MELiSSA

TECHNICAL NOTE

TECHNICAL NOTE 85.6

Invitation to Tender, Technical Data Package & List of Bidders – Higher Plant Chamber Prototype for the MELiSSA Pilot Plant

Memorandum of Understanding 19071/05/NL/CP

MELiSSA

TECHNICAL NOTE

Prepared by/Préparé par	Dr. Geoffrey Waters, Theresa Rondeau Vuk
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1. Introduction

The information contained in this technical has been prepared for the solicitation of bidders to construct the HPC Prototype Shell for the MELiSSA Pilot Plant. Sub-system integration and functional test of the chamber will occur the University of Guelph CESRF prior to delivery to the MPP.

The documentation provided herein is identical to that posted on the Government of Canada's Tender Site, known as Merx. This is a requirement for the selection of bidders by public firms. Slight modifications in formatting have been made to the documentation in order to conform to the ESA TN template. No changes in content have been made.

Not included in this TN is the document: - "General Conditions of Tender for the Selection of Suppliers by Prime Contractors in the Frame of MELiSSA's Major Procurements." This document was provided to bidders at the time of invitation but is not repeated here since it is on record as an official ESA document.

Additionally, Section 6 entitled "Guidelines for the preparation of Proposal in Response to RFP 518," has been included in this TN. This section was not provided to bidders on the original Merx posting but was provided to interested bidders in the second call for proposals (see below).

Following close of bids on September 14, 2006, no proposals were received. An information meeting was held to clarify the project requirements. The closing of bids was therefore extended until October 20, 2006. The invitation to tender was not placed on Merx a second time, but rather, interested bidders were provided with the documentation provided herein as it was already part of public record.

The list of potential bidders found in Section 7 was not provided to the bidders and is included for ESA information only.

The Technical documentation of Section 4 was derived from TN 85.5. It is significantly reduced in scope so as not to disclose information other than what was necessary for the bidders to complete an informed proposal.

At the time of writing, the Tender Evaluation Board will be reviewing three bids arising from the second call for proposals on November 7 and 8, 2006. At the time of second bid closing on October 20, 2006, a total of three bids/proposals were received.

2. Request for Proposal - University of Guelph RFP 518

REQUEST FOR PROPOSAL

2006 REQUEST FOR PROPOSAL FOR MELiSSA HIGHER PLANT CHAMBER PROTOTYPE

#RFP-518

BY

THE UNIVERSITY OF GUELPH

CLOSING DATE: September 14, 2006
CLOSING LOCATION: University of Guelph
Purchasing Services

This Request for Proposal must be obtained from MERX in order to be considered a valid bid.

2.1. Purpose and Content

The University of Guelph, under contract with the European Space Agency (ESA) hereby invites qualified Canadian suppliers to submit proposals for the MELiSSA Higher Plant Chamber Prototype (large scale modified environmental plant growth chamber). The successful Bidder will be sub-contracted by the University of Guelph (as prime contractor to ESA) to further design, construct and document a Higher Plant Chamber Prototype for assembly and testing at the University of Guelph. Once assembled, tested, accepted and fully functional the University will ship this customized chamber to its final destination - the ESA's, MELiSSA Pilot Plant facility housed at the Universitat Autonoma de Barcelona.

The proposal document consists of:
Section 2.1 - Purpose and Content
Section 2.2 - Instructions to Bidders
Section 2.3 - Evaluation and Award
Section 2.4 - Award Contract
Section 2.5 - Table of Acronyms
Section 2.6- The Project
Section 2.7 - Special Terms and Conditions
Section 2.8 - Purchase Order Terms and Conditions
Section 2.9 - Cost Analysis Sheet
Section 2.10 - Summary Proposal Form
Section 3- Statement of Work/Special Instructions
Section 4 - Technical Data Package
Section 5 - - Requirements for Management, Reporting, Deliverables, Meetings

Not Included in this TN – "General Conditions of Tender for the Selection of Suppliers by Prime Contractors in the Frame of MELiSSA's Major Procurements." This documentation, however was provided to bidders on the Merx system (see above).

2.2. Instructions to Bidders

Proposals will be accepted up to 0930:00 hours (local time) on Thursday, September 14, 2006 at the office of Dale Stevanus, C.P.P., Manager, Purchasing Services, 50 Stone Road East, University Centre, Level 5, University of Guelph, Guelph, Ontario N1G 2W1 only. Proposals received after the above closing time and date will not be considered and will be returned to the Bidder. (Note: Time according to the National Research Council.)

Proposals should be submitted as follows; 8 hard copies and 2 CD-ROMs, in a sealed package bearing the name and address of the Bidder and clearly marked on the outside:

"Proposal for MELiSSA Higher Plant Chamber Prototype #RFP-518"

As a convenience to Bidders, proposals may be submitted by facsimile to 519-767-1251 **(one copy of priced pages and the Summary Proposal Form only, executed as per Clause 2.7)** providing that the original faxed price pages and the complete proposal, dated no later than the proposal closing date is received by the University within twenty four (24) hours of closing time.

In the event twenty-four hours from closing time falls on a Saturday, Sunday or statutory holiday, such time shall be extended to 0930:00 hours local time on the first business day following thereafter.

However, the University of Guelph accepts no responsibility or liability for misdirected, unreadable, incomplete or confidential facsimile bids or electronic mail questions and it is the sole responsibility of the Bidder to ensure their transmission has been received by the authorized representative of the University in a timely manner. By faxing bids or emailing questions, the Bidder specifically waives any right of confidentiality in their transmission.

Proposal documents must be completed in accordance with the requirements of the Request for Proposal documents and no amendment or change to proposals will be accepted after the closing date and time.

Proposals shall be irrevocable for one hundred twenty (120) days following close of bidding and shall be retained by the University.

Bidders acknowledge the University is subject to the Ontario Freedom of Information and Protection of Privacy Act. Bidders shall clearly mark "Confidential" all information regarding trade secrets, commercial, financial, labour relations, technical or other aspects of the Bidder's proposal, which in the Bidder's opinion are of a proprietary or confidential nature and are significant enough to be injurious to the Bidder should this information be

provided under a request of information.

The University shall use all reasonable efforts to hold all information marked "Confidential" by the Bidder in strict confidence where required or permitted by law but shall not be liable for any action as contemplated by Section 62(2) of the Act.

If the University's response to a request under the Act is appealed to the Information and Privacy Commissioner for Ontario, the Bidder shall have the burden of proof per Section 53 of the Act. The Bidder shall be responsible for all costs related to its confidentially requirements.

Proposals must be originally and irrevocably signed by an authorized representative of the Bidder when submitted. Failure to properly sign the Proposal will result in disqualification of the Proposal without further consideration and the Proposal shall be returned to the Bidder at the Bidder's sole expense.

Upon award (if any), the successful Bidder will be required to supply proof satisfactory to the University of appropriate authorization to bind the Bidder.

Questions regarding this Request for Proposal may be **submitted in writing** (fax, mail or email only) up to **seventy-two (72) hours** prior to the closing time and date. Should the question be considered relevant to all Bidders, the University will provide both the question and the written answer to all known Bidders via the MERX open bidding system. Bidders are solely responsible for ensuring the University has a current address and fax number on file for the Bidder.

In the event the Bidder decides not to submit a proposal, they are requested to advise Dale Stevanus (see Clause 2.12), in order to remain on the Bidder's list.

The entire proposal request document consists of Sections and Appendices as stated in Clause 1.1. Where duplication in conditions appear between the University of Guelph's Request for Proposal, Sections 1 to 10 and the (ESA) European Space Agency's General Conditions of Tender, the University of Guelph's terms and conditions will prevail.

In the event the Bidder can not comply with any term, condition or requirement of this Request for Proposal, such non-compliance must be clearly noted on the Bidder's letterhead and submitted with the proposal. Bidders are cautioned that such non-compliance may result in disqualification of the Bidder's proposal, in the sole discretion of the University of Guelph, Purchasing Services.

No allowance will be made for unnoted non-compliance of any kind by the Bidder.

All questions and communications regarding this Request for Proposal shall be directed

(only) to: **up to September 01/06**

Dale Stevanus, Manager
Purchasing Services
University Centre, Level 5
University of Guelph
Guelph, Ontario N1G 2W1
Telephone - 519-824-4120 ext 58483
Fax - 519-767-1251
Email - dstevanu@uoguelph.ca

after September 01/06
CA Franchetto
Purchasing Services
University Centre, Level 5
University of Guelph
Guelph, Ontario N1G 2W1
Telephone - 519-824-4120 ext 52135
Fax - 519-767-1251
Email - cfranche@uoguelph.ca

No other representative of the University is to be contacted regarding this Request for Proposal. The University accepts no responsibility for, and the Bidder agrees not to rely upon, any verbal or written statements or representations from any other person, whether or not employed by the University.

While the University will not consider more than one bid from a Bidder under the same or different names, the University is prepared to consider, in addition to the original bid, alternative bids submitted within the same bid package providing such are clearly marked as alternatives.

Bidders are cautioned that proposals will be solely evaluated upon the disclosed evaluation criteria and no linkage of offers to donations, scholarships or similar arrangements will be considered.

The International Sale of Goods Act does not apply to this Request for Proposal or any contract formed as a result of this Request for Proposal.

The laws of the Province of Ontario shall apply to this Request for Proposal and any contract formed as a result of this Request for Proposal, and the Courts of Ontario shall have exclusive jurisdiction over any contract formed as a result of this Request for Proposal.

The University of Guelph's name, logo, crest, etc. shall not be used without the prior written consent of the University.

2.3. Evaluation and Award

The University of Guelph intends to award a contract to the Bidder whose proposal offers the best value to the University. However, the University is under no obligation to award any contract in whole or in part and the University reserves the right in its sole discretion to cancel this Request for Proposal process at any time before or after closing without providing reasons for such cancellation.

The lowest or any proposal may not necessarily be accepted.

Basis of Selection: All proposals will be evaluated upon the following criteria but not necessarily restricted to:

Weight Factors		
40%	A)	Concept, design, construction and suitability
20%	B)	Project pricing offered
20%	C)	Warranties (domestic & international - Spain)
10%	D)	Lead-time from date of order to delivery
10%	E)	Payment & other commercial terms

Any award made by the University shall be made in writing and shall be subject to the availability of funding at the time of award (if any).

In the event of mathematical errors in extension of prices or other ambiguities, unit prices shall govern over total bid prices and words shall govern over numbers.

In order to obtain the most advantageous offer for the University, the University reserves the right in its sole discretion:

a) to waive irregularities and/or minor non-compliance by any Bidder with the requirements of this Request for Proposal;
b) to request clarification and/or further information from one or more Bidders after closing without becoming obligated to offer the same opportunity to all Bidders; and
c) to enter into negotiations with one or more Bidders without being obligated to negotiate with, or, offer the same opportunity to all Bidders.

Bidders are advised however to submit a complete offer as their bid. Any waiver, clarification or negotiation will not be considered as an opportunity for Bidders to correct errors in their bids.

The University shall not be responsible for any expenses or charges incurred by a Bidder in preparing or submitting a proposal nor in providing any additional information considered necessary by the University for evaluation of proposals.

The University reserves the right in its sole discretion to amend this Request for Proposal at any time prior to close of bidding and Bidders are cautioned to ensure they have received all addenda (if any) prior to submitting a bid. Should the University issue any changes to this Request for Proposal, the University will endeavor to notify all Bidders to whom the Request for Proposal has been issued via the MERX open bidding system.

2.4. Award Contract

The award contract to the successful Bidder (if any) shall include the terms of this Request for Proposal, including General Conditions of Tender for the Selection of Suppliers by Prime Contractors in the Frame of MELiSSA's Major Procurements and the terms of the University of Guelph's Purchase Order (a copy of which is included in this RFP package) together with those terms of the Bidder's proposal which are not inconsistent with the University of Guelph's documents and which have been specifically accepted by the University.

The successful Bidder (if any) may not assign or subcontract any of the award contract without the prior written consent of the University.

The successful Bidder (if any) shall indemnify the University of Guelph, its Board of Governors, students, employees, servants and/or agents from all damage, damages, losses, costs, claims, demands, actions, suits or proceedings which may arise directly or indirectly as a result of the negligent or wrongful acts or omissions of the successful Bidder (if any), its employees, agents and/or servants in the performance or purported performance of any of its obligations under the contract, whether or not such claims are initiated by third parties or arise between the parties.

The successful Bidder (if any) shall carry at all times during the performance of the work commercial general liability insurance with a limit of not less than $3,000,000 inclusive per occurrence for bodily injury (including death) and damage to property including loss of use thereof. Such insurance shall at a minimum include coverage of broad form property damage, contractual liability, completed operations and product liability, and automobile liability (owned and non-owned), and such other types of insurance as would be carried by a prudent person performing such contract work and as the University of Guelph may from time to time require.

The University of Guelph shall be named as an additional insured without right of subrogation in all policies of insurance.

All such policies of insurance shall provide that the Insurers shall give at least thirty (30) days written notice to the University prior to any cancellation, material changes, or amendments restricting coverage of any policy or policies.

The successful Bidder (if any) shall provide a certificate of such insurance to the University as a condition of receiving the award within five (5) days of notification of award or prior to commencing the work, whichever is sooner.

The successful Bidder (if any) shall at all relevant times carry Workplace Safety and Insurance Board of Ontario coverage or Employers Liability Insurance in the amount of not less than $3,000,000 and shall submit its WSIB number together with a letter from the appropriate WSIB Department indicating there are no outstanding fees, fines, claims or debts due on the Contractor's WSIB account, to the University of Guelph prior to the commencement of the work.

The successful Bidder (if any) shall warrant its work and/or products for a period of not less than one (1) year from completion, installation or supply against all defects and deficiencies in manufacture, workmanship and installation. The successful Bidder (if any) shall also promptly remedy or replace any defect or deficiency, in the goods or services as solely determined by the University, upon notice from the University to do so, and at no cost to the University.

Should the successful Bidder (if any) fail to remedy any defect or deficiency promptly within a reasonable time after notice to do so, the University may remedy the defect or deficiency, at the successful Bidder's (if any) cost.Any products supplied and installed by the successful Bidder (if any) shall be installed in such a manner as to preserve any and all manufacturer's warranties, for the benefit of the University.

The successful Bidder (if any) must ensure all equipment has the necessary legislated government approvals prior to delivery, including but not limited to, Canadian Standards Association approval (at no additional cost to the University of Guelph) and be so labelled. Any equipment found not to be properly certified and labelled will be returned to the Bidder at no cost to the University of Guelph. Payment may be withheld pending satisfactory certification and labelling of equipment delivered.

The University and the successful Bidder (if any) acknowledge and agree that they are independent contractors in a contract for goods and/or services and no employer - employee, partnership nor agency relationship is intended or created by their agreement.

The successful Bidder (if any) shall be solely responsible for all matters relating to statutory deduction of all taxes, employment insurance, Canada Pension, carry Workplace Safety and Insurance Board of Ontario insurance premiums, leave,

remuneration, discipline and all licenses and permits which may be or may become required to perform the Work.

Notwithstanding the above, while at the University of Guelph, personnel of the successful Bidder (if any) must observe all regulations and policies of the University including parking and traffic regulations. Vehicles shall be parked in areas, at the successful Bidder's (if any) expense, as directed by the University's Parking Administration.

In addition to any rights of termination at law or in equity, the University of Guelph shall have the right to terminate any contract formed with the successful Bidder(s) (if any) upon written notice to the successful Bidder.

2.5. Table of Acronyms

The following list of acronyms is provided to abbreviate the text contained in this document.

AD: Applicable Document
AIL: Action Item List
CAE: Computer Assisted Engineering
CER: Critical Engineering Review
CDR: Critical Design Review
CESRF: Controlled Environment System Research Facility (of the University of Guelph)
CSA: Canadian Space Agency
CTC: Constant Temperature Control Ltd.
ESA: European Space Agency
ESTEC: European Research and Technology Centre
HPC: Higher Plants Chamber
KOM: Kick-Off Meeting
MELiSSA: Micro-Ecological Life Support Systems Alternative
MPP: MELiSSA Pilot Plant
MOU: Memorandum of Understanding
NASA: National Aeronautics and Space Administration
PM: Progress Meeting
RD: Reference Document
SOW: Statement of Work
TDP: Technical Data Package
TN: Technical Note
UAB: Universitat Autonoma de Barcelona
UoG: University of Guelph
WP: Work Package

2.6. The Project

Overview

The European Space Agency's Micro-Ecological Life Support System Alternative (MELiSSA) project has been conceived as a tool for developing the technology of future biological life support systems required for long-term human space missions. The main life support functions of MELiSSA are the recycling of waste (inedible biomass, faeces, urine), carbon dioxide and minerals and the production of food, fresh water and air revitalization. Based on the principle of an aquatic ecosystem, MELiSSA is comprised of four microbial compartments and a higher plant compartment integrated in a closed loop. Over the last 15 years, the MELiSSA process development has followed a progressive approach of integration and validation. Each compartment is studied, designed and demonstrated at laboratory scale before being scaled-up for subsequent integration into the MELISSA Pilot Plant (MPP) at the Universitat Autonoma de Barcelona (UAB), Barcelona, Spain.

Since 1989, considerable scientific work related to data collection and mathematical modelling has been performed in order to understand and develop control algorithms for each microbial compartment of the MELiSSA loop. As a result of the knowledge accumulated and the designs proposed over the years, the first generation (laboratory scale) of each microbial compartment was constructed and thus validated individually. Later, in 1995, the existing units of the MELiSSA loop were transferred to the Universitat Autonoma de Barcelona (UAB), where the microbial compartments were accommodated for further demonstration of the MELiSSA loop at pilot scale. The compartments IVa, II, III and I were among the first to be re-designed into pilot scale reactors. Today a few of these compartments have been integrated into a closed loop with promising results. In the meantime, work related to higher plant cultivation systems has progressed to that of preliminary design and the metabolic characterization of MELiSSA candidate crops, namely beet and lettuce and to a lesser extent wheat, soybean and kale. Therefore, the MELiSSA process is sufficiently advanced to allow for the integration of the Higher Plant Compartment (HPC, CIVb) into the Pilot Plant.

Research in the design of the HPC has been focused at the University of Guelph (UoG), Controlled Environment Systems Research Facility (CESRF) since its involvement in the MELiSSA program starting in 1997. Studies have included: design criteria for full canopy sealed chambers, the development of cultural management strategies for specific MELiSSA candidate crops (including soybean, wheat, lettuce, beet and kale), the formulation and validation of theoretical gas exchange and nutrient dynamic models, the development of management protocols for the stabilization of long term and photo-oscillatory behaviour of canopy gas exchange, the quantification of volatile organic (ethylene) emissions by plants in closed systems and the determination of higher plant

compartment sizing and bio-regenerative life support system costing relative to physico-chemical technologies.

Research at the MPP is designed to gather information on the performance of integrated MELiSSA compartments. As such, the HPC prototype to be detailed and constructed within the frame of this contract is not optimized for space applications (i.e. lunar or Mars base) or for the mass production of biomass in support of metabolic and mineral composition analyses. Instead, the design concept outlined in this proposal is based on the technical specifications formulated for the prototype with the idea that the prototype will serve to elucidate issues and demonstrate technology challenges under the conditions of systems integration. The prototype is therefore to be used as part of the systems test-bed for which the MPP is intended.

The appended Statement of Work (SOW, Appendix 1) defines the Work Packages (WPs) required of the successfully selected sub-contractor to further the design, document and build the HPC shell for integration into the MPP. Upon construction and final delivery of the shell to the University of Guelph CESRF, additional components such as analytical equipment, nutrient delivery and control systems will be assembled by CESRF staff to the shell, tested within the CESRF and shipped to the MPP for final installation and operational verification. In addition to the final design and construction of the chamber shell, the successful sub-contractor will be asked to provide CAE 3D drawings of the complete chamber system. These diagrams will form part of the as-built technical documentation for the complete HPC prototype.

The work presented herein is required to address an immediate need for a prototype to be installed in the MPP. It is foreseen, however, that not less than four additional chambers will be constructed for service within the MELiSSA consortium, in Europe/Canada. The provision of these additional chambers falls outside of this current SOW but such activity is in the planning stages for contracts to be awarded by ESA within the next 3 to 4 year horizon.

Objectives

The primary objectives of this activity are three:

- Finalize the detailed design of the HPC prototype shell with particular reference to the structural engineering of the chamber shell, air-locks, access panels, air handling plenum and ducts, roof and hydroponics conveyer system. This phase includes the provision of technical drawings/blue prints which will facilitate the shell's construction.

- Construction of the chamber shell according to the technical specifications provided (TDP, Appendix 2) either at the sub-contractor's premises (with shipment to the

CESRF for further systems integration) or on the premises of the CESRF by the sub-contractor's staff.

- Provision of the "as-built" technical drawings/blue prints and 3D CAD/CAE drawings of the complete HPC prototype, including integrated systems, to be furnished to UoG-CESRF as part of the final documentation package.

Background Studies

The UoG-CESRF and UAB have finalized the design criteria for the HPC prototype. A preliminary and Critical Design Review (CDR) has been recently completed together with ESA and UoG. As a result of the CDR a number of aspects of the chamber design require further development.

These include:

- Structural engineering of the prototype shell
- Detailed design of the air-lock, interior air-lock door and glove-box access systems
- Detailed design of the hydroponics growing trays
- Structural engineering of the prototype roof
- Assessment of design impacts of chamber interior access doors positioned along the length of the long chamber side-wall
- Assessment of the possibility of including wheels on the chamber to facilitate movement
- Detailed chamber construction plan
- Completion of blue prints and as built technical drawings of the chamber

While much of the chamber design criteria has been well defined, the successful sub-contractor will be asked to engage in a "design-build" of the prototype in accordance with the technical data package (TDP, Appendix 2).

Taking into consideration the MPP integration plan and the time frame of the prime contract associated with this activity, the work proposed in this SOW will end with the delivery of the prototype shell to CESRF, its functional verification, and the provision of associated design documentation.

2.7. Special Terms and Conditions Pertaining to this RFP

Specifications: Specifications provided indicate the desired minimum requirement and are intended to be generic and not reflect any one manufacturer preference. Each Bidder should submit their design - build concept and provide full technical specifications and supporting documentation within their proposal.

Specification Compliance: Bidders must indicate which specifications they cannot comply to and what they propose as an alternative. This information must be documented and included in their bid submission.

ISO Standards: It is preferred that Bidders manufacture to ISO 9001:2000 Standards. Bidders shall indicate their status on the Summary Proposal Form.

Equivalency: The University of Guelph in its sole discretion shall determine equivalency and acceptability of design. The design will reviewed according to the information provided in the TDP and its ability to meet those technical requirements.

Utility Requirements: Bidders must indicate all electrical, plumbing and installation requirements including details of power requirements, voltage, current phase and operational limits.

Prices: Bidders must submit net prices in Canadian funds, exclusive of duty and taxes, for the prototype as specified on the Cost Analysis Sheet. All prices are to be FOB, University of Guelph with delivery to the University location as specified at time of order. Pricing to include loading, cartage, unloading charges, uncrating and removal of packaging material, assembly and placing in position ready for hook-up.

This prototype project has a budget limit of $280,000 (Canadian funds) which cannot be exceeded. Prices offered must be firm.

Payment Terms: Preference will be given to Bidders who propose Net 30 Days following 'acceptance for use'. Bidders not proposing this payment term must submit their proposed schedule of payment(s). These terms will be subject to negotiation.

Delivery: Bidders to indicate on the Summary Proposal Form the number of days to deliver following award of order.

Acceptance Testing: Following hook-up by the University, the chambers will be operated to a point where full functionality is exercised. Deficiencies would be addressed at that time and corrected by the successful Bidder to the satisfaction of the University. Upon final written approval and acceptance by the University, final payment would be released.

Warranty: Bidders must provide a minimum one (1) year warranty unless otherwise indicated and indicate coverage on the Summary Proposal Form. *Note: Warranty will commence upon final acceptance of equipment after installation and testing i.e. fully operational.* Consistent with the evaluation criteria cited in Clause 3.2, Bidders who offer a warranty period commensurate with the anticipated operational life of the chamber of

five (5) years will be favoured. Bidders should therefore provide competitive warranty terms.

References: Bidders must provide a minimum of two references currently using custom designed controlled environment rooms/facilities/chambers, including names, addresses and telephone numbers. The University reserves the right to contact any or all references to discuss functionality and service of the Bidder.

Short-listed Bidders: Based on the evaluation criteria (Clause 3.2), Bidders accepted to the short list will be notified by September 20th and will be asked to present their proposals to the Tender Evaluation Board on September 25th or 26th at the University of Guelph. Short-listed Bidders will be provided with additional instructions at time of notification.

2.8. Purchase Order Terms and Conditions

Acceptance of Contract: The Supplier by the Acceptance of this Order accepts all the terms and conditions hereof. These terms and conditions supersede and take precedence over any and all previous verbal or written arrangements in connection with this Order. Any deletions, modifications, alterations of, or additions to the terms and conditions of the Order to be binding shall be in writing and signed by both the Supplier and the University of Guelph (herein after called the Purchaser) and shall be attached to this Purchase Order Form.

Time of Essence and Cancellations: Time shall be of the essence under this Agreement. In the event of Supplier's failure to deliver as and when specified, Purchaser reserved the right to cancel this order, or any part thereof without prejudice to its other rights, saving the university harmless for any expenses caused by the failure to deliver on time, even though the university accepts delivery of the items or machinery. The Supplier agrees that Purchaser may return part or all of any shipment so made and charge Supplier with any loss or expense sustained as a result of such failure to deliver.

Price: Unless otherwise specified, the price inserted on the face of this Order represents the complete cost to the Purchaser as at the point of delivery specified herein and includes every license fee, patent royalty, Government and Municipal tax, levy and charge of every description and charges for crating, boxing and cartage.

Changes: The Purchaser reserves the right at any time to make changes in drawings and specifications as to any material or work covered by this order. In the event any additional cost or savings results from such change, the Supplier shall notify the Purchaser thereof and obtain written approval from the Purchaser before proceeding with this order.

Inspection: The Purchaser reserves the right to reject and return goods to the Supplier at Supplier's expense, if not in accordance with all the details shown on this Purchase Order.

Warranty: By accepting this order, Supplier warrants that the subject matter of this order is free from defects in materials, workmanship and fabrication, and that all merchandise delivered shall be of the quality, quantity, size, description and dimensions specified and shall be strictly in accordance with the Purchaser's specifications, drawings and approved sample, if any, and suitable for the purpose designated. These warranties shall survive acceptance and payment, and shall ensure to the benefit of the Purchaser, its successors, assigns, customers and the end user of its products and shall not be deemed to be exclusive. This warranty is in addition to any warranties of additional scope given by Supplier to Purchaser.

Compliance with Law: In accepting this order Supplier represents that it has and will continue during the performance of this order to comply with the provisions of all federal, provincial and local laws and regulations from which liability may accrue to Purchaser from any violation thereof.

Patents and Copyright: By accepting this order, the Supplier guarantees that the subject matter thereof and its sale or use of them will not infringe any Canadian or foreign letters, patent, or copyright, and the Supplier agrees to defend, protect and save harmless the Purchaser against all suits at law or in equity and from all damages, claims and demands whatsoever for actual or alleged infringements or any patent or copyright by reason of the use of the subject matter.

Conditions and Printing: All negatives and artwork become the property of the University of Guelph, but may be retained by the printer, at the discretion of the jobs originator, for possible future use at no charge for handling or storage.

Approvals: All electrical equipment supplied must be C.S.A. or Electrical Safety Authority approved at no cost to the Purchaser.

Cash Discount: Cash discounts will be calculated from the date the invoice is acceptable to Purchaser.

G.S.T.: It is the responsibility of Canadian Suppliers to register and collect G.S.T. if total taxable income exceeds $30,000 annually.

2.9. Cost Analysis Sheet

All prices to exclude Duty & Federal Sales Tax

Work Package	Description	Labour	Materials	Extended Price
1	Management (estimated hours _____)	$	$	$
2	Engineering Design Review and Finalization (estimated hours _____)	$	$	$
3	Prototype Construction Plan (estimated hours _____)	$	$	$
4	Chamber Shell Part Procurement and Chamber Shell Construction (estimated hours _____)	$	$	$
5	As-Built Drawings, Specifications and Assembly Procedures (estimated hours _____)	$	$	$
6	Functional Verification of the Prototype Shell (estimated hours _____)	$	$	$
Total Dollars				**$**

2.10. Summary Proposal Form

Dale Stevanus, C.P.P.
Manager, Purchasing Services
University of Guelph
University Centre, Level 5
Guelph, Ontario N1G 2W1

Dear Sir:

We, the undersigned, having carefully examined the proposal documents, do hereby offer to enter into a contract with the University of Guelph for the supply and assembly of the above mentioned prototype and agree to the conditions outlined in said documents, at the prices indicated.

Total Dollars excl Duty & Taxes $_____

Payment Terms _____

Days to deliver following award of order _____

Warranty - Ref Clause 7.10 _____ year(s)

WSIB evidence of compliance attached Yes_____ No_____

ISO 9001:2000 Certified Yes_____ No_____

Clause 4.4 General Liability Insurance coverage limit $_____

_____ _____
Authorized Signature Name (print or type)

_____ _____
Title Company Name

_____ _____
Date

_____
Corporate Seal Address

3. Appendix 1 to RFP 518 – Statement of Work

The sub-contractor shall undertake a program of work which shall include but need not be limited to the following work packages.

WP 1: Management

The sub-contractor shall nominate a project manager who will efficiently manage the activities. The requirements for management are described in Appendix 3.

WP 2: Engineering Design Review and Finalization

On the basis of the chamber prototype technical data package (Appendix 2) the sub-contractor shall identify challenges and engineering alternatives for the following key aspects of the chamber shell:

A100 – Chamber Roof
The sub-subcontractor shall complete the structural engineering of the glass roof. The roof may be constructed out of a series of glass panels over the 5 m long span of the chamber but its support structure must minimize shading to the crop growing area. Additionally, the roof shall be engineered to allow for placement of the overhead lighting system and its support beams. Supply of the chamber lighting system and its support beams, however, are not requested of the sub-contractor.

A200 – Chamber Base
The sub-contractor should review the documentation provided in the Technical Data package (Appendix 2) and propose engineering alternatives for the construction of the chamber base. The base shall include access doors or panels that allow for servicing of equipment stored in the base. The base should also be designed with retractable wheels to promote chamber movement and shall be engineered to provide structural support to the components mounted above it (A300 and A500).

A300 – Air Handling Section
In consultation with UoG-CESRF the sub-contractor shall review the engineering requirements for the air handling section of the shell and provide alternatives for its structural design, taking into consideration the need to promote air flow from the air handling section along one chamber side wall (plenum). The air handling section shall also be designed to allow for the placement and mounting of heat exchange coils, fans and condensation collection pans according to the specifications defined by the CESRF. The sub-contractor will assist in the selection of the air handling equipment but is not asked to supply this equipment as part of the shell's construction.

A400 – Air Locks

The sub-contractor shall propose engineering of the chamber air locks with particular emphasis on the air lock exterior door with glove boxes and the interior air lock door. The design should include provisions for sealing the exterior door against the air lock frame. Additionally, the interior air lock door shall be retractable to allow for the movement for both seedlings and mature crops from the chamber interior (A500) into the air lock. The air lock design shall minimize air exchange with the chamber interior (A500) and shall take into consideration the need to purge the air lock air volume after exposure to ambient air. The air lock should also be connected to the crop conveyer system of the chamber interior so that movement of hydroponics trays is possible between the air lock and the conveyer of the growing volume.

A500 – Growing Volume

The sub-contractor shall propose the structural engineering of the main chamber growing volume including the stainless steel growing trays, conveyer system, roof mounting, mounting of the air locks and connection to the air handling space. The growing space design should also include final design of the air handling plenum along one side wall, the interior air handling vents and air return to the air handling space. The shell for the crop growing volume should also include insulation and aesthetic covering.

Using information from the technical data package (Appendix 2), the sub-contractor will consolidate the detailed engineering specifications. Detailed engineering specifications shall include, but need not be limited to the following;

- Technical drawings and blue prints
- 3D CAE models
- Interfaces specifications
- Materials quality specifications
- Fasteners specifications

The drawings should be prepared in AutoCAD software to facilitate the activity of WP 8.

The results of this WP shall be gathered into a document CESRF-TN-1 “Detailed Engineering of the HPC Prototype for MELiSSA, including technical diagrams and blueprints,” which is subject to the approval of CESRF.

Output: CESRF-TN-1 “Detailed Engineering of the HPC Prototype for MELiSSA, including technical diagrams and blueprints”

WP 3: Prototype Construction Plan

On the basis of the output of WP 2 and the time frame of this activity, the sub-contractor shall prepare a chamber shell construction test plan, including;

- Description of the construction facility to be employed if other than the CESRF
- List of potential part suppliers
- Time-line for construction
- Assembly procedure
- Leakage test plan and procedure

Additionally, if the sub-contractor elects to construct the prototype shell on the CESRF premises, the test plan shall include the requirements of staff and equipment (both of the sub-contractor and CESRF) needed to complete construction at the CESRF.

The results of this WP shall be described in the document CESRF-TN2 "Prototype Shell Construction Plan".

The sub-contractor shall convene a Critical Engineering Review (CER) meeting to be held at CESRF to present results of WP2 and WP3.

Upon successful review, the contractor shall proceed to WP 4.

Output: CESRF-TN-2 "Prototype Shell Construction Plan"
Critical Engineering Review (CER)

WP 4: Chamber Shell Part Procurement and Chamber Shell Construction

On the basis of CESRF-TN-1 the sub-contractor will procure all necessary parts to complete construction of the prototype shell. Upon the delivery of parts to the selected assembly site, the sub-contractor will maintain a database in EXCEL format as supplied by UoG-CESRF. The database will include, but may not be limited to, information on the mass, dimensions, supplier, cost and warranty of the procured parts. Upon delivery of each part they shall be labelled (preferably with a barcode system) and linked to the electronic database. The sub-contractor shall supply a complete list of parts and the electronic database.

Upon delivery of parts, the sub-contractor shall construct the prototype in accordance with CESRF-TN-2 "Prototype Shell Construction Plan."

Prior to the delivery of the prototype shell (if the selected assembly site is other than the CESRF), the sub-contractor shall conduct a passive leakage test using CO_2 marker gas.

The CO_2 concentration shall be set to 2000 ppm in the chamber and allowed to decay to ambient concentrations (approx. 400 ppm) in accordance with the leak test plan contained in CESRF-TN-2. Upon verification of leakage rates within acceptable limits (< 7% per day, Appendix 2), the shell may be delivered to the CESRF. If the shell is to be constructed on-site at CESRF, the same leakage test shall be performed prior to finalization of this work package.

If the observed chamber leakage test is not within specified limits, the sub-contractor will undertake corrective action prior to delivery, or acceptance of the shell at the CESRF.

Output: CESRF-TN-3 "List of Procured Parts and Database"
Electronic database of procured parts in the EXCEL template supplied by CESRF
CESRF-TN-4 "Results of Preliminary Leakage Test in Electronic File"
Prototype Shell

WP 5: Chamber Shell As-Built Technical Drawings, 3D CAE models, Interfaces Specifications and Assembly Procedures

Considering the prototype shell as-built, the sub-contractor shall consolidate the technical documentation provided in WPs 2 and 3. 3-D CAE models of the chamber shell shall also include the associated chamber components:

- the assembled irrigation system
- lighting
- air handling units

Technical information on the equipment forming the complete prototype system will be provided by CESRF to facilitate the preparation of such drawings

The technical information shall be reported in the document CESRF-TN 5 "Chamber Shell As-Built Technical Drawings, 3D CAE models, Interfaces Specifications and Assembly Procedures" and will be submitted to UoG-CSERF for approval.

Output: CESRF-TN-5 "Chamber Shell As-Built Technical Drawings, 3D CAE models, Interfaces Specifications and Assembly Procedures."

WP 6: Functional Verification of the Prototype Shell at CESRF

Upon successful delivery of the prototype shell and the assembly of parallel components, the sub-contractor shall be involved in the repeat of leakage tests performed at the end of WP 4. If the resulting leakage tests are greater than allowable levels (<7% per day) the

sub-contractor shall be involved in troubleshooting and eventual corrective action related to improving the air-tightness of the shell.

Additionally, the sub-contractor will be involved in the performance assessment of the crop conveyer system and air handling system to ensure proper functionality. If fault is found with any part supplied by the sub-contractor, corrective action shall be taken.

The sub-contractor shall provide assistance in the preparation of final documentation of the chamber verification test results as it relates to the chamber shell performance. Chamber verification test reports will be the main criteria of the chamber shell acceptance.

Output: CESRF-TN-6: “Inputs to chamber verification test report”

4. Appendix 2 to RFP 518 – Technical Data Package

4.1 Introduction

Staff of the Controlled Environment Systems Research Facility (CESRF) at the University of Guelph and the Department d'Enginyeria Química, Universitat Autònoma de Barcelona (UAB) have been actively collaborating in an effort to integrate a Higher Plant Chamber (HPC) into the MELiSSA loop. Immediate goals are to integrate the HPC into the MELiSSA Pilot Plant (MPP) facility, located at UAB.

The main steps involved in HPC integration are:

- design of an HPC prototype, which shall be detailed in the frame of this activity
- assessment of mass balance of the MPP including an HPC using data derived from empirical production trials for the purposes of sizing the HPC
- technical development and documentation of the prototype chamber
- development of dynamic models/control laws of gas exchange and nutrient uptake for MELiSSA candidate crops
- formulation of local control algorithms for both the autonomous and integrated operation of the HPC within the Pilot Plant
- construction of the HPC
- connection of the gas, liquid and solid loops of MELiSSA to the HPC

The information contained in this TDP is intended to guide the Bidder in the preparation of its proposals. Any additional comments on the technical feasibility of these designs would be welcomed in the bidder's proposal.
In this package, some information is included to maintain coherency. The Bidder is reminded that the work proposed consists of the further design and construction of the chamber shell.

4.2 The MELiSSA Pilot Plant Facility

The prototype will be functionally tested at the UoG CESRF and shipped to the MELiSSA Pilot Plant facility in Barcelona for final installation. The Bidder is reminded that it is responsible for shipment of the prototype shell to the University of Guelph CESRF only. For reference purposes, some technical details of the MELiSSA Pilot Plant Facility are provided here.The laboratory volume devoted to the HPC in the new UAB facility is 288 m^3 with a footprint area of 12 x 6 m and a height of 4 m. The infrastructure at UAB includes the key services listed below.

- Electrical power: tri-phasic/bi-phasic, 30 kW (28.5A), 220V, 50Hz

- De-mineralized and tap water lines
- Air conditioning equipment
- Chilled Water supplies, for HPC thermal control

Gas lines: Compressed air, CO_2, N_2, O_2

4.3 Prototype Dimensions

Three selected species will be initially tested within the chamber including; wheat (*Triticum aestivum* L.), lettuce (*Lactuca sativa* L. cv. Grand Rapids) and beet (*Beta vulgaris* cv. Detroit Medium Red). These crops are representatives of plants with varying harvest index (edible biomass/total biomass, dwb) and mineral composition.

From empirical productivity values obtained from controlled environment trials of beet and lettuce (CESRF) it was determined that a crop production space of 5 m^2 per chamber is required.

Table 4-1. HPC Prototype Dimensions

Dimension	Value
Total available production space	5 m^2
Chamber Length	5 m
Air lock length (each, including interior door)	0.50 m
Interior chamber/air-lock width	1 m
Exterior chamber width (maximum room access width)	1.3 m
Width of air handling envelope	0.10 m
Chamber insulation width with aesthetic covering (each chamber side and trim)	0.20 m

According to the layout of the HPC prototype housing facility within the MPP, these dimensions would allow for a total end clearance of 6 m (3 m either end, less benches and analytical system bay).

4.4 Materials

The materials used for construction of the chamber should be selected so as to minimize off-gassing. They should also be non-toxic to higher plants. A list of proposed materials and their possible uses is shown below. This list applies to wetted parts on equipment not specifically mentioned below.

Table 4-2. HPC materials, [1] Pure phenolic thermosetting resinous coating, [2] Fluoroelastomer heat resistant.

Chamber Part	Materials
Walls, floors, valves, air plumbing	Stainless steel 316
Roof, windows	Tempered glass
Liquid reservoirs and tubing	Polypropylene (PP)
Heat exchanger, motor parts, oxidation barriers	"Heresite"
O-rings, solenoid seats	"Viton"

4.5 Logistics

The chamber is designed so as to promote efficient horticultural practice while allowing for change out of technologies should there be a desire for an upgrade. Additionally, access doors have been included on the side of the chamber to facilitate chamber cleaning, diseased plant removal and other logistical tasks. Contact surfaces for the doors will be sealed with Viton gaskets. The end air locks of the chamber are also fitted with glove boxes allowing access into the air lock interior when its external doors are closed. The glove boxes should be positioned on the air lock access door so that the operator may easily reach across the air lock length (0.5 m).

4.6 Basic HPC structure

The chamber is proposed to have access areas (air-locks) located at each of its ends. One is to be used in the seeding procedure and the other to be used in harvesting the mature plants. This configuration allows for a staged culture strategy and dampens the CO_2 sequestration dynamic associated with canopy development.

The hardware necessary for the operation of the chamber is proposed to be situated below the growing area and air locks so as to improve space utilization efficiency in the area dedicated to the HPCs within the Pilot Plant facility.

The prototype chamber is divided into five sub-systems (A100 – A500). These include the lighting loft (A100), the liquid sub-system area (A200), the air handling volume (A300), chamber access areas (A400) and the crop growing volume (A500).

All exterior shell components shall be constructed of either stainless steel (or glass, in the case of the chamber roof) and should have a minimum wall thickness of 0.635 cm (¼").

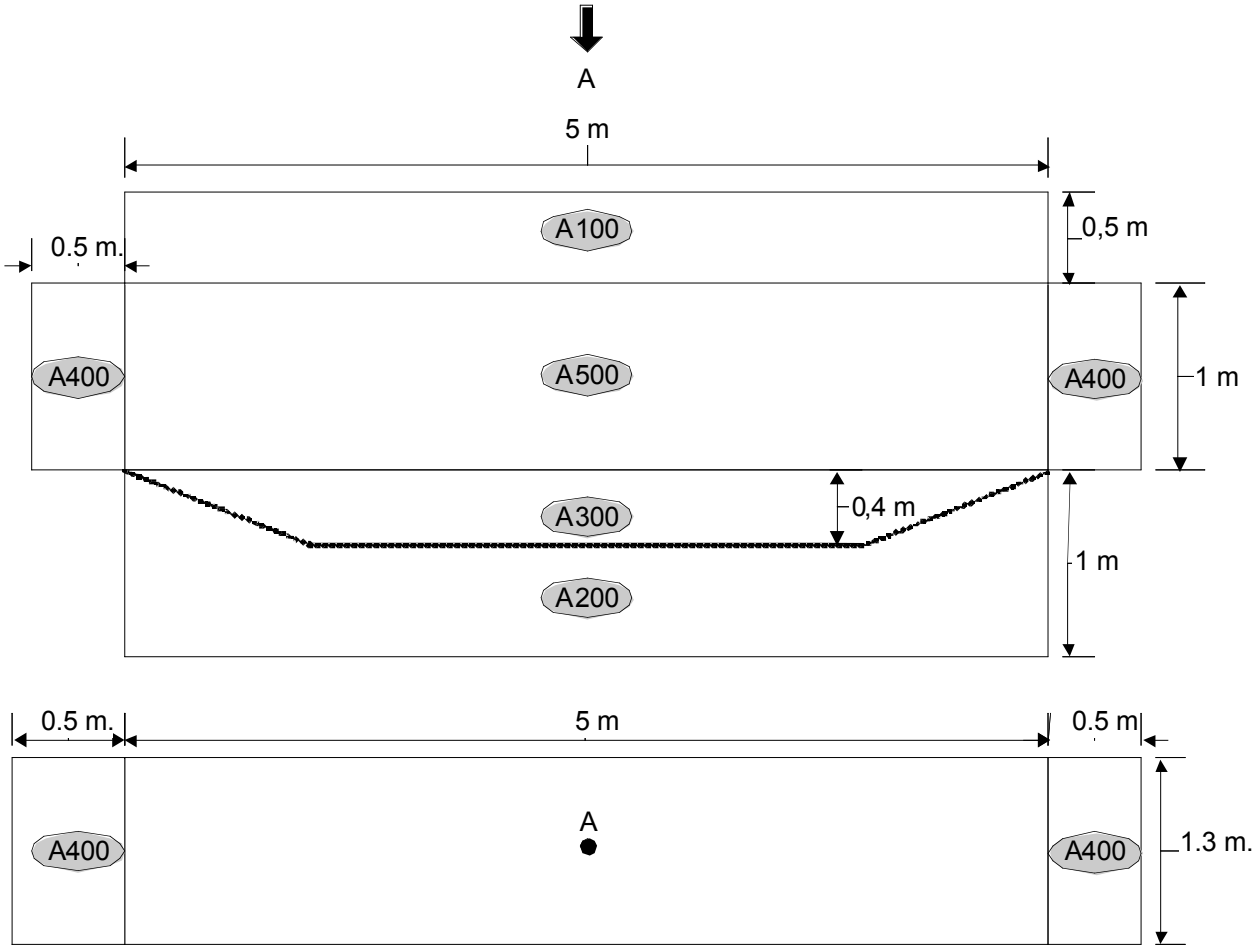

Figure 4-1. Schematic exterior view of the HPC prototype.

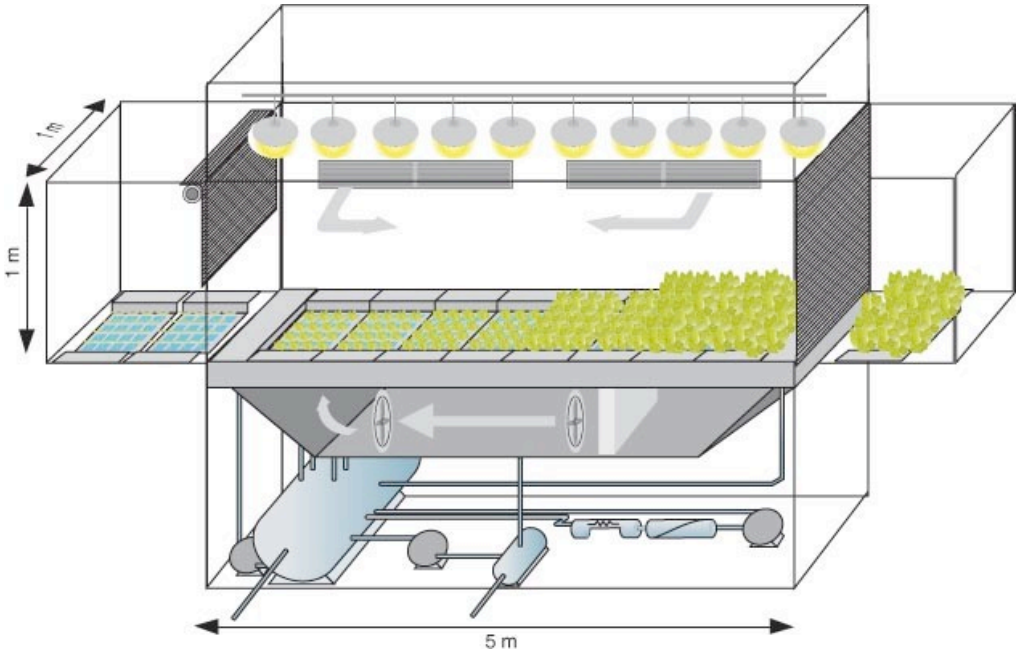

Figure 4-2. Cut-away representation of the higher plant chamber for integration into the Pilot Plant.

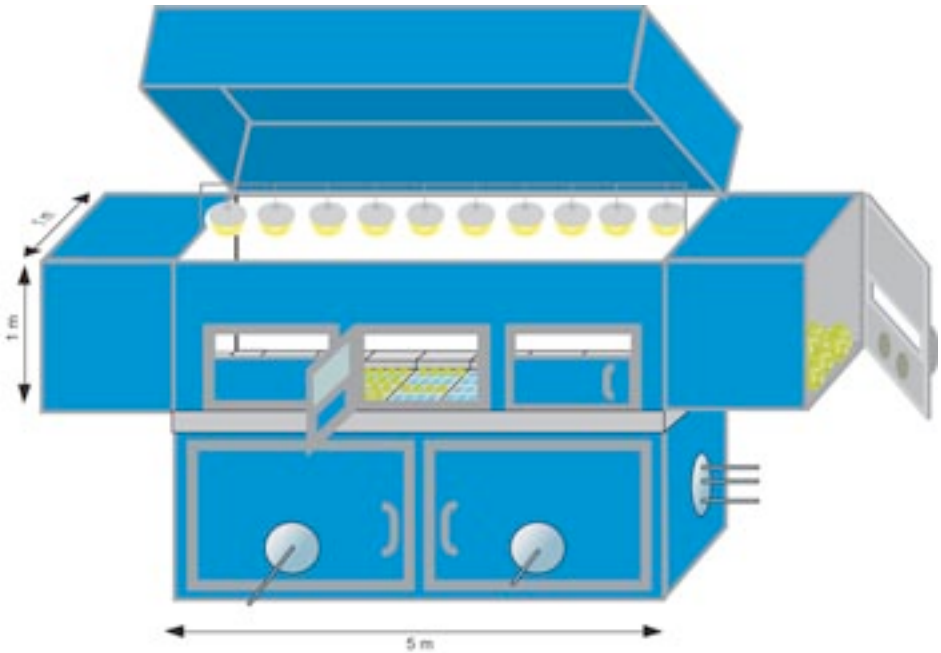

Figure 4-3. Exterior view of the higher plant chamber designed for integration into the MELiSSA Pilot Plant.

4.7 Functional Description of the Prototype

4.7.1 Atmospheric Control - Temperature, Humidity, Pressure and Composition

Air will be conditioned for temperature and humidity and re-circulated inside the chamber. Externally supplied chilled water and hot water are to be circulated through sealed and "heresite" coated (baked oxidation barrier) heat (cold and hot) exchange coils mounted in an internal plenum at the base of the chamber. Condensate from the chilled water coil will be collected on a slanted steel pan and collected and measured in a condensate collection reservoir (20 L reservoir volume). The condensate water may then be pumped back into the hydroponics reservoir and/or to the crew compartment of the MELiSSA loop depending on demand.

The chamber will be fitted with two 200 litre double sealed Teflon bags (or similar bladder material) positioned in the base of the chamber. The Teflon bags serve as a passive approach to atmospheric pressure management in the chamber since they will expand or contract with variable atmospheric volume within the chamber growing interior as associated with programmed diurnal temperature fluctuations. The bags will each be connected via manifolds to the chamber growing volume using a 50 mm diameter stainless steel tube. The total temperature range influencing gas volume in the chamber represented by a single bag capacity of 200 L (nominally filled at 100L) is about $\pm$6 degrees. The total capacity of the two bladders together amounts to a volume change associated with +12 degrees.

The diagram below presents the anticipated air flow through the chamber. The Bidder is asked to comment on its feasibility and on the possibility of air through a single side-wall only.

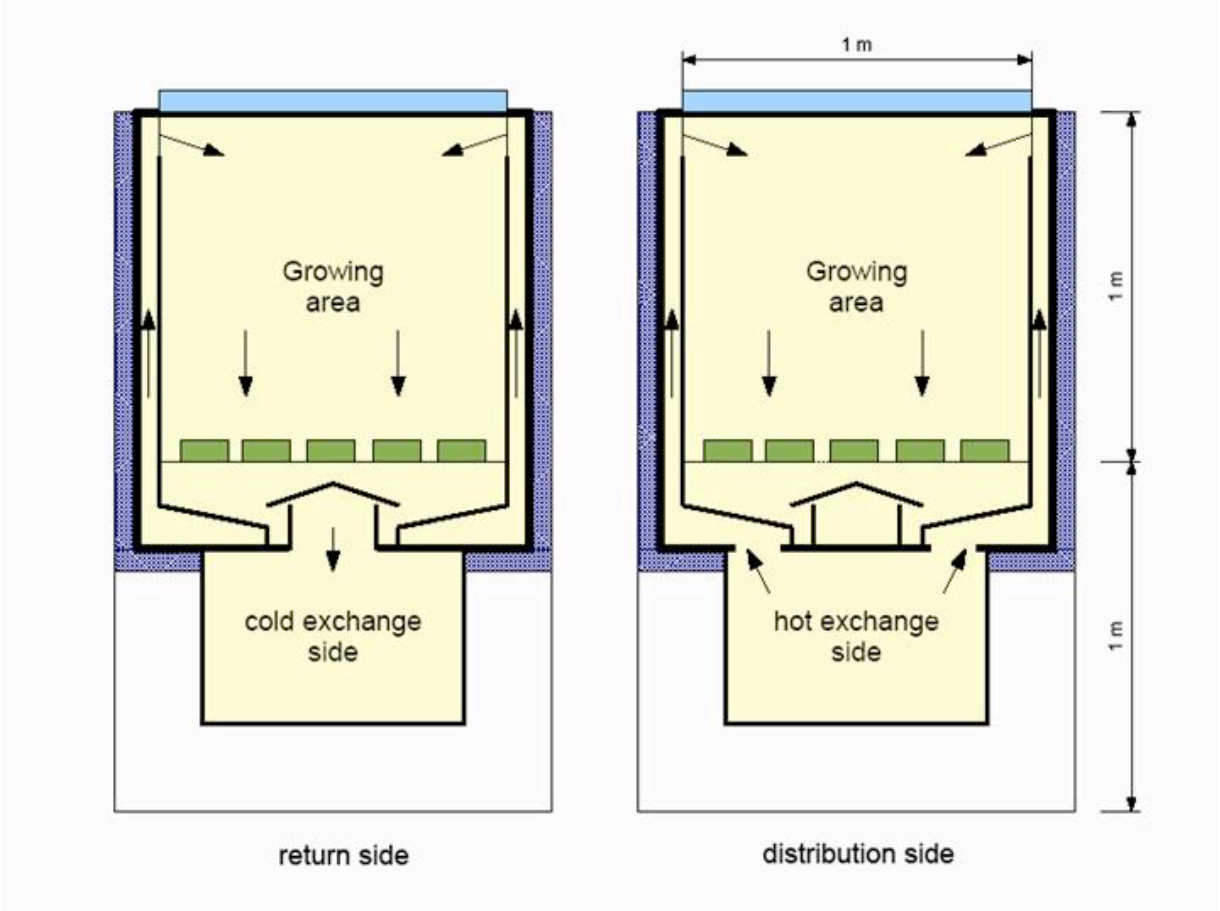

Figure 4-4. Representation of the air flow patterns within the prototype. Air moves through a plenum positioned on the side walls of the chamber and through vents (louvers) positioned on the upper side of the growing volume. Return is through vents positioned below the hydroponics tray support.

4.7.2 Hydroponics System Operation

The nutrient requirements for the plants are supplied in a hydroponics medium stored in a polypropylene nutrient solution reservoir mounted on the underside the chamber. The solution is pumped into the chamber to the head of sloped stainless steel troughs (trays) using a water cascade system. The trays are 1 m long and 20 cm wide (outer edge) each and are oriented along the width of the chamber (perpendicular to their line of travel on the conveyer system). The chamber has a total length of 5 m and can therefore accommodate up to 25 trays.

4.7.3 Lighting System Operation

The plant growth chambers will be equipped with 10 lamps, 5 each of 600W HPS and 400W MH externally mounted overhead to provide illumination through a 10 mm tempered glass roof. Initially, static ballasts will be used.

4.8 HPC Prototype Shell Technical Specifications

4.8.1 Chamber Access System

Access to the chamber growing area is gained through i) air-locks positioned at both chamber ends and ii) hinged doors positioned along the length of one side (exposed) on the chamber. The air locks are designed to reduce atmospheric leakage or cross contamination between the chamber interior and exterior during seeding and harvesting procedures. On the interior side of the air-lock is a rolling door. The door is activated by relays to allow for remote opening or closing when the exterior air-lock door is closed.

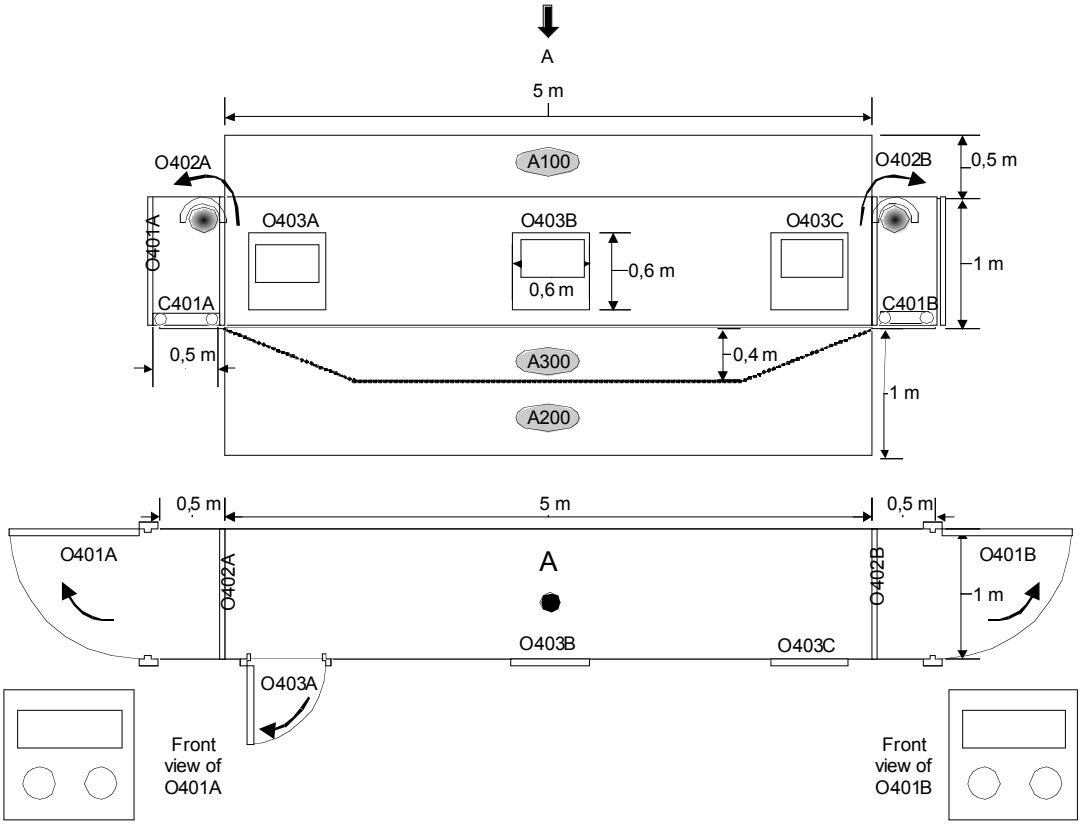

Figure 4-5. Schematic of the HPC access air locks

During periodic cleaning of the HPC, the side doors may be opened to access the depths of the chamber interior. These doors will be opened manually and will be fitted with gaskets and bolts/wing nuts to ensure a seal against the exterior chamber wall when not in use. The height of each side door is proposed to be 0.6m with the width not to exceed clearance between chambers within the MPP (i.e. 0.6m).

4.8.2 Liquid subsystem

Crops will be grown in hydroponics using a Nutrient Film Technique (NFT). In this method, a thin film of nutrient solution, which is always in contact with the plants, flows through a channel that contains the plant roots. The trays span with the width of the chamber and are sloped at a 2% grade. Basic schemes of the plant NFT trays and the HPC liquid loop are depicted in figures (listed numerically).

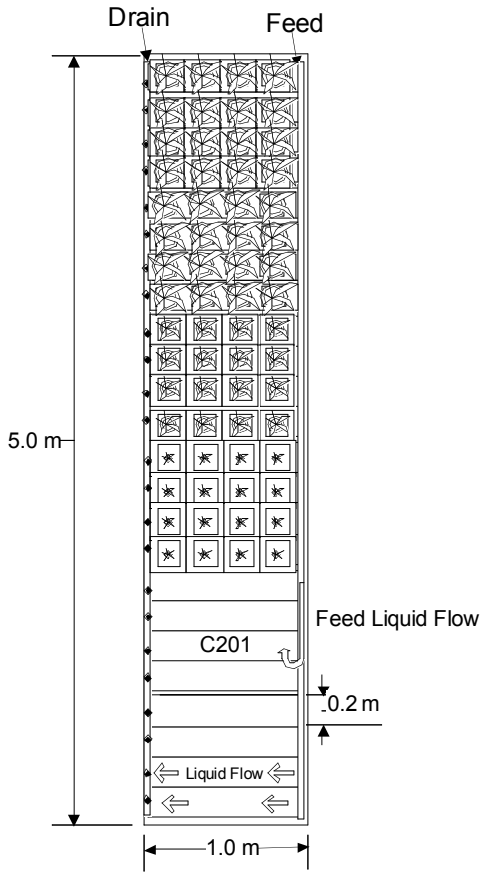

Figure 4-6. Top view of the growing trough distribution.

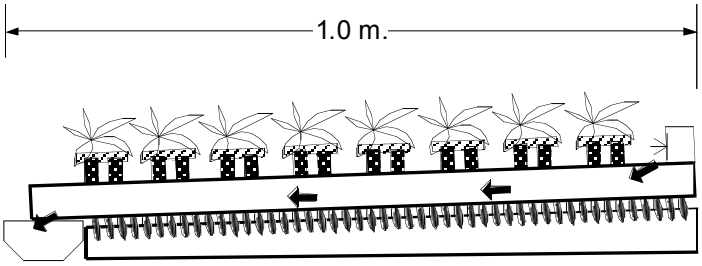

Figure 4-7. Representation of the growing trough distribution and in side profile.

The nutrient solution will be pumped (P201) from the external reservoir (T201) into the chamber in steel tubing to the head of sloped, one meter long troughs (C201) spanning the width of the chamber. A water cascade system will be used to deliver solution at the tray heads. The troughs will be 0.20 m in width (outer edge) and will rest on a support rack with wheels (conveyer). The trays are connected on their lateral side and will be moved manually down the length of the chamber during the harvesting and seeding procedures using a winch and pulley system. The direction of tray movement on the conveyer is perpendicular to the direction of solution flow (i.e. along the long axis of the chamber).

A condensed water tank (T202) is used to collect condensate from the air handling system. When the chiller is activated for chamber temperature control, atmospheric water vapour will condense on the coil and be collected in a trough positioned underneath. Gravity assists the feed of condensed water to the condensate collection tank. This condensate water may then be pumped from the collection tank into the nutrient reservoir or out of the HPC to the compartments of the MELiSSA loop requiring fresh water (i.e. crew).

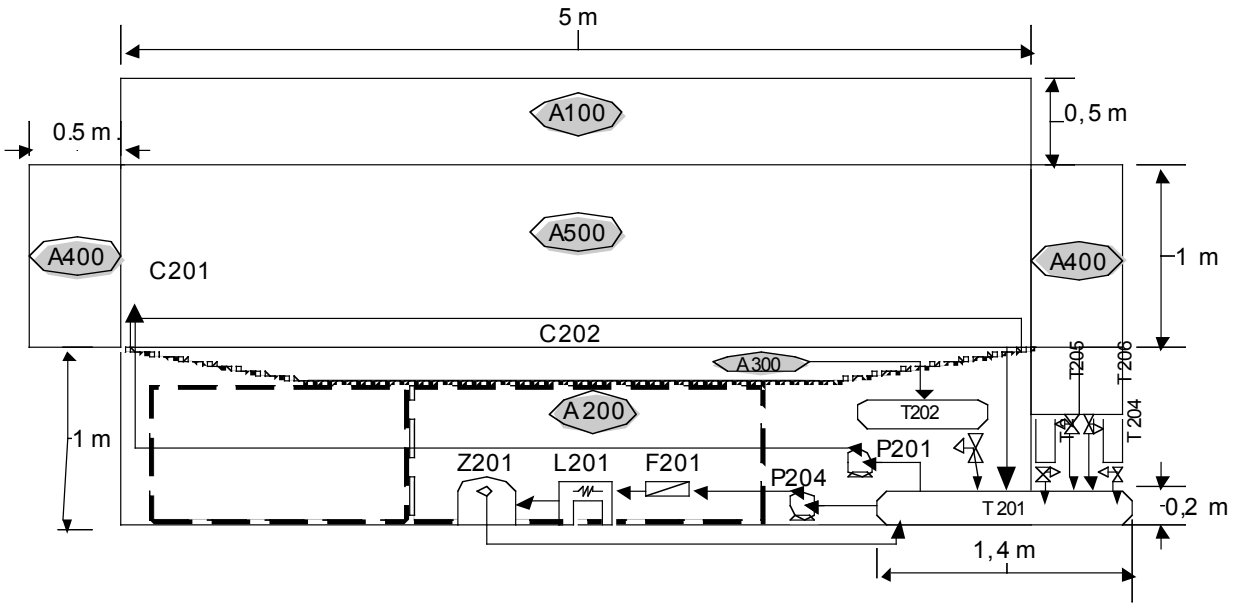

Figure 4-8. Representation of the HPC liquid sub-system. The growing troughs, C201, is behind C202 in this profile view. Dotted lines indicate the position of the access panels in the chamber belly.

4.8.3 The Crop Growing Volume

In order to supply CO_2 to the plants, to maintain a minimum vertical or horizontal temperature gradient and to evacuate heat from the chamber, an air circulation system is required. Thus, air should be conditioned for temperature and humidity and re-circulated inside the chamber.

In order to provide an internal air circulation of one air exchange per minute two fans with motors will be located in the sub-chamber bay (A300). The volume of the chamber considered includes 5 m^3 of growing volume and some volume of mechanical plenum (excluding airlock) leading to a required >5 m^3/min air exchange capacity.
A basic representation of the airflow direction inside the chamber is depicted in the figure below.

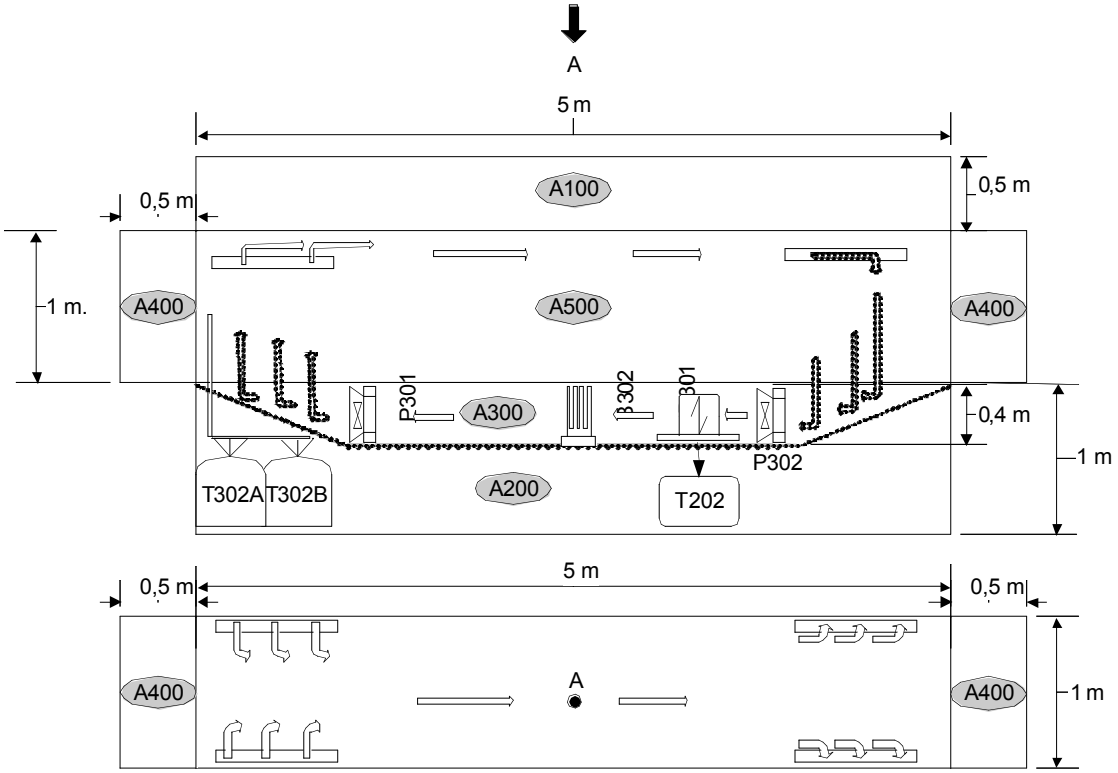

Figure 4-9. Air circulation patterns and handling system for the prototype chamber (Masot, 2004).

Thermal control is achieved using radiator coils mounted under the chamber. Chamber air is circulated around the radiator which is fed by laboratory hot water and chilled water supplies. In cooling the chamber, chilled water flows through the coil causing the condensation of atmospheric water vapour. The collected condensation is either returned to the hydroponics reservoir or is used by another MELiSSA compartment (i.e. potable water for crew). Humidification of the chamber is handled by injections of purified water vapour into the chamber atmosphere.

4.9 Chamber Shell Equipment List and Specifications

The following tables summarize the equipment requirements for the HPC. Equipment is listed by HPC area (A100-500) and wherever possible the equipment specifications are provided. For all shell parts. The following identifies equipment, in addition to the basic HPC shell that shall be supplied by successful Bidder.

Table 4-3. Shell Equipment list and specifications for the HPC

Equipment/Part	Quant.	Identification	Specifications
A100			
Lamp loft cover	1	N/A	Steel cover with hinges
Glass Roof	1	N/A	1 cm (0.4") thick, tempered/laminated glass (sectioned)
A200			
Hydroponics troughs, channels	30	C201	PP, 20cm wide, 1m long
Collecting/return trough	1	C202	PP 10cm wide, 5 m long
A300 and A500			
Chamber Shell	1	N/A	0.635 cm thick, 316 stainless steel
Insulation layer	1	N/A	TBD
Aesthetic covering	1	N/A	ESA Blue, thickness TBD
Teflon expansion bags	2	T302A-B	200L each
Tray conveyer	1	C501	TBD
Air flow vents	10	O501A-J	TBD
Chamber base access doors	3	N/A	TBD
Interface for chilled and hot water lines	1	N/A	TBD
Condensate collection pan	1	N/A	TBD
A400			
Air Lock	2	A401A, A401B	0.5 m x 1m x 1m, x 0.63 cm thick 316 Stainless Steel
Exterior Air Lock Door with glove box access and window	2	O401A, O401B	1m x 1m x 1m x 0.63 cm thick, 316 Stainless Steel
Interior Air Lock Door with motor	2	O402A, O402B	Rolling Door (TBD)
Air Lock Conveyer	2	C401A, C401B	TBD

4.10 Other Design Considerations

In addition to the structural and control loop requirements of the chamber noted above the following considerations should also be made.

4.10.1. Aesthetics

The chamber should have an exterior colour of ESA blue. All internal parts should be constructed of inert materials. Air locks and glove boxes shall be constructed of tempered glass. Appropriate electrical and plumbing tracking should be used.

4.10.2. Units of Measure

The chamber shell and its components shall be constructed entirely of metric sized parts.

4.11 Additional Technical Specifications

Under its prime contract, the University of Guelph is required to deliver a complete prototype shell which meets the technical specifications outlined in the Preliminary Requirements Specifications (Annex to Doc TEC-MCT/2005/3466/In/Cp). The successful Bidder will be supplied with these technical specifications at the time of project kick-off. Additional technical specifications relevant to the bidding process are provided below:

- Operational Pressure: 1010 mbar +/- 20 mbar within 1 hour.
- Leakage rate of CO_2: Less than 7% per day.
- The HPC shall withstand/operate as required when submitted to depressurization rate of 650 Pa/s (for at least 2 min, starting at ambient pressure) and a re-pressurization rate of 450 Pa/s (for at least 3 min, starting at 100 Pa) which may occur during gas connection with other MPP sub-systems.
- Sharp edges and corners which are permanently exposed to the operators shall be rounded.
- Protruding screws and bolts shall be capped.
- Touch Temperature: The maximum allowable temperature for continuous contact with bare skin shall be 45 Deg C. Warning labels shall be provided on any surface where temperature can be found higher than 46 Deg C.
- Protruding wiring, cables, sensors and similar components shall be protected against shorting by operators moving around the HPC prototype and against the effect of liquid leakage or connection.
- Shatterable materials shall be covered with material such as polycarbonate (Lexan).
- Material used in the construction of the HPC prototype shall be evaluated for flammability.
- All products considered for use in the MPP shall be evaluated for off-gassing and odour contamination.
- Items intended for structural applications shall possess a high resistance to stress corrosion cracking.
- Organic materials used in the pressurized environment shall be evaluated for fungus resistance. Materials which are non-nutrient for fungi should be used.
- Fluid compatibility: materials exposed to corrosive or hazardous fluids shall be evaluated or tested for compatibility.
- Limited life material: The contractor shall ensure that all materials that have a limited life characteristic have their date of manufacture (when available, otherwise date of delivery) and shelf life expiry date accurately and clearly marked on each lot/batch.
- The HPC prototype shall have a normal life time of 5 years.
- The HPC prototype shall be mounted on wheels to allow for easy displacement on flat surfaces.

- The HPC shall be designed in such a way so as to promote disassembly and shipment to Barcelona.

5. Appendix 3 to RFP 518 – Requirements for Management, Reporting, Deliverables and Meetings

The following requirements are derived from ESA's Standard Requirements for Management, Reporting, Meetings and Deliverables for ESA contracts and shall apply to the present activity.

5.1. Management

5.1.1. General

The sub-contractor shall carry out an effective and economical management and the Project manager nominated by the sub-contractor shall be responsible for the management and execution of the work to be performed and for the coordination and control of the work within the consortium.

5.1.2. Communications

All communications to the University of Guelph and CESRF shall be in writing/email and addressed to the University of Guelph CESRF representatives designated at time of award.

5.1.3. Access

During the course of the contract the University of Guelph and/or CESRF shall be afforded free access to any plan, procedure, specification or other documentation relevant to the program of work. Areas and equipment used during the development/testing activities associated with the contract shall also be available for inspection and audit.

The sub-contractor shall notify the University of Guelph and CESRF at least three weeks before the start of any test program, or as mutually agreed, in order to enable representatives from the CESRF or the European Space Agency to select those tests that it wishes to witness. The University of Guelph will notify the sub-contractor of its visit at least one week in advance.

5.2. Reporting

5.2.1. Minutes of Meeting

The sub-contractor is responsible for the preparation and distribution of minutes of all meetings held in conjunction with this sub-contract. Type versions shall be issued and distributed to all participants and to the CESRF's technical and administrative interface not later than 10 days after the relevant meeting.

The minutes shall clearly identify all agreements made and actions accepted at the meeting together with an update of the Action Item List (AIL). A draft should be signed at the end of the meeting.

5.2.2. Document List

The sub-contractor shall create and maintain a Document List, recording all the documents produced during its work, including reports, specifications, plans and minutes. The list shall indicate the document reference, type of document, date of issue, status (draft or approved), confidentiality level and distribution. This list should be continuously updated and shall be reviewed during relevant progress meetings.

5.2.3. Action Item List (AIL)

The sub-contractor shall maintain an Action Item List (AIL), recording all actions agreed with the University of Guelph. Each item will be uniquely numbered with reference to the minutes of the meeting at which the action was agreed and will record the date of origin, due date, originator and actionee. The AIL update shall be reviewed at relevant progress meetings.

5.2.4. Bar Chart Schedule

The sub-contractor shall be responsible for maintaining the bar-chart agreed at the kick-off meeting.

The sub-contractor shall present an up-to-date chart for review at all consequent meetings, indicating the current status of the contract activity (WPs completed, documents delivered, etc.)

Modifications of the schedule shall only be contractually binding if approved in writing by the University of Guelph's representative for contractual and administrative matters mentioned in the draft contract.

5.2.5. Progress Reports

The sub-contractor shall provide, every two weeks, a progress report, addressed to the University of Guelph CESRF Technical Officer, covering the contractual activities. The report shall refer to the current activities on the latest issued bar-chart and shall give:

- Description of progress: actual vs schedule, milestones and events accomplished
- Reasons for slippages and/or problem areas, if any and corrective actions planned or taken, with revised completion dates per activity
- Events anticipated to be accomplished in the next reporting period
- Status report on all long lead or critical delivery items
- Action items completed during the reporting period
- Milestone payment status
- Expected date for major schedule items

5.2.6. Problem Notification

The sub-contractor shall immediately notify the CESRF technical officer of any event likely to cause major delays to the time schedule of the work program or significantly impact the scope of the work to be performed (due to e.g. procurement problems, unavailability of facilities or resources etc.).

5.2.7. Technical Documentation

As soon as they become available, the sub-contractor shall submit to the CESRF all technical notes, engineering drawings, manufacturing plans, test plans, test procedures, specifications and Task/WP reports which are produced during the execution of the contract.

Any technical documentation to be discussed at a meeting with the CESRF shall be submitted one week prior to such a meeting.

Technical documents from the sub-contractor will be submitted to ESA only after review and acceptance by the contractor.

All tests under the sub-contract shall be performed according to test plans and test procedures approved by the CESRF technical officer.

5.3. Meetings

The project kick-off meeting shall take place at the CESRF and will include review of the existing CESRF facilities.

Progress meetings will be held via telecon, at the CESRF premises or at the sub-contractors premises (by mutual agreement) at monthly intervals.

The final presentation will take place at the CESRF premises.

Additional meetings are not excluded and ad hoc meetings may be requested by either the CESRF or the sub-contractor.

The sub-contractor shall give the CESRF prior notice of any meetings involving third parties to be held in conjunction with the contract. The CESRF will reserve the right of participation in such meetings.

With due notice to the sub-contractor, the CESRF reserves the right to invite third parties to meetings, including representatives from ESA, to facilitate information exchange.

For all meetings the sub-contractor will ensure that proper notice is given. The sub-contractor will be responsible for ensuring the participation of its personnel as needed.

For each meeting, the sub-contractor will provide an agenda and handouts of any presentations.

5.4. Deliverables

5.4.1. Documents

During the execution of the project, the sub-contractor shall prepare and deliver the technical notes identified in Table 1, within the corresponding work packages. It is understood that the content of TNs provided by the sub-contractor provided (as per Table 1) will be included in ESA-MELiSSA TNs as per the requirements of the prime contract.

The sub-contractor and the UoG-CESRF Technical Officer will agree on the format, preparation and means of delivery of the TNs listed in Table 1 and any additional documentation required to support the objectives of the project.

Delivery of a technical data package, summary report and abstract are not required by the sub-contractor.

Each technical note shall be delivered to the UoG-CESRF in an electronic format using software mutually agreeable to the sub-contractor and the UoG-CESRF.

Table 5-1. Technical Documentation to be supplied by the Sub-Contractor

Technical Note	Title
CESRF-TN-1	Detailed Engineering of the HPC Prototype for MELiSSA
CESRF-TN-2	Prototype Shell Technical Diagrams and Blue Prints
CESRF-TN-3	Prototype Shell Construction Plan
CESRF-TN-4	List of Procured Parts and Database
CESRF-TN-5	Chamber Shell As-Built Technical Drawings, Assembly Procedures and Documentation
CESRF-TN-6	Complete Prototype 3D-CAE Drawings

5.4.2. Photographic Documentation

The sub-contractor shall supply digital photographs of hardware under manufacture showing major progress as well as test set-ups.

5.4.3.Hardware

Any hardware (including test equipment and control electronics) built and/or purchased under the sub-contractor shall be delivered, after completion of associated tests, to the CESRF premises, unless otherwise agreed upon in writing by the University of Guelph – CESRF.

Additionally, all parts procured as part of the prototype shell construction shall be labelled and referenced in an equipment database using an EXCEL template. This template will be provided to the sub-contractor by UoG-CESRF after successful review of CESRF-TN-3 “Prototype Shell Construction Plan”.

5.4.4. Computer Programs

In this context, computer programs are understood as data files, CAD/CAE design drawings and engineering calculations / software output of any type and shall be provided to the University of Guelph – CESRF.

6. Guidelines for the Preparation of Proposals in Response to RFP-518 - MELiSSA Higher Plant Chamber Prototype

6.1. Introduction

For the purposes of this Invitation to Tender, the European Space Agency's "General Conditions of Tender for the selection of Suppliers by Prime Contractors in the frame of MELiSSA's major procurements," and referred to as the General Conditions of Tender shall apply as specified, amended or supplemented by these Special Conditions of Tender. In the event of conflict between the General and the Special Conditions, the special conditions shall prevail.

In order to assist the bidder in compiling its offer and checking its compliance with the requirements, and to enable the University of Guelph and ESA to evaluate it, a check-list is appended hereto.

Paragraph 4.2 of the General Conditions of Tender is hereby amended as follows:

Statement concerning the use of existing intellectual property rights of the Tenderer
If the Tenderer intends to use own background data corresponding to existing intellectual property rights owned by the Tenderer, he is expected to state this in his tender and he may already identify such background data either in the tender itself or during the Contract preparation.

6.2. Length or Proposal

The proposal shall be concisely written; a rough guideline is that the total number of pages should not exceed 100 pages, not including standard company information or brochures which the bidder wishes to append to demonstrate its background and experience.

6.3. Contents of the Proposal

6.3.1. Cover Letter

In addition to the information contained in Section 2.10.2 of the General Conditions of Tender, the cover letter shall contain the following:

- The names, telefax, e-mail and telephone numbers of the performs who will be responsible for the technical and contractual management of any resulting contract and who would be nominated as such in the contract.
- The name, address, telefax, e-mail and telephone number of the bidder's contact person to whom all communications relating to the ITT should be addressed.
- The name of the author(s) of the proposal

6.3.2.Contents of the Technical Proposal

- The bidder shall provide an introduction showing his understanding of the technical requirements and shall outline the main problems and his proposed solutions to solve them. Comments on the work activities specified are invited. Any comments, which would assist the objectives of this study, are also welcome.
- The bidder shall submit a first iteration, as far as practicable, of the activities described in the Statement of Work, including, if possible, the selection of a preferred concept, together with technical evidence of its validity in terms of feasibility and development risk.
- The bidder shall submit a study plan showing the study logic of the envisaged work to be undertaken, making use of a flow chart. The bidder shall specify the proposed investigations to be performed, giving justification for his choice.
- The bidder shall submit a critical review of the technical data package indicating conformance or eventual deviations with relevant justification (preferably in the form of a matrix).
- The bidder shall submit a statement of compliance to the Statement of Work clearly defining any proposed deviation with relevant justification (preferably in the form of a matrix).

6.3.3. Contents of the Financial, Management and Administrative Proposal (including costing, planning, WBS etc. and contractual response).

6.3.3.1. *Background Experience of the Company (-ies)*

The bidder shall describe the relevant experience that he and any of his sub-contractors, if any, have for the performance of the work, which is the subject of the present ITT.

6.3.3.2. *Organization and Management*

The bidder shall present the structure of his organization, and where it is proposed to subcontract part of the work, the structure of the industrial group. The structure of the group and of the individual companies shall be shown by means of organigrammes, which clearly show the tasks, position, authority and name of the persons proposed for the work, and in particular the project manager and the contracts officer. Lines of communication and reporting and means for settling disagreements shall be described.

The bidder shall preset his management plans, policies and procedures for this activity including discussion of the management control organization, the procedures that will be used to exercise control over the project and the proposed sub-contractor control (if any).

6.3.3.3. *Facilities*

The bidder shall submit a brief description of all facilities which are proposed to be used for the work offered, including those facilities which are still to be developed/built and or purchased (with a statement of the costs of developing/building/purchasing the facility are to be directly or indirectly charged to the contract. Modifications to existing facilities are also to be described. For the purposes of this provision facilities include hardware/computer software/manufacturing and test equipment/computers/word processors, etc.

If the bidder proposes to use the CESRF facilities for construction a statement of facility requirements shall be described.

6.3.3.4. *Key Personnel*

Key personnel are defined as persons who, because of their individual qualifications and positions are proposed for the work, and indicated as such in the bidder's organigramme. Key personnel shall be proposed to one level below the study/project manager, both for the main contractor and any sub-contractors of the bidder.

For each key person identified, the bidder shall:

- Provide a curriculum vitae, giving in particular the work experience of the person concerned, and a brief description of the person's present job and responsibilities;
- Indicate his position in the bidder's organisation;
- Define the proportion of the person's working time that is devoted to the work offered.

6.3.3.5. *List of Deliverable Items*

The bid shall contain a complete list of all items that are to be delivered per planning phase, under a resulting contract.

6.3.3.6. *Work Breakdown Structure*

With respect to the work definition given in the Statement of Work (Appendix 1), bidders shall propose the relevant Work Breakdown Structure and Work Package Description down to a reasonable level of detail, providing full visibility on the organization of the different (groups of) tasks and on the companies and staff responsible for their execution. Work Package descriptions shall comply with the layout of the standard ESA PSS-A20 form (provided below) and shall contain all the required information with particular attention to the input, task description and output fields.

With respect to the requirements for management, reporting, meetings and deliverables (Appendix 3 to the ITT) the bidder shall include a Work Package for Management and Reporting in his proposal. All management tasks, such as meetings, progress reports and final documentation shall be carried out under this Work Package.

6.3.3.7. *Planning*

The expected total duration of the contract is 6 months, with delivery of the prototype shell to the University of Guelph CESRF not later than April 31, 2007.

In establishing his planning, the bidder shall take into account the need for the UoG-CESRF to review and approve intermediate deliverables and shall include sufficient time for the CESRF to do this.

6.3.3.8. *Cost Price Data*

The bidder shall submit costing forms including the following information:

- Direct labour cost (manpower effort in manhours, gross hourly rate)
- Cost elements such as: raw materials, semi finished products, external services, transport and insurance, travels
- General expenses such as: general and administration expenses, R & D expenses
- Profit
- Total cost of all Work Packages

Notes:
The University of Guelph CESRF has earmarked for this activity a maximum budget of $280 000 Canadian Dollars.

The bidder shall submit the costing form noted above in Canadian Dollar currency only.

6.3.3.9. *Profit*

The fee (profit) shall not exceed eight (8) % of the base cost,

6.3.3.10. *Type of Price*

The type of price for this activity is a firm fixed price

6.3.3.11. *Milestone Payment Plan*

The bidder shall propose a suitable payment plan.

6.3.3.12. *Travel and Subsistence Plan*

The bidder shall submit a brief description of the travels he envisages for the execution of the contract together with the related cost details. This shall be given in the form of a matrix:

WP Ref.	Purpose of Trip	Departure Point	Destination	Travel Cost/person	No. of persons	Duration	Subsistence rate/day	Total cost of travel	Total Subsistence cost

6.3.3.13. *Warranty*

The bidder shall clearly specify in its tender the warranty to be provided for all chamber shell components it will supply.

6.3.3.14. *Contract Acceptance*

The bidder shall expressly state as follows:

- its acceptance of the terms of the draft contract/purchase order
- its acceptance of the statement of work

6.3.3.15. *Instructions for Completing Form PSS-A20*

The purpose of this form is to obtain a detailed description of the work to be performed under this Work Package (WP).

Unless specified otherwise in the Special Conditions of Tender (if any), WP descriptions are to be supplied at the task/equipment level. Each form shall contain the following information:

- Name of project
- Designation of project phase (if applicable)
- Work package reference defined in Work Breakdown Structure
- Title of Work Package
- Firm responsible
- Number of the sheet and total number of sheets pertaining to a given Work Package Description (use continuation sheets as appropriate)
- Major constituent to which the work package belongs. This shall not be limited to hardware subsystems but shall cover, as appropriate, functional task areas, such as management, product assurance, etc.
- Identifier of the start event which denotes commencement of the work package activities on the respective network
- Plan date of the work package start event. The date shall be based on planning calculations
- Issue number of the Work Package Description
- Identifier of the end event, which denotes completion of the work package activities on the respective network
- Plan date of the work package end event. The date shall be based on planning calculations
- Date of latest issue of the Work Package Description
- The name of the contractor's employee responsible for the work package (WP manager)
- List of items (documentation and/or hardware) which must be completed, or be available to start the work package
- List of items (documentation and/or hardware) which must be completed, or be available to end the work package
- List of tasks specifically excluded, if appropriate, in order to increase clarity of the scope of the work package.

WORK PACKAGE DESCRIPTION PSS-A-20

PROJECT:	PHASE:	WP REF:
WP Title Contractor Major Constituent (eg Subsystem) Start event Planned Date End Event Planned Date WP Manager		Sheet of Issue Ref Issue Date

7. List of Potential Bidders

Angstrom Engineering
Andrew Bass
Cambridge, ON
FAX 519-653-8884

BioChambers Incorporated
Winnipeg, MB
FAX 204-582-1024

Can-Trol Environmental Systems Limited
Markham, ON
FAX 905-415-8083

Constant Temperature Control Limited
Aurora, ON
FAX 905-841-1669

Conviron
Reg Quiring
Winnipeg, MB
FAX 204-786-7736

Microzone Corporation
David Puddy
Ottawa, ON
FAX 613-831-8321