

**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**

**SOLICITATION AMENDMENT
MODIFICATION DE L'INVITATION**

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

Comments - Commentaires

**Vendor/Firm Name and Address
Raison sociale et adresse du
fournisseur/de l'entrepreneur**

Issuing Office - Bureau de distribution
Public Works and Government Services Canada
Ontario Region
33 City Centre Drive
Suite 480
Mississauga
Ontario
L5B 2N5

Title - Sujet Environmental Control Chambers	
Solicitation No. - N° de l'invitation 01686-160103/A	Amendment No. - N° modif. 002
Client Reference No. - N° de référence du client 01686-160103	Date 2015-07-15
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:	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée	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

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

01686-160103

Amd. No. - N° de la modif.

002

File No. - N° du dossier

TOR-5-38039

Buyer ID - Id de l'acheteur

tor016

CCC No./N° CCC - FMS No/ N° VME

SEE ATTACHED

This amendment 002 is being issued to address question and to revise the solicitation.

Question and Answer:

Question 1:

At specification 2.1 "ELECTRICAL CERTIFICATION" as published in Requirement 1 and Requirement 2 of ANNEX "A".

Will you accept products that are not CSA Certified but are CSA Approved under CSA Special Inspection programs and meets the requirements of *SACC clause B1501C, Electrical Equipment*, which states:

B1501C Electrical Equipment

All electrical equipment supplied under the Contract must be certified or approved for use in accordance with the Canadian Electrical Code, Part 1, before delivery, by a certification organization accredited by the Standards Council of Canada.

Answer 1:

We will accept CSA Approval under CSA Special Inspection programs and inspection criteria must meet the requirements of SACC clause B1501C. CSA Special inspection must be completed at the factory and all special inspection documentation must be provided for each growth chamber to Agriculture and Agri-Food Canada.

Any additional on site electrical inspections required by Ontario Hydro (Hydro 1) Electrical Safety Authority (ESA) having jurisdiction will be the responsibility of the Contractor supplying the new growth chambers. The Contractor will schedule, supply all electrical drawings and electrical component details and pay for all costs associated with any special inspections required by the (ESA). Alterations to the Growth Chambers required by the (ESA) will be at the expense of the Contractor.

Revision to Solicitation

Delete:

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.

Insert:

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 financial bid 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.

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.

3.1.1 Exchange Rate Fluctuation

3.1.1.1 Exchange Rate Fluctuation

SACC Manual Clause C3011T (2013-11-06), Exchange Rate Fluctuation

Section III: Certifications

Bidders must submit the certifications required under Part 5.
In Part 6 – Resulting Contract Clauses

Insert:

6.11 Electrical Equipment
SACC Manual Clauses B1501C (2006-06-16) Electrical Equipment

Revise Annex A as follows:

Annex A - Requirement 1

At – Article 2.1 Electrical Certification

Delete:

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.

Insert:

2.1 Electrical Certification: All Growth chambers must be certified or approved for use and operation in accordance with the Canadian Electrical and Safety Code, Part 1. Any onsite inspections required by the local Electrical Safety Authority (ESA) Hydro 1, will be the responsibility of the Contractor supplying the new Growth Chambers. The Contractor will schedule, supply all electrical drawings and electrical component details and pay for all costs associated with any special inspections required by the (ESA).

Alterations required to meet any (ESA) requirements will be at the Contractors expense.

Annex A - Requirement 2

At – Article 2.1 Electrical Certification

Delete:

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.

Insert:

2.1 Electrical Certification: All Growth chambers must be certified or approved for use and operation in accordance with the Canadian Electrical and Safety Code, Part 1. Any onsite inspections required by the local Electrical Safety Authority (ESA) Hydro 1, will be the responsibility of the Contractor supplying the new Growth Chambers. The Contractor will schedule, supply all electrical drawings and electrical component details and pay for all costs associated with any special inspections required by the (ESA).

Alterations required to meet any (ESA) requirements will be at the Contractors expense.

Replace Annex A with attached Annex A – Revision 1, attached herein.

ANNEX "A"

REQUIREMENT 1 – REVISION 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: *All Growth chambers must be certified or approved for use and operation in accordance with the Canadian Electrical and Safety Code, Part 1. Any onsite inspections required by the local Electrical Safety Authority (ESA) Hydro 1, will be the responsibility of the Contractor supplying the new Growth Chambers. The Contractor will schedule, supply all electrical drawings and electrical component details and pay for all costs associated with any special inspections required by the (ESA).*

Alterations required to meet any (ESA) requirements will be at the Contractors expense.

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 – REVISION 1

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:** *All Growth chambers must be certified or approved for use and operation in accordance with the Canadian Electrical and Safety Code, Part 1. Any onsite inspections required by the local Electrical Safety Authority (ESA) Hydro 1, will be the responsibility of the Contractor supplying the new Growth Chambers. The Contractor will schedule, supply all electrical drawings and electrical component details and pay for all costs associated with any special inspections required by the (ESA).*

Alterations required to meet any (ESA) requirements will be at the Contractors expense.

- 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.
- 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.