aluminium finish or polished stainless steel. The chamber must be equipped with mechanical fastening devices which will allow the chamber to be secured to the floor with concrete anchors.	
3.2	Each growth chamber must be equipped with two front mounted access doors complete with thermal gasket, keyed magnetic locks and stainless steel hinges. Each door must be supplied with one (1) dual pane observation window with a minimum glass size of 10"x 14" (254mm x 355mm) complete with a light tight cover, pull handle and latching hardware.	
3.3	Each growth chamber must be equipped with two (2), internally mounted 120 Volt AC duplex receptacles, rated for damp locations and wired with overload	

	protection.	
3.4	Outside dimensions must be 100"W x 35½"D x 116"H (2540mmW x 900mmD x 2945mmH) ± 2" (50mm)	
3.5	Inside dimensions must be 97" W x 30½"D (2465mmW x 775mmD) ± 2" (50mm)	
3.6	Interior growth area must be no less than 19 to 20 ft² (1.9m²).	
3.7	Growth height must be no less than 67" (1700mm) from growth floor to light canopy in the UP position.	
3.8	Each growth chamber must be equipped with one hose bib and connected to the local control system for timed control of automatic watering.	
3.9	Each growth chamber must be equipped with a central control panel located between the access doors.	
3.10	Each growth chamber must be equipped two (2) instrumentation ports with a minimum diameter of 1.5 inches (38mm) and complete with light tight caps.	
3.11	Each growth chamber must be supplied with a factory installed removable aluminium or stainless steel perforated growth floor which allows conditioned air movement in a vertical direction through the crop and then through the light canopy.	
3.12	Each growth chamber drain pan must be corrosion resistant and must be waterproofed in order to avoid water leakage through the side panels. Agriculture and Agri-Food Canada (AAFC) will connect all chamber drains to existing floor drain systems in the complex. All drain openings and drain lines installed as part of the chamber by the manufacturer must be capable of evacuating evaporator defrost cycle condensation and excess plant watering.	
3.13	Each growth chamber must be set up for single tier operation with vertical air flow.	
3.14	Each growth chamber must be assembled and tested at the manufacturing facility prior to shipment and delivery to ensure chamber performance meets all factory performance objectives.	
4.0	Mandatory Lighting Requirements – High Light Intensity	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
4.1	In the single tier vertical air flow configuration mode, the Contractor must ensure light intensity at a minimum of 1100 to 1125 micromoles/m²/s measured at 6" (150mm) from lamps, verified at 25°C with 100 hour old lamps.	
4.2	Each growth chamber must be equipped with an adjustable light canopy that will ensure a balance spectrum for research plant materials using T5 fluorescent and Halogen incandescent lamps.	
4.3	Each growth chamber must have a counterbalanced light bank system, adjustable to a minimum of 67" (1700mm) from the floor.	
4.4	Contractor must ensure that fluorescent and incandescent lamps are controlled independently with	

	a minimum of 4 or 5 programming levels for each lamp type.	
4.5	Contractor must ensure energy efficient electronic ballasts are easily accessible for servicing and that cooling will be provided by adequate air circulating fan motors.	
4.6	Each growth chamber must be provided with a factory installed quantum light meter for display purposes and recording of light output of each new growth chamber.	
5.0	Mandatory Temperature Requirements – Standard and Low Temperature Operation	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
5.1	Standard temperature operation range: Must ensure full operation with a minimum temperature range of +4°C to +40°C lights OFF; +10°C to +40°C lights ON (full fresh air) is provided.	
5.2	Low temperature operation range: Must ensure full operation with a minimum temperature range of +2°C to +40°C lights OFF/ON (Full fresh air above +4°C) is provided. When operating in low temperature range: Must provide a multi-circuit evaporator coil that is designed to continuously control temperature with no temperature spike during defrost and that is accomplished by staging the operation of the evaporator circuits, cycling one through defrost while the active circuits maintain temperature control within the chamber.	
5.3	Must ensure a temperature control within $\pm 0.5^{\circ}\text{C}$, from control temperature set point.	
5.4	Must ensure primary temperature safety limits are provided for programmable high and low temperature alarm limit that automatically follows the programmed set point.	
5.5	Must provide secondary temperature safety limits to provide independent high and low temperature limit.	
5.6	Must ensure an audible alarm is provided for both limits and that activation of safety limit set points turns off power to the chamber.	
5.7	Must provide a vertically adjustable sensing device located in the growth area to ensure a continuous sample of growth room air is drawn over the sensors for accurate controlling, measuring and recording at plant location and ensuring to mitigate lamp radiation.	
6.0	Mandatory Relative Humidity Requirements	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
6.1	Must provide additive humidity to achieve a minimum of 90% Relative Humidity (RH) lights OFF and 80% (RH) lights ON, limited by a +25°C maximum dew point through the incorporation of spray nozzles, requiring 60 psi (4.2 bar) pressure, that are programmed with the control system.	
6.2	Must ensure humidity control is within $\pm 3\%$ (RH) and	

	system must incorporate a dry humidity sensor located in a device for sensing, measuring and controlling. Must provide misting programming through the microprocessor controller.	
6.3	Must provide a separate dehumidification coil to allow reduction in humidity to at least 40% (RH) at +25°C.	
7.0	Mandatory Refrigeration System and Components	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
7.1	Must provide a water-cooled, hermetically sealed condensing unit mounted on top of growth chamber. Must ensure valves provide continuous flow and variable temperature returns to cooling water. All growth chambers will be connected to a Central Cooling Tower supply and return system.	
7.2	Must provide a hot-gas refrigeration system incorporating a 3-way proportional valve to ensure a steady-state system without the use of individual solenoids on separate heating and cooling circuits. Must ensure unit is capable of switching from cooling tower operations to domestic city water, includes a thermostatic 3-way water valve, and is equipped with a hand operated bypass shut off valve and a water condenser sized for maximum inlet water temperature of +29°C. Maximum pressure drop across condenser and water valve shall not exceed 10 psi (0.7 bar).	
7.3	Must ensure evaporator coil be copper-tube construction.	
7.4	Must ensure condensing unit is charged with CFC-free refrigerant.	
7.5	In the single tier configuration mode, must ensure air in the chamber is directed uniformly upward (vertical) through the floor at less than 50 ft/min (15.2 m/min).	
7.6	Must ensure the refrigeration system is capable of removing radiant lamp heat.	
7.7	Must ensure conditioning unit has sufficient fans, heaters and valves necessary to meet the specified parameters.	
7.8	Fresh air control must have individual manual adjustment of positively sealed inlet and outlet from open 20 ft³/min (0.57 m³/min) to close.	
7.9	Monitoring: a) Refrigeration system operation must be monitored by the control system, including visual and audible alarm. b) Pressure transducers must be installed to allow for real-time diagnostics for preventative maintenance and repair.	
8.0	Mandatory Control System	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
8.1	Contractor must provide a touch screen controller with a back lit high resolution display monitor at each unit. Must ensure daily programs can be linked to simulate multi day or seasonal programs. Must ensure up to eight programs may be sequenced together. Must provide an on screen help manual for programming.	

	Must provide a status screen to display set point conditions, unit ID number and operating indicators of various components.	
8.2	Contractor must ensure all controlled parameters at each unit can be recorded to provide a log of actual experimental results. Must ensure that stored data can be transferred to a desktop via a portable storage device and local area network. Must ensure graphing of both set points and actual performance values is provided. Pan and zoom functions to increase resolution must be incorporated. Must provide graphing program to view historical data in graph form to compare with actual performance. Must ensure a continuous on-screen graphical display of the last 24 hours of room performance and next 8 hours of unit set point program. Inputs and controlled parameters must be automatically logged to provide a historical record of performance.	
8.3	Growth chamber controllers must have multi-level security password protection capability.	
8.4	Each growth chamber controller must be equipped with an on screen diagnostic display of optional inputs and outputs such as refrigeration valves, damper motors, etc., that allows service personnel access to the service life of the components including lamp burning hours, valve cycles etc.	
8.5	Must ensure each unit is equipped with a start-up delay stagger activation of units.	
8.6	Must ensure each unit controller is shipped communications-ready for connection to a Central Management System or local area network.	
8.7	Each growth chamber must be equipped with dry contact relays to allow operator to track and receive high and low temperature alarms, humidity, lighting and other controlled parameters from the unit. The unit must allow the integration with existing Building Alarm System, Central Management and local network. Must ensure that alarms can be logged to a portable storage device and the network.	
10.0	Mandatory Carbon Dioxide Enrichment System	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
10.1	Each new controlled environment chamber must be equipped with a factory installed carbon dioxide enrichment monitoring and control system.	
10.2	Carbon dioxide control requirements ambient to 3000 parts per million.	
10.3	The Contractor must supply all components, carbon dioxide regulator, carbon dioxide control valve, carbon dioxide injection system and carbon dioxide gas analyzer.	

Mandatory Requirement as per Annex A – Requirement 2.		Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
2.0	General Mandatory Requirements	
2.1	Growth chambers must be provided with product certification to CSA (Canadian Safety Association) and/or ULC (United Laboratories of Canada) Standards. Proof of certification for entire product must be provided.	
2.2	Each Growth chamber must be configured for 120/208 volt, three phase, 60 cycle, four wire plus ground electrical service.	
2.3	Contractor must ensure equipment and labor includes a warranty for a minimum of 2 years (24 months) from date of onsite installation, startup and commissioning. Proof and details of warranty must be provided to Agriculture and Agri-Food Canada. Response to service calls must be within 8 hours of call placement, 7 days per week. A qualified, factory trained and certified service technician must be on site within 24 hours during regular business day (7h00 – 17h00) to address any reported problem. Manufacturer must guarantee the availability of parts and components for a minimum of 10 years.	
2.4	Contractor must provide light scans that verify specified micromoles/m ² /sec measure at 6" (150mm), from the lamps, verified at 25°C with 10 hour old lamps.	
3.0	Mandatory Construction Technical Requirements (Requirement 2)	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
3.1	Wall panel construction must be woodless with CFC-free insulation. Exterior panels must be aluminium, finished with baked on enamel paint having either a smooth or pebbled finish or high polished stainless steel. Interior panels and doors must be finished with high reflective white enamel baked on smooth aluminium sheets or high polished stainless steel. End walls must have a reflective specular aluminium finish or polished stainless steel. The chamber must be equipped with mechanical fastening devices which will allow the chamber to be secured to the floor with concrete anchors.	
3.2	Each growth chamber must be equipped with two front mounted access doors complete with thermal gasket, keyed magnetic locks and stainless steel hinges. Each door must be supplied with one (1) dual pane observation window with a minimum glass size of 10"x 14" (254mm x 355mm) complete with a light tight cover, pull handle and latching hardware.	
3.3	Each growth chamber must be equipped with two (2), internally mounted 120 Volt AC duplex receptacles, rated for damp locations and wired with overload protection.	

3.4	Outside dimensions shall be 104"W x 35½"D x 78"H (2640mmW x 901mmD x 1980mmH) ± 2" (50mm).	
3.5	Inside dimensions shall be 73" W x 31½"D (1854mmW x 800mmD) ± 2" (50mm).	
3.6	Interior growth area must be no less than 15 to 16 ft² (1.4m²) to (1.5m²).	
3.7	Growth height must be no less than 57" (1448mm) from growth floor to light canopy in the UP position.	
3.8	Each growth chamber must be equipped with one (1), hose bib and connected to the local control system for timed control of automatic watering.	
3.9	Each growth chamber must be equipped with a central control panel located at the left or right end of the growth chamber depending on the machine area location.	
3.10	Each growth chamber must be equipped with two (2) instrumentation ports with a minimum diameter of 1 inch (25.4mm) and sealing caps.	
3.11	Each growth chamber must be supplied with a factory installed removable aluminium or stainless steel perforated growth floor which allows conditioned air movement in a vertical direction through the crop and then through the light canopy.	
3.12	Each growth chamber drain pan must be corrosion resistant and must be waterproofed in order to avoid water leakage through the side panels. Agriculture and Agri-Food Canada (AAFC) will connect all chamber drains to existing floor drain systems in the complex. All drain openings and drain lines installed as part of the chamber by the manufacturer must be capable of evacuating evaporator defrost cycle condensation and excess plant watering.	
3.13	Each growth chamber must be set up for single tier operation with vertical air flow.	
3.14	Each growth chamber must be assembled and tested at the manufacturing facility prior to shipment and delivery to ensure chamber performance meets all factory performance objectives.	
4.0	Mandatory Lighting Requirements – Light Intensity	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
4.1	In the single tier vertical air flow configuration mode, contractor must ensure light intensity at a minimum of 875 to 925 micromoles/m²/s measured at 6" (150mm) from lamps, verified at 25°C with 100 hour old lamps.	
4.2	Each growth chamber must be equipped with an adjustable light canopy that will ensure a balanced spectrum for research plant materials using T5 fluorescent and Halogen incandescent lamps.	
4.3	Each growth chamber must have a counterbalanced light bank system, adjustable to a minimum of 57" (1448mm) from the floor.	

4.4	Contractor must ensure that fluorescent and incandescent lamps are controlled independently with a minimum of 4 or 5 programming levels for each lamp type.	
4.5	Contractor must ensure energy efficient electronic ballasts are easily accessible for servicing and that cooling will be provided by adequate air circulating fan motors.	
4.6	Each growth chamber must be provided with a factory installed quantum light meter for display purposes and recording of light output supplied in each new chamber.	
5.0	Mandatory Temperature Requirements – Standard Temperature Operation	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
5.1	Standard temperature operation range: Must ensure full operation with a minimum temperature range of +4°C to +45°C lights OFF; +10°C to +45°C lights ON (full fresh air) is provided.	
5.2	Must ensure temperature control within $\pm 0.5^{\circ}\text{C}$, from control temperature set point.	
5.3	Must ensure primary temperature safety limits are provided for programmable high and low temperature alarm limit that automatically follows the programmed set point.	
5.4	Must provide secondary temperature safety limits to provide independent high and low temperature limit.	
5.5	Must ensure an audible alarm is provided for both limits and that activation of safety limit set points turns off power to the chamber.	
5.6	Must provide a vertically adjustable sensing device located in the growth area to ensure a continuous sample of growth room air is drawn over the sensors for accurate controlling, measuring and recording at plant location and ensuring to mitigate lamp radiation.	
6.0	Mandatory Relative Humidity Requirements	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
6.1	Must provide additive humidity to achieve a minimum of 90% RH lights OFF and 80% RH lights ON, limited by a +25°C maximum dew point through the incorporation of spray nozzles, requiring 60 psi (4.2 bar) pressure, that are programmed with the control system.	
6.2	Must ensure humidity control is within $\pm 3\%$ RH and system must incorporate a dry humidity sensor located in a device for sensing, measuring and controlling. Must provide misting programming through the microprocessor controller.	
6.3	Must provide a separate coil dehumidification to allow reduction in humidity to at least 40% RH at +25°C.	

7.0	Mandatory Refrigeration System and Components	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
7.1	Must provide a water-cooled, hermetically sealed condensing unit for each growth chamber that is easily accessible. Must ensure valves provide continuous flow and variable temperature returns to cooling water. All growth chamber will be connected to a Central Cooling Tower supply and return system.	
7.2	Must provide a hot-gas refrigeration system incorporating a 3-way proportional valve to ensure a steady-state system without the use of individual solenoids on separate heating and cooling circuits. Must ensure unit is capable of switching from cooling tower operations to domestic city water, includes a thermostatic 3-way water valve, and is equipped with a hand operated bypass shut off valve and a water condenser sized for maximum inlet water temperature of +29°C. Maximum pressure drop across condenser and water valve shall not exceed 10 psi (0.7 bar).	
7.3	Must ensure evaporator coil be copper-tube construction.	
7.4	Must ensure condensing unit is charged with CFC-free refrigerant.	
7.5	In the single tier configuration mode, must ensure air in the chamber is directed uniformly upward (vertical) through the floor at less than 50 ft/min (15.2 m/min).	
7.6	Must ensure the refrigeration system is capable of removing radiant lamp heat.	
7.7	Must ensure conditioning unit has sufficient fans, heaters and valves necessary to meet the specified parameters.	
7.8	Fresh air control must have individual manual adjustment of positively sealed inlet and outlet from open 20 ft³/min (0.57 m³/min) to close.	
7.9	Monitoring: a) Refrigeration system operation must be monitored by the control system, including visual and audible alarm. b) Pressure transducers must be installed to allow for real-time diagnostics for preventative maintenance and repair. c) Proportional refrigeration control valve must have feedback for monitoring the valves position by Building Management System.	
8.0	Mandatory Control System	Cross-reference to Literature Provided, Annex , Page No., Item No. etc.
8.1	Contractor must provide a touch screen controller with a back lit high resolution display monitor at each unit. Must ensure daily programs can be linked to simulate multi day or seasonal programs. Must ensure up to eight programs may be sequenced together. Must provide an on screen help manual for programming. Must provide a status screen to display set point conditions, unit ID number and operating indicators of various components.	

8.2	Contractor must ensure all controlled parameters at each unit can be recorded to provide a log of actual experimental results. Must ensure that stored data can be transferred to a desktop via a portable storage device and local area network. Must ensure graphing of both set points and actual performance values is provided. Pan and zoom functions to increase resolution must be incorporated. Must provide graphing program to view historical data in graph form to compare with actual performance. Must ensure a continuous on-screen graphical display of the last 24 hours of room performance and next 8 hours of unit set point program. Inputs and controlled parameters must be automatically logged to provide a historical record of performance.	
8.3	Growth chamber controllers must have a multi-level security password protection capability.	
8.4	Each growth chamber controller must be equipped with an on screen diagnostic display of optional inputs and outputs such as refrigeration valves, damper motors, etc., that allows service personnel access to the service life of the components including lamp burning hours, valve cycles etc.	
8.5	Must ensure each unit is equipped with a start-up delay to stagger activation of units.	
8.6	Must ensure each unit controller is shipped communications-ready for connection to a Central Management System and the local area network.	
8.7	Each growth chamber must be equipped with dry contact relays to allow operator to track and receive high and low temperature alarms, humidity, lighting and other controlled parameters from the unit. The unit must allow the integration with existing Building Alarm System, Central Management and local network. Must ensure that alarms can be logged to a portable storage device and the network.	