

**RETURN BIDS TO:**  
**RETOURNER LES SOUMISSIONS À:**  
Bid Receiving - PWGSC / Réception des  
soumissions - TPSGC  
Gare Maritime Champlain  
Champlain Maritime Harbour  
901, Cap Diamant  
901, Cap Diamant  
Québec  
Québec  
G1K 4K1

**REQUEST FOR PROPOSAL**  
**DEMANDE DE PROPOSITION**

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

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

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

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

**Comments - Commentaires**

<b>Title - Sujet</b> Levée aérienne autonome	
<b>Solicitation No. - N° de l'invitation</b> W7701-103543/A	<b>Date</b> 2011-05-31
<b>Client Reference No. - N° de référence du client</b> W7701-10-3543	
<b>GETS Reference No. - N° de référence de SEAG</b> PW-\$QCL-032-13805	
<b>File No. - N° de dossier</b> QCL-1-34002 (032)	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Solicitation Closes - L'invitation prend fin</b> <b>at - à 02:00 PM</b> <b>on - le 2011-07-06</b>	
<b>Time Zone</b> <b>Fuseau horaire</b> Heure Avancée de l'Est HAE	
<b>F.O.B. - F.A.B.</b> <b>Plant-Usine:</b> <input type="checkbox"/> <b>Destination:</b> <input checked="" type="checkbox"/> <b>Other-Autre:</b> <input type="checkbox"/>	
<b>Address Enquiries to: - Adresser toutes questions à:</b> Boudrias, Marie-M.	<b>Buyer Id - Id de l'acheteur</b> qcl032
<b>Telephone No. - N° de téléphone</b> (418) 649-2806 ( )	<b>FAX No. - N° de FAX</b> (418) 648-2209
<b>Destination - of Goods, Services, and Construction:</b> <b>Destination - des biens, services et construction:</b> R & D POUR LA DÉFENSE CANADA - VALCARTIER BATIMENT 53 2459 BOUL. PIE XI NORD QUÉBEC Québec G3J1X5 Canada	

**Instructions: See Herein**

**Instructions: Voir aux présentes**

**Vendor/Firm Name and Address**

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

**Issuing Office - Bureau de distribution**

TPSGC/PWGSC  
Gare Maritime Champlain  
Champlain Maritime Harbour  
901, Cap Diamant  
901, Cap Diamant  
Québec  
Québec  
G1K 4K1

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

## **Request for Proposal**

### **Study of Guidance, Navigation and control for Autonomous Airlift**

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## PART 1 - GENERAL INFORMATION

### 1. Introduction

The bid solicitation document is divided into seven parts plus attachments and annexes as follows:

- Part 1 General Information: provides a general description of the requirement;
- Part 2 Bidder Instructions: provides the instructions, clauses and conditions applicable to the bid solicitation;
- Part 3 Bid Preparation Instructions: provides bidders with instructions on how to prepare their bid;
- Part 4 Evaluation Procedures and Basis of Selection: indicates how the evaluation will be conducted, the evaluation criteria that must be addressed in the bid, if applicable, and the basis of selection;
- Part 5 Certifications: includes the certifications to be provided;
- Part 6 Security Requirements: includes specific requirements that must be addressed by bidders; and
- Part 7 Resulting Contract Clauses: includes the clauses and conditions that will apply to any resulting contract.

The annexes include the Statement of Work (annex A), the Basis of Payment (annex B), the Security Requirements Check List (annex C) and the Contractor Disclosure of Foreground Information (annex D).

### 2. Summary

**Title** : Study of Guidance, Navigation and control Concepts for autonomous Airlift

**Objectives** :

The objectives of the work are to conduct an extensive study on the guidance, navigation and control (GNC) technologies for enabling autonomous airlift. The work should focus on GNC synthesis, analysis and validation to prove the concept of autonomous air lift (AAL) with multiple miniature unmanned air vehicles (MUAVs) of rotorcraft type.

**Tasks** :

The tasks included in this contract include :

- Task 1: Scientific literature review
- Task 2: Robust stabilization and relative positioning system for AAL
- Task 3: Automatic payload monitoring and grappling system
- Task 4: Coordinated control, guidance and navigation for autonomous air lift
- Task 5: Demonstration of autonomous airlift at the DRDC Valcartier I2EAR facility
- Task 6: Documentation of systems design and results obtained

For each of the above task, subtasks are associated.

**Client department :**

The services will be rendered to Defence Research and Development Canada (DRDC-Valcartier).

**Period of the contract :**

The contract period is 30 months from the contract award date.

**Contract funding :**

The estimated amount of funding available for this contract is \$360,000.00 (GST not included).

**Intellectual property rights :**

Any intellectual property rights arising from the performance of the Work under the resulting contract will belong to Canada.

**Work Location :**

Part of the work will be carried out on site at Defence Research and Development Canada - Valcartier, located at 2459 Pie-XI Blvd. North, Quebec City, Quebec. More specifically, Tasks 2.3, 3.4, 4.3, 5.1 and 5.2 will be carried out at the DRDC Valcartier I2EAR facility. Such on-site experiments are essential for the study of AAL: (1) to prove the feasibility of the design with DRDC Valcartier's in-house analytical tools, systems, software, and test platforms, (2) to verify the correct functioning of the AAL system with the other available onboard unmanned air vehicles, (3) to study the performance of the overall team of unmanned air vehicles under controlled conditions of operation, and (4) to ensure an appropriate integration of all the components/systems/devices/platforms.

**Security requirements :**

There are security requirements associated with the requirement. For additional information, see Part 6: Security, Financial and Other Requirements, and Part 7: Resulting Contract Clauses. Bidders should consult "Security Requirements for PWGSC Bid Solicitations – Instructions to Bidders" (<http://www.tpsgc-pwgsc.gc.ca/app-acq/lc-pl/lc-pl-eng.html#a31>) on the Departmental Standard Procurement Documents Web site.

**Other information :**

- The requirement is subject to the provisions of the Agreement on Internal Trade (AIT).
- The requirement is limited to Canadian services.

**4. Debriefings**

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

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## PART 2 - BIDDER INSTRUCTIONS

### 1. Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the *Standard Acquisition Clauses and Conditions* (<http://sacc.pwgsc.gc.ca/sacc/index-e.jsp>) Manual issued by Public Works and Government Services Canada.

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

The **2003** (2011-05-13) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

**Subsection 5.4 of 2003**, Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: sixty (60) days

**Insert: one hundred twenty (120) days**

#### 1.1 SACC Manual Clauses

**A7035T** (2007-05-25), List of Proposed Subcontractors

### 2. Submission of Bids

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

Due to the nature of the bid solicitation, bids transmitted by facsimile or e-mail to PWGSC will not be accepted.

### 3. Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority, preferably by e-mail at the following address : [marie-michele.boudrias@tpsgc-pwgsc.gc.ca](mailto:marie-michele.boudrias@tpsgc-pwgsc.gc.ca), **no later than five (5) calendar days before the bid closing date**. Enquiries received after that time may not be answered.

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

#### 4. **Applicable Laws**

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

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

#### 5. **Basis for Canada's Ownership of Intellectual Property**

Defence Research and Development Canada - Valcartier has determined that any intellectual property rights arising from the performance of the Work under the resulting contract will belong to Canada.

- (a) The Treasury Board, granted Defence Research and Development Canada exemption from the Treasury Board Policy on "Title to Intellectual Property Arising Under Crown Procurement Contracts"

#### 6. **Maximum Funding**

The maximum funding available for the contract resulting from the bid solicitation is **\$360,000.00** (Goods and Services Tax or the Harmonized Sales Tax extra, as appropriate). Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available.

## PART 3 - BID PREPARATION INSTRUCTIONS

### 1. Bid Preparation Instructions

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

- Section I : Technical Bid (**4 hard copies**)  
 Section II : Financial Bid (**2 hard copies**)  
 Section III : Certifications (**1 hard copie**)

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 30% recycled paper;
- (c) print double sided (duplex printing);
- (d) use a numbering system that corresponds to the bid solicitation; and
- (e) submit bound bids using cerlox, staples, etc., but no binders.

#### Section I : Technical Bid

In their technical bid, bidders should demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements. Bidders should demonstrate their capability and describe their approach in a thorough, concise and clear manner for carrying out the work.

The technical bid should clearly address and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that bidders address and present topics in the order of the evaluation criteria under the same headings. To avoid duplication, bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed.

#### Section II : Financial Bid

**1.1** Bidders must submit their financial bid in accordance with the following :

- (a) A firm all-inclusive hourly rate for each category of resources and for each year of the contract period.

The total amount of Goods and Services Tax or Harmonized Sales Tax is to be shown separately, if applicable.

The estimated funding available for the Contract resulting from the bid solicitation is **\$360,000.00** CAD, the Goods and Services Tax or the Harmonized Sales Tax excluded, FOB destination for goods, customs duties and excise taxes included. This disclosure does not commit Canada to pay the estimated funding available.

The information should be provided in accordance with the **Financial Bid Presentation Sheet in Attachment 1**.

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- (b) For Canadian-based bidders, prices must be in Canadian funds, Canadian customs duties and excise taxes included, and Goods and Services Tax (GST) or Harmonized Sales Tax (HST) excluded.

For the purpose of the bid solicitation, bidders with an address in Canada are considered Canadian-based bidders and bidders with an address outside of Canada are considered foreign-based bidders.

### **Section III : Certifications**

Bidders must submit the certifications required under **Part 5**.

## PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

### 1. Evaluation Procedures

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

#### 1.1 Technical Evaluation

##### 1.1.1 Mandatory Technical Criteria

There is no Mandatory Technical Criteria for this Request for proposal.

##### 1.1.2 Point Rated Technical Criteria

Refer to **Attachment 2, Point Rated Technical Criteria.**

#### 1.2 Financial Evaluation

##### 1.2.1 Evaluation of Price

The price of the bid will be evaluated in Canadian dollars, the Goods and Services Tax or the Harmonized Sales Tax excluded, FOB destination, Canadian customs duties and excise taxes included.

For evaluation purposes only, the price of the bid will be the **total estimated cost to a limitation of expenditure.**

##### 1.2.2 Mandatory financial criteria

The bidder must submit a Basis of Payment to a Limitation of Expenditure that does not exceed **\$360,000.00** CAD GST/HST excluded, FOB destination (for goods), all applicable customs duty and excise taxes included.

## 2. Basis of Selection

### 2.1 Basis of Selection - Highest Rated Within Budget

To be declared responsive, a bid must:

- (a) comply with all the requirements of the bid solicitation;
- (b) meet all mandatory technical evaluation criteria;
- (c) obtain the required minimum points for each group of criteria with a pass mark;
- (d) obtain the required minimum points overall for the technical evaluation criteria which are subject to point rating.

Bids not meeting (a) or (b) or (c) or (d) will be declared non responsive. The responsive bid with the highest number of points will be recommended for award of a contract, provided that the total evaluated price does not exceed the budget available for this requirement. In the event that the highest number of points is obtained by more than one responsive bid, the responsive bid with the lowest evaluated price will be recommended for award of a contract.

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## PART 5 - CERTIFICATIONS

Bidders must provide the required certifications to be awarded a contract. Canada will declare a bid non-responsive if the required certifications are not completed and submitted as requested.

Compliance with the certifications bidders provide to Canada is subject to verification by Canada during the bid evaluation period (before award of a contract) and after award of a contract. The Contracting Authority will have the right to ask for additional information to verify the bidders' compliance with the certifications before award of a contract. The bid will be declared non-responsive if any certification made by the Bidder is untrue, whether made knowingly or unknowingly. Failure to comply with the certifications or to comply with the request of the Contracting Authority for additional information will also render the bid non-responsive.

### 1. Certifications Precedent to Contract Award

The certifications in **Attachment 3, Certifications Precedent to Contract Award**, should be completed and submitted with the bid but may be submitted afterwards. If any of these required certifications is not completed and submitted as requested, the Contracting Authority will so inform the Bidder and provide the Bidder with a time frame within which to meet the requirement. Failure to comply with the request of the Contracting Authority and meet the requirement within that time period will render the bid non-responsive.

## PART 6 - SECURITY REQUIREMENTS

### 1. Security Requirement

1. Before award of a contract, the following conditions must be met:
  - (a) the Bidder must hold a valid organization security clearance as indicated in Part 7 - Resulting Contract Clauses;
  - (b) the Bidder's proposed individuals requiring access to classified or protected information, assets or sensitive work site(s) must meet the security requirement as indicated in Part 7 - Resulting Contract Clauses;
  - (c) the Bidder must provide the name of all individuals who will require access to classified or protected information, assets or sensitive work sites.
2. Canada will not delay the award of any contract to allow bidders to obtain the required clearance.
3. For additional information on security requirements, bidders should consult the "Security Requirements for PWGSC Bid Solicitations - Instructions for Bidders" (<http://www.tpsgc-pwgsc.gc.ca/app-acq/lc-pl/lc-pl-eng.html#a31>) document on the Departmental Standard Procurement Documents Web site.

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## PART 7 - RESULTING CONTRACT CLAUSES

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

### 1. Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work at Annex A and the Contractor's technical bid entitled \_\_\_\_\_ (to be completed at the contract award), dated \_\_\_\_\_ (to be completed at the contract award).

### 2. Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions (<http://ccua-sacc.tpsgc-pwgsc.gc.ca/pub/acho-eng.jsp>) Manual issued by Public Works and Government Services Canada.

#### 2.1 General Conditions

**2040** (2011-05-16), General Conditions - Research & Development, apply to and form part of the Contract.

#### 2.2 Supplemental General Conditions

The following supplemental general conditions apply to and form part of the Contract:

**4002** (2010-08-16), Software Development or Modification Services

**4003** (2010-08-16), Licensed Software

#### 2.3 SACC Manual Clauses

**K3410C** (2008-12-12), Canada to Own Intellectual Property Rights in Foreground Information

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### 3. Security Requirement

1. The Contractor must, at all times during the performance of the Contract, hold a valid Designated Organization Screening(DOS), issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC).
2. The Contractor personnel requiring access to sensitive work site(s) must EACH hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC.
3. Subcontracts which contain security requirements are NOT to be awarded without the prior written permission of CISD/PWGSC.
4. The Contractor must comply with the provisions of the:
  - (a) Security Requirements Check List and security guide (if applicable), attached at **Annex C**;
  - (b) Industrial Security Manual (Latest Edition).

### 4. Term of Contract

#### 4.1 Period of Contract

The contract period is **30 months** from the contract award date.

### 5. Authorities

#### 5.1 Contracting Authority

The Contracting Authority for the Contract is:

Marie-Michèle Boudrias  
Public Works and Government Services Canada  
Champlain Harbour Station  
901, Cap Diamant  
Québec, Québec, G1K 4K1

Telephone: 418-649-2806  
Facsimile: 418-648-2209  
E-mail address: marie-michele.boudrias@tpsgc.pwgsc.gc.ca

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

**5.2 Technical Authority** (to be completed by Canada at the contract award)

The Technical Authority for the Contract is:

Name : \_\_\_\_\_  
 Organization : \_\_\_\_\_  
 Telephone: \_\_\_\_\_  
 Facsimile: \_\_\_\_\_  
 E-mail address: \_\_\_\_\_

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

**5.3 Contractor's Representative** (to be completed by the contractor)**Administrative representative :**

Name :  
 Telephone :  
 Facsimile :  
 Email :

**Technical representative :**

Name :  
 Telephone :  
 Facsimile :  
 Email : \_

**6. Payment****6.1 Basis of Payment**

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in Annex B, to a limitation of expenditure of \$\_\_\_\_\_ (amount to be inserted at contract award). Customs duties are included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

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## 6.2 Limitation of Expenditure

1. Canada's total liability to the Contractor under the Contract must not exceed \$\_\_\_\_\_ (amount to be inserted at contract award). Customs duties are included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.
2. No increase in the total liability of Canada or in the price of the Work resulting from any design changes, modifications or interpretations of the Work, will be authorized or paid to the Contractor unless these design changes, modifications or interpretations have been approved, in writing, by the Contracting Authority before their incorporation into the Work. The Contractor must not perform any work or provide any service that would result in Canada's total liability being exceeded before obtaining the written approval of the Contracting Authority. The Contractor must notify the Contracting Authority in writing as to the adequacy of this sum:
  - (a) when it is 75 percent committed, or
  - (b) four (4) months before the Contract expiry date, or
  - (c) as soon as the Contractor considers that the contract funds provided are inadequate for the completion of the Work,whichever comes first.
3. If the notification is for inadequate contract funds, the Contractor must provide to the Contracting Authority a written estimate for the additional funds required. Provision of such information by the Contractor does not increase Canada's liability.

## 6.3 Method of Payment

### 6.3.1 Progress Payments

1. Canada will make progress payments in accordance with the payment provisions of the Contract, no more than once a month, for cost incurred in the performance of the Work up to **90 percent** of the amount claimed and approved by Canada if:
  - (a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111 (<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>) and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;
  - (b) the amount claimed is in accordance with the Basis of payment;
  - (c) the total amount for all progress payments paid by Canada does not exceed **90 percent** of the total amount to be paid under the Contract;
  - (d) all certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives.

2. The balance of the amount payable will be paid in accordance with the payment provisions of the Contract upon completion and delivery of the item if the Work has been accepted by Canada and a final claim for the payment is submitted.
3. Progress payments are interim payments only. Canada may conduct a government audit and interim time and cost verifications and reserves the right to make adjustments to the Contract from time to time during the performance of the Work. Any overpayment resulting from progress payments or otherwise must be refunded promptly to Canada.

#### 6.4 SACC Manual Clauses

**A9117C** (2007-11-30), T1204 - Direct Request by Customer Department  
**C0305C** (2008-05-12), Cost Submission

#### 6.5 Discretionary Audit

SACC Manual Clause **C0705C** (2010-01-11), Discretionary Audit

### 7. Invoicing Instructions - Progress Claim

1. The Contractor must submit a claim for progress payment using form PWGSC-TPSGC 1111 (<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>).

Each claim must show:

- (a) all information required on form PWGSC-TPSGC 1111;
- (b) all applicable information detailed under the section entitled "Invoice Submission" of the general conditions;
- (c) a list of all expenses;
- (d) expenditures plus pro-rated profit or fee;
- (e) the description and value of the milestone claimed as detailed in the Contract.

Each claim must be supported by:

- (a) a copy of time sheets to support the time claimed;
  - (b) a copy of the invoices, receipts, vouchers for all direct expenses, and all travel and living expenses;
  - (c) a copy of the monthly progress report.
2. Goods and Services Tax (GST) or Harmonized Sales Tax (HST), as applicable, must be calculated on the total amount of the claim before the holdback is applied. At the time the holdback is claimed, there will be no GST/HST payable as it was claimed and payable under the previous claims for progress payments.
  3. The Contractor must prepare and certify one original and two (2) copies of the claim on form PWGSC-TPSGC 1111, and forward it to the following address for certification.

**ATTN : Mrs Suzanne Larrivée**

Supply Support Clerk

Public Works and Government Services Canada

Champlain Harbour Station  
 901, Cap-Diamant, suite 240  
 Quebec, Quebec  
 G1K 4K1

**E-mail address** : suzanne.larrivee@tpsgc-pwgsc.gc.ca

The Contracting Authority will then forward the original and two (2) copies of the claim to the Technical Authority for certification and onward submission to the Payment Office for the remaining certification and payment action.

4. The Contractor must not submit claims until all work identified in the claim is completed.

## 8. Certifications

**8.1** Compliance with the certifications provided by the Contractor in its bid is a condition of the Contract and subject to verification by Canada during the entire contract period. If the Contractor does not comply with any certification or it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

### 8.2 SACC Manual Clauses

**A3060C** (2008-05-12), Canadian Content Certification

## 9. Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in \_\_\_\_\_ (to be inserted at contract award).

## 10. Priority of Documents

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

- (a) the Articles of Agreement;
- (b) the supplemental general conditions **4002** (2010-08-16), Software Development or Modification Services
- (c) the supplemental general conditions **4003** (2010-08-16), Licensed Software
- (d) the general conditions **2040** (2011-05-16), General Conditions - Research & Development;
- (e) **Annex A**, Statement of Work;
- (f) **Annex B**, Basis of Payment;
- (g) **Annex C**, Security Requirements Check List;
- (h) **Annex D**, Contractor Disclosure of Foreground Information;
- (i) the Contractor's bid dated \_\_\_\_\_ (insert date of bid).

**11. Defence Contract**

SACC Manual clause **A9006C** (2008-05-12), Defence Contract

**12. Foreign Nationals (Canadian Contractor)**

SACC Manual clause **A2000C** (2006-06-16), Foreign Nationals (Canadian Contractor)

**13. Insurance**

SACC Manual clause **G1005C** (2008-05-12), Insurance

**14. Progress reports**

1. The Contractor must submit monthly reports, in electronic format, on the progress of the Work, to both the Technical Authority and the Contracting Authority.
2. The progress report must contain three parts:
  - (a) PART 1: The Contractor must answer the following three questions:
    - (i) Is the project on schedule?
    - (ii) Is the project within budget?
    - (iii) Is the project free of any areas of concern in which the assistance or guidance of Canada may be required?

Each negative response must be supported with an explanation.

- (b) PART 2: A narrative report, brief, yet sufficiently detailed to enable the Technical Authority to evaluate the progress of the Work, containing as a minimum:
  - (i) A description of the progress of each task and of the Work as a whole during the period of the report. Sufficient sketches, diagrams, photographs, etc., must be included, if necessary, to describe the progress accomplished.
  - (ii) An explanation of any variation from the work plan.
  - (iii) A description of trips or conferences connected with the Contract during the period of the report.
  - (iv) A description of any major equipment purchased or constructed during the period of the report.
- (c) PART 3: The "Contract Plan and Report Form", PWGSC-TPSGC 9143, (or an equivalent form acceptable to the Contracting Authority) showing the following:
  - (i) Actual and forecast expenditure on a monthly basis for the period being covered. (Expenditures are to be outlined by month and by task.)

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- (ii) Progress of the Work against the Contractor's original Contract Plan. The form will provide the basis for planning and estimating the cost of work, and reporting actual progress and cost against the plan during contract performance.

## 15. Site Regulations

The Contractor must comply with all standing orders or other rules, instructions and directives in force on the site where the Work is performed.

## ATTACHMENT 1

### FINANCIAL BID PRESENTATION SHEET

1. LABOUR: at firm all-inclusive rates, GST/HST extra, profit must be included in the hourly rates, in accordance with the following:

**BIDDERS ARE REQUESTED TO QUOTE ONE FIRM HOURLY RATE PER PROPOSED RESSOURCES, PER PERIOD.**

Labour Categories and proposed ressources	Firm Hourly Rate						Total amount for the contract period
	Contract Periods						
	A Date of Award to 2012-03-31	B Total Est. Hours	C 2012-04-01 to 2013-03-31	D Total Est. Hours	E 2013-04-01 to the end of the contract period	F Total Est. Hours	
Labour Category :  Name of the proposed ressource :  	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$
Labour Category :  Name of the proposed ressource :  	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$
Labour Category :  Name of the proposed ressource :  	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$

Labour Categories and proposed ressources	Firm Hourly Rate						Total amount for the contract period
	Contract Periods						
	A Date of Award to 2012-03-31	B Total Est. Hours	C 2012-04-01 to 2013-03-31	D Total Est. Hours	E 2013-04-01 to the end of the contract period	F Total Est. Hours	
Labour Category : _____ Name of the proposed ressource : _____	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$
Labour Category : _____ Name of the proposed ressource : _____	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$
Labour Category : _____ Name of the proposed ressource : _____	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$
Labour Category : _____ Name of the proposed ressource : _____	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$ _____ / hour	_____ hours	\$

For each ressources, the total amount will be calculated as follows : (A X B) + (C X D) + (E X F)

TOTAL ESTIMATED LABOUR: \$ \_\_\_\_\_

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**Items 2 through 7 shall be completed if the Bidder's rates in 1. above do not include the following:**

**If an item is not applicable, write "NA" on the total estimated line.**

**The total estimated cost for the equipment (item 2), the rentals (item 3) and the materials and supplies (item 4) should not exceed \$40,000.00 (GST/HST extra).**

2. EQUIPMENT: at laid down cost without markup

Description	Firm unit price	Total est. Qty.
(a)	\$	
(b)	\$	
(c)	\$	
(d)	\$	
(e)	\$	

TOTAL ESTIMATED EQUIPMENT: \$ \_\_\_\_\_

3. RENTALS : at actual cost without markup

Description	Firm unit price	Total est. Qty.
(a)	\$	
(b)	\$	
(c)	\$	
(d)	\$	
(e)	\$	

TOTAL ESTIMATED RENTALS: \$ \_\_\_\_\_

4. MATERIALS AND SUPPLIES: at laid down cost without markup

Description	Firm unit price	Total est. Qty.
(a)	\$	
(b)	\$	
(c)	\$	
(d)	\$	
(e)	\$	

TOTAL ESTIMATED MATERIALS AND SUPPLIES: \$ \_\_\_\_\_

## 5. SUBCONTRACTS: at actual cost without markup

Support for the proposed subcontractor's price is required in the same details as that required for the Bidder's price. The estimated price for subcontracts should include all direct charges and travel & living expenses which would be to the account of the subcontractor.

Subcontract 1		Name of the subcontractor :	
Items	Description	Firm unit price	Total estimated hours or total estimated quantity
1. Labour			
2. Equipment			
3. Rentals			
4. Materials and supplies			
5. Travel and living			
6. Other direct charges			
Total amount for subcontract 1 :			

Subcontract 2		Name of the subcontractor :	
Items	Description	Firm unit price	Total estimated hours or total estimated quantity
1. Labour			
2. Equipment			
3. Rentals			
4. Materials and supplies			
5. Travel and living			
6. Other direct charges			
Total amount for subcontract 2 :			

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TOTAL ESTIMATED SUBCONTRACTS: \$ \_\_\_\_\_

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6. TRAVEL & LIVING: at actual cost without markup but not to exceed the limits of the Treasury Board Travel Directive. With respect to the TB Travel Directive, only the meal, private vehicle and incidental allowances specified in Appendices B, C and D of the TB Travel Directive <http://www.tbs-sct.gc.ca/hr-rh/gtla-vgcl/> and the other provisions of the directive referring to "travellers" rather than those referring to "employees", are applicable. **Details are to be provided on a separate sheet.**

TOTAL ESTIMATED TRAVEL & LIVING: \$ \_\_\_\_\_

7. OTHER DIRECT CHARGES : at actual cost without markup

Description	Price
(a)	
(b)	
(c)	

TOTAL ESTIMATED OTHER DIRECT CHARGES: \$ \_\_\_\_\_

**TOTAL ESTIMATED COST TO A LIMITATION OF EXPENDITURE: \$ \_\_\_\_\_  
(GST/HST extra)**

## ATTACHMENT 2

### POINT RATED TECHNICAL CRITERIA

#### 1. Point Rated Technical Criteria

Description of the criteria	Max. score	Min. score
<b>1. Merit of the technical proposal</b>	<b>29</b>	<b>14</b>
<p><i>1.1 Degree of understanding of context, objectives and scope of work</i></p> <p>The bidder should demonstrate their understanding of project context, objectives and scope in a clear and concise manner (2 pages or less).</p>	5	
<p><i>1.2 Risk Identification</i></p> <p>The bidder should identify project risks, clearly demonstrating an understanding of these risks and presenting a plan to reduce the relevant risks.</p>	5	
<p><i>1.3 Strategy and methodology proposed to achieve objectives and realism of activities</i></p> <p>The bidder should clearly describe the strategy and the methodology it intends to adopt and follow in order to meet the technical specifications of the project. The technical strategy proposed should be consistent with the requirements of the project and should demonstrate a level of realism to conduct the tasks. The bidder should provide enough details to describe its proposed strategy and methodology for each of the tasks of the project.</p>	5	

Description of the criteria	Max. score	Min. score
<p><i>1.4 Proposed innovations and improvements</i></p> <p>The bidder will be evaluated on the quality and the innovations of its proposed solution in accordance with the following topics :</p> <p>a. Originality of proposed concepts and systems of robust stabilization for miniature unmanned rotorcraft and sling load.</p> <p>b. Originality of proposed concepts and systems of teaming autonomous air lift</p> <p>c. Pertinence of proposed concepts and systems is placed into context with respect to other research works.</p> <p>d. Exploitation of information fusion, onboard sensing information, robust control, adaptive control, supervisory control or finite state machine</p> <p>e. Real-time and integration issues pointed out and at least one feasible solution is proposed.</p>	10	
<p><i>1.5 Clarity and accuracy of the data provided</i></p> <p>The bidder will be evaluated based on the clarity (ease of understanding), the completeness and the veracity of the proposal, and the accuracy of the data provided.</p>	4	
<p><b>2. Merit of the management proposal</b></p>	<b>12</b>	<b>4</b>
<p><i>2.1 Project control methods and techniques (quality assurance process)</i></p> <p>The Bidder should describe how it proposes to control the management of the project, in particular quality assurance process and proposed methodology. The bidder should describe the project management methodology and tools.</p>	3	
<p><i>2.2 Conformity and realism of the work schedule</i></p> <p>The Bidder should include a list of specific tasks and deliverables and the proposed schedule for completion or delivery. Also, the bidder should present a calendar and a manpower loading.</p>	5	
<p><i>2.3 Management and availability of personnel</i></p> <p>The Bidder should describe the assignment of work pertaining to management of the contract/project, concept/system design, and experimental/implementation work. Also, the Bidder should provide a means to substitute personnel, if needed.</p>	4	

Description of the criteria	Evaluation scale	Max. score	Min. score
<b>3. Experience of personnel assigned to the project</b>			
The bidder will be evaluated based on the CVs of the personnel assigned to the project.			
Each CV should provide enough information to help the evaluation team to evaluate the proposal. This means that the CVs should describe each <u>professional experience, publication and training</u> related to the criteria, which pertains mostly to the following information:			
<ul style="list-style-type: none"> <li>a. the topic,</li> <li>b. the context,</li> <li>c. the objectives,</li> <li>d. the scope,</li> <li>e. the software tools involved,</li> <li>f. the project periods (months and year),</li> <li>g. the exact dates of the involvement of the proposed resources,</li> <li>h. the tasks performed by the proposed resources, and/or</li> <li>i. the level of involvement of the resources in the project.</li> </ul>			
<i>3.1 Academic background of the personnel assigned to the project.</i>		<b>7</b>	
a. PhD training in any of those disciplines: control, aerospace or aeronautics, mathematics and optimization, electrical engineering, mobile robotics, mechatronics, mechanical engineering.	<p><b>5 points</b> – Two or more resources assigned to the project have a PhD training in one or more of the disciplines listed in this criterion.</p> <p><b>1 point</b> – Only one resource assigned to the project has a PhD training in one or more of the disciplines listed in this criterion.</p> <p><b>0 point</b> – There is no PhD holder in one of the disciplines listed in this criterion.</p>	<b>5</b>	
b. Master's degree in any of those disciplines: control, aerospace or aeronautics, mathematics and optimization, electrical engineering, mobile robotics, mechatronics, mechanical engineering.	<p><b>2 points</b> – Two or more resources assigned to the project have a Master's degree in one or more of the disciplines listed in this criterion.</p> <p><b>1 point</b> – Only one resource assigned to the project has a Master's degree in one or more disciplines listed in this criterion.</p> <p><b>0 point</b> – There is no Master's degree holder in one of the disciplines listed in this criterion.</p>	<b>2</b>	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p>3.2 <i>Experience of the personnel assigned to the project in internships in control of aircraft and/or rotorcraft and/or mobile robots, contract or consulting work for aerospace and defense sectors, active research in the area of control, teaching in the area of control, and graduate studies in control of aircraft (manned and/or unmanned) and/or rotorcraft and/or mobile robots.</i></p> <p>The global mark given to the bidder will be based on the TOTAL months of experience of all personnel involved at a minimum of 20% of a full-time work schedule.</p>	<p><b>4 points</b> – The resources assigned to the project have a total of 120 months or more of experience in one or more disciplines listed in this criterion.</p> <p><b>1 point</b> – The resources assigned to the project have 60 to 119 months of experience in one or more disciplines listed in this criterion.</p> <p><b>0 point</b> - The resources assigned to the project have fewer than 60 months of experience in one or more disciplines listed in this criterion.</p>	4	
<p>3.3 <i>Experience of the personnel assigned to the project in R&amp;D projects involving design and delivery of algorithms, software, real-time models and simulators, and embedded control electronics in the context of unmanned vehicles and/or mobile robots (delivery of <u>real-time workshop compliant and Quarc-compliant Simulink models of guidance, navigation and control algorithms for unmanned aircraft/ground vehicles</u>)</i></p>	<p><b>4 points</b> – <u>At least one of the resources</u> assigned to the project having a minimum of 20% involvement has experience in R&amp;D projects involving design and delivery of algorithms, software, real-time models and simulators, and embedded control electronics in the context of unmanned vehicles and/or mobile robots. The resource has delivered <u>real-time workshop compliant and Quarc-compliant Simulink models of guidance, navigation and control algorithms for unmanned aircraft/ground vehicles.</u></p> <p><b>2 points</b> - <u>At least one of the resources</u> assigned to the project having a minimum of 20% involvement has experience in R&amp;D projects involving design and delivery of algorithms, software, real-time models and simulators, and embedded control electronics in the context of unmanned vehicles and/or mobile robots. The resource has delivered <u>real-time workshop compliant Simulink models of guidance, navigation and control algorithms for unmanned aircraft/ground vehicles, but not Quarc-compliant Simulink models.</u></p> <p><b>0 point</b> – Any other situations.</p>	4	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p>3.4 <i>Experience of the personnel assigned to the project in team projects involving academia, industry and government.</i></p>	<p><b>1 point</b> – At least one of the resources assigned to the project having a minimum of 20% involvement has already participated in a team project involving academia, industry and government.</p> <p><b>0 point</b> – Any other situations.</p>	1	
<p>3.5 <i>Experience of the personnel assigned to the project in the publication/authorship of recognized peer-reviewed scientific journals and books from 2002 to 2011 in the control-related areas of interest, i.e. in aircraft/rotorcraft/mobile robot guidance, navigation and control, in adaptive control, in nonlinear control, in estimation, in information fusion, in cooperative control, in robotics, in control theory, in control practice, in networked control systems, in vibration control, in finite-state machines, in control of inverted pendulum, or in fault-tolerant control.</i></p> <p>The global mark given to the bidder will be based on the TOTAL number of publications of all personnel involved at a minimum of 20% of a full-time work schedule.</p>	<p><b>7 points</b> – The personnel assigned to the project has published/authored/co-authored <b>in total:</b></p> <ul style="list-style-type: none"> <li>- 10 or more <u>peer-reviewed journal articles and/or book chapters, and</u></li> <li>- A minimum of 2 edited/co-edited or authored/co-authored <u>books.</u></li> </ul> <p><b>5 points</b> – The personnel assigned to the project has published/authored/co-authored <b>in total:</b></p> <ul style="list-style-type: none"> <li>- at least 8 <u>peer-reviewed journal articles and/or book chapters, and</u></li> <li>- a minimum of 1 edited/co-edited or authored/co-authored <u>books.</u></li> </ul> <p><b>2 points</b> – The personnel assigned to the project has published/authored/co-authored:</p> <ul style="list-style-type: none"> <li>- at least 5 <u>peer-reviewed journal articles and/or book chapters and/or books.</u></li> </ul> <p><b>0 points</b> – otherwise.</p>	7	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p><i>3.6 Experience of the personnel assigned to the project with commercial-off-the-shelf rapid control prototyping environment/software for guidance, navigation and control using:</i></p> <p>(1) Matlab (2) Simulink, (3) Real-time Workshop, (4) Quarc.</p> <p>The mark given to the bidder will be based on having at least one member of personnel involved at a minimum of 20% of a full-time work schedule.</p>	<p><b>4 points</b> – At least one of the resources assigned to the project having a minimum of 20% involvement has been involved in at least one project of value greater than or equal to 150K\$ using commercial-off-the shelf rapid control prototyping environment/software for guidance, navigation and control using (1) Matlab, (2) Simulink, (3) Real-time Workshop, <u>and</u> (4) Quarc.</p> <p><b>2 points</b> – At least one of the resources assigned to the project having a minimum of 20% involvement has been involved in at least one project of value greater than or equal to 150K\$ using commercial-off-the shelf rapid control prototyping environment/software for guidance, navigation and control using a maximum of two of the following: (1) Matlab, (2) Simulink, (3) Real-time Workshop, <u>and</u> (4) Quarc.</p> <p><b>0 points</b> – otherwise.</p>	4	
<p><b>4.0 Experience of the proposed resources with regards to Tasks 2 to 5</b></p> <p>The same resource can be proposed for more than one criterion and more than one resource can be proposed for a given criterion. If more than one resource is proposed for the same criterion, each one will be evaluated individually and the final score for this criterion will be obtained by means of an average.</p> <p>The bidder will be evaluated based on the CVs of the personnel assigned to the specific criteria, and whose involvement in a Task is at least 20% of a full-time work schedule.</p> <p>Each CV should provide enough information to help the evaluation team to evaluate the proposal. This means that the CVs should describe each <u>professional experience, publication and training</u> related to the criteria, which pertains mostly to the following information :</p> <ol style="list-style-type: none"> <li>a. the topic,</li> <li>b. the context,</li> <li>c. the objectives,</li> <li>d. the scope,</li> <li>e. the software tools involved,</li> <li>f. the project periods (months and year),</li> <li>g. the exact dates of the involvement of the proposed resources,</li> <li>h. the tasks performed by the proposed resources, and/or</li> <li>i. the level of involvement of the resources in the project.</li> </ol>		36	8

Description of the criteria	Evaluation scale	Max. score	Min. score
<p>4.1 Experience of the resource(s) who will be responsible for Task 2 in robust stabilization and feedback control.</p>	<p>a. <b>3 points</b> - Delivery as author/co-author of <b>real-time workshop compliant Simulink models</b> to clients or as part of graduate work (evidence being author/co-author of <u>at least one</u> report or memorandum or thesis or article or book chapter or book or contractor report containing one or more models).</p> <p><b>0 point</b> - otherwise</p>	3	
	<p>b. <b>2 points</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book or contractor report in the area of <b>robust control or in adaptive control or in optimal control or in fault-tolerant control or in nonlinear control or in vibration control of a dynamic system.</b></p> <p><b>0 point</b> - otherwise</p>	2	
	<p>c. <b>2 points</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book or contractor report in the area of <b>unmanned vehicle guidance, navigation or control.</b></p> <p><b>0 point</b> - otherwise</p>	2	
	<p>d. <b>3 points</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book or contractor report in the area of <b>optimization algorithms applied to unmanned vehicles.</b></p> <p><b>0 point</b> - otherwise</p>	3	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p>4.2 Experience of the resource(s) who will be responsible for Tasks 3 and 4 in individual unmanned vehicle control, guidance and navigation, and in exploitation of sensor information.</p>	<p>a. <b>2 points</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book or contractor report in the area of <b>trajectory generation or guidance laws or navigation or path following or trajectory tracking</b>.</p> <p><b>0 point</b> - otherwise</p>	2	
	<p>b. <b>3 points</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book or contractor report in the area of <b>fault-tolerant control systems or health management for air vehicles (rotorcraft or aircraft)</b>.</p> <p><b>0 point</b> - otherwise</p>	3	
	<p>c. <b>5 points</b> – Experience <b>in-progress or completed</b> thesis work at the Master's or PhD level at a recognized university within the last 10 years either in <b>sonar navigation</b> for unmanned vehicles or in <b>vision-based guidance, navigation and control</b> for unmanned vehicles or in <b>exploitation of sensor information</b> for unmanned vehicles, or in <b>state estimation/filtering</b>.</p> <p><b>0 point</b> - otherwise</p>	5	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p>4.3 <i>Experience of the resource(s) who will be responsible for Tasks 2 and 4 in cooperative control, guidance and navigation for a small team of networked unmanned vehicles.</i></p>	<p>a. <b>3 points</b> - Experience in the <b>design or analysis or test of a formation control system of unmanned vehicles or mobile robots</b> (evidence being author/co-author of <u>at least one</u> report or memorandum or thesis or article or book chapter or book).</p> <p><b>0 point</b> - otherwise</p>	3	
	<p>b. <b>3 points</b> - Experience in <b>networked control systems</b> design or analysis (evidence being author/co-author of <u>at least one</u> report or memorandum or thesis or article or book chapter or book).</p> <p><b>0 point</b> - otherwise</p>	3	
	<p>c. <b>1 point</b> - Delivery as author/co-author of <u>at least one</u> report or memorandum or thesis or journal article or book chapter or book in the area of <b>optimization principles applied to a network of unmanned vehicles</b>.</p> <p><b>0 point</b> - otherwise</p>	1	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p><i>4.4 Experience of the resource(s) who will be responsible for Task 5 pertaining to indoor flight experiments and systems integration.</i></p> <p>The bidder will be evaluated based on the CVs of the personnel assigned to the specific criteria, and whose involvement in Task 5 is at least 20% of a full-time work schedule. Types of valid experience with indoor flight experiments include: graduate work at university, contractual work for a government laboratory, or practical private company work.</p>	<p><b>7 points</b> - Experience in setting up a multi-vehicle control laboratory within the last 10 years, and using <b>all</b> of the following :</p> <ul style="list-style-type: none"> <li>- Simulink</li> <li>- Matlab</li> <li>- Real-time workshop</li> <li>- Quarc</li> <li>- RT-Lab</li> <li>- Commercial wheeled robots and/or rotorcraft drones</li> <li>- Wi-Fi communications.</li> </ul> <p><b>4 points</b> - Experience in setting up a multi-vehicle control laboratory within the last 10 years, and using <b>a maximum of 6</b> of the following :</p> <ul style="list-style-type: none"> <li>- Simulink</li> <li>- Matlab</li> <li>- Real-time workshop</li> <li>- Quarc</li> <li>- RT-Lab</li> <li>- Commercial wheeled robots and/or rotorcraft drones</li> <li>- Wi-Fi communications.</li> </ul> <p><b>2 points</b> - Experience in setting up a multi-vehicle control laboratory within the last 10 years, and using <b>a maximum of 4</b> of the following :</p> <ul style="list-style-type: none"> <li>- Simulink</li> <li>- Matlab</li> <li>- Real-time workshop</li> <li>- Quarc</li> <li>- RT-Lab</li> <li>- Commercial wheeled robots and/or rotorcraft drones</li> <li>- Wi-Fi communications.</li> </ul> <p><b>0 point</b> - otherwise</p>	7	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p><i>4.5 Experience of the project manager in the supervision of R&amp;D projects involving guidance, navigation and control concepts/systems for unmanned aircraft.</i></p>	<p><b>2 points</b> – The project manager has more than 36 months of experience in the supervision of R&amp;D projects involving guidance, navigation and control concepts/systems for unmanned aircraft.</p> <p><b>1 point</b> - The project manager has between 12 and 35 months of experience in the supervision of R&amp;D projects involving guidance, navigation and control concepts/systems for unmanned aircraft.</p> <p><b>0 point</b> - The project manager has fewer than 12 months of experience in the supervision of R&amp;D projects involving guidance, navigation and control concepts/systems for unmanned aircraft.</p>	2	
<b>5. Experience of the compagny</b>		<b>15</b>	<b>5</b>
<p><i>5.1 Previous experience of the company in defence R &amp; D projects with value over 100K\$.</i></p>	<p><b>5 points</b> – The company has been involved in 2 or more projects in defence R&amp;D with value over 100K\$.</p> <p><b>2 points</b> – The company has been involved in 1 project in defence R&amp;D with value over 100K\$.</p> <p><b>0 point</b> - The company has never been involved in project in defence R&amp;D with value over 100K\$.</p>	5	

Description of the criteria	Evaluation scale	Max. score	Min. score
<p><i>5.2 Previous experience of the company in multi-year project (2 years or more) in cooperative UAV guidance, navigation and control.</i></p>	<p><b>10 points</b> – The company has been involved in at least one multi-year project in cooperative UAV guidance, navigation and control.</p> <p><b>5 points</b> – The company has not been involved in at least one multi-year project in cooperative UAV guidance, navigation and control, but has been involved in at least one single UAV guidance, navigation, and control project.</p> <p><b>3 points</b> – The company has not been involved in at least one multi-year project in cooperative or individual UAV guidance, navigation and control, but has been involved in at least one mobile robot guidance, navigation, and control project.</p> <p><b>0 point</b> – otherwise.</p>	10	
<b>Total</b>	<b>119</b>	<b>55</b>	

## ATTACHMENT 3

### CERTIFICATIONS PRECEDENT TO CONTRACT AWARD

#### 1. Federal Contractors Program for Employment Equity - Certification

##### 1.1 Federal Contractors Program - \$200,000 or more

1. The Federal Contractors Program (FCP) requires that some suppliers, including a supplier who is a member of a joint venture, bidding for federal government contracts, valued at \$200,000 or more (including all applicable taxes), make a formal commitment to implement employment equity. This is a condition precedent to contract award. If the Bidder, or, if the Bidder is a joint venture and if any member of the joint venture, is subject to the FCP, evidence of its commitment must be provided before the award of the Contract.

Suppliers who have been declared ineligible contractors by Human Resources and Skills Development Canada (HRSDC) are no longer eligible to receive government contracts over the threshold for solicitation of bids as set out in the *Government Contracts Regulations*. Suppliers may be declared ineligible contractors either as a result of a finding of non-compliance by HRSDC, or following their voluntary withdrawal from the FCP for a reason other than the reduction of their workforce to less than 100 employees. Any bids from ineligible contractors, including a bid from a joint venture that has a member who is an ineligible contractor, will be declared non-responsive.

2. If the Bidder does not fall within the exceptions enumerated in 3.(a) or (b) below, or does not have a valid certificate number confirming its adherence to the FCP, the Bidder must fax (819-953-8768) a copy of the signed form LAB 1168, Certificate of Commitment to Implement Employment Equity, to the Labour Branch of HRSDC.
3. The Bidder, or, if the Bidder is a joint venture the member of the joint venture, certifies its status with the FCP, as follows:

The Bidder or the member of the joint venture

- (a)  is not subject to the FCP, having a workforce of less than 100 full-time or part-time permanent employees, and/or temporary employees having worked 12 weeks or more in Canada;
- (b)  is not subject to the FCP, being a regulated employer under the *Employment Equity, Act*, S.C. 1995, c. 44;
- (c)  is subject to the requirements of the FCP, having a workforce of 100 or more full-time or part-time permanent employees, and/or temporary employees having worked 12 weeks or more in Canada, but has not previously obtained a certificate number from HRSDC (having not bid on requirements of \$200,000 or more), in which case a duly signed certificate of commitment is attached;
- (d)  is subject to the FCP, and has a valid certificate number as follows: \_\_\_\_\_ (e.g. has not been declared an ineligible contractor by HRSDC.)

Further information on the FCP is available on the HRSDC Web site

(<http://www.hrsdc.gc.ca/eng/labour/equality/fcp/index.shtml>).

## 2. Former Public Servant Certification

Contracts with former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts with FPS, bidders must provide the information required below.

### Definitions

For the purposes of this clause,

"former public servant" is any former member of a department as defined in the *Financial Administration Act*, R.S., 1985, c. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

- (a) an individual;
- (b) an individual who has incorporated;
- (c) a partnership made of former public servants; or
- (d) a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means, in the context of the fee abatement formula, a pension or annual allowance paid under the *Public Service Superannuation Act* (PSSA), R.S., 1985, c. P-36, and any increases paid pursuant to the *Supplementary Retirement Benefits Act*, R.S., 1985, c. S-24 as it affects the PSSA. It does not include pensions payable pursuant to the *Canadian Forces Superannuation Act*, R.S., 1985, c. C-17, the *Defence Services Pension Continuation Act*, 1970, c. D-3, the *Royal Canadian Mounted Police Pension Continuation Act*, 1970, c. R-10, and the *Royal Canadian Mounted Police Superannuation Act*, R.S., 1985, c. R-11, the *Members of Parliament Retiring Allowances Act*, R.S., 1985, c. M-5, and that portion of pension payable to the *Canada Pension Plan Act*, R.S., 1985, c. C-8.

### Former Public Servant in Receipt of a Pension

Is the Bidder a FPS in receipt of a pension as defined above? **YES ( ) NO ( )**

If so, the Bidder must provide the following information:

- (a) name of former public servant;
- (b) date of termination of employment or retirement from the Public Service.

## Work Force Reduction Program

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of a work force reduction program? **YES ( ) NO ( )**

If so, the Bidder must provide the following information:

- (a) name of former public servant;
- (b) conditions of the lump sum payment incentive;
- (c) date of termination of employment;
- (d) amount of lump sum payment;
- (e) rate of pay on which lump sum payment is based;
- (f) period of lump sum payment including start date, end date and number of weeks;
- (g) number and amount (professional fees) of other contracts subject to the restrictions of a work force reduction program.

For all contracts awarded during the lump sum payment period, the total amount of fees that may be paid to a FPS who received a lump sum payment is \$5,000, including the Goods and Services Tax or Harmonized Sales Tax.

## Certification

By submitting a bid, the Bidder certifies that the information submitted by the Bidder in response to the above requirements is accurate and complete.

### 3. Canadian Content Certification

This procurement is limited to Canadian services.

The Bidder certifies that:

- ( ) the services offered are a Canadian service as defined in paragraph 2 of clause **A3050T**.

#### 3.1 SACC Manual clause A3050T (2010-01-11), Canadian Content Definition

### 4. Status and Availability of Resources

The Bidder certifies that, should it be awarded a contract as a result of the bid solicitation, every individual proposed in its bid will be available to perform the Work as required by Canada's representatives and at the time specified in the bid solicitation or agreed to with Canada's representatives. If for reasons beyond its control, the Bidder is unable to provide the services of an individual named in its bid, the Bidder may propose a substitute with similar qualifications and experience. The Bidder must advise the Contracting Authority of the reason for the substitution and provide the name, qualifications and experience of the proposed replacement. For the purposes of this clause, only the following reasons will be considered as beyond the control of the Bidder: death, sickness, maternity and parental leave, retirement, resignation, dismissal for cause or termination of an agreement for default.

If the Bidder has proposed any individual who is not an employee of the Bidder, the Bidder certifies that it has the permission from that individual to propose his/her services in relation to the Work to be performed and to submit his/her résumé to Canada. The Bidder must, upon request from the Contracting Authority, provide a written confirmation, signed by the individual, of the permission given to the Bidder

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and of his/her availability. Failure to comply with the request may result in the bid being declared non-responsive.

## **5. Education and Experience**

The Bidder certifies that all the information provided in the résumés and supporting material submitted with its bid, particularly the information pertaining to education, achievements, experience and work history, has been verified by the Bidder to be true and accurate. Furthermore, the Bidder warrants that every individual proposed by the Bidder for the requirement is capable of performing the Work described in the resulting contract.

## **6. Language Capability**

The Bidder certifies that it has the language capability required to perform the Work, as stipulated in the Statement of Work.

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## ANNEX A

### STATEMENT OF WORK

#### 1. General

##### 1.1 Title

Study of Guidance, Navigation and Control Concepts for Autonomous Airlift

##### 1.2 Objective

The objectives of the work are to conduct an extensive study on the guidance, navigation and control (GNC) technologies for enabling autonomous airlift. The work should focus on GNC synthesis, analysis and validation to prove the concept of autonomous air lift (AAL) with multiple miniature unmanned air vehicles (MUAVs) of rotorcraft type.

##### 1.3 Background

The force multiplier provided by the deployment of groups or formations of unmanned-manned aerial vehicles flying in a coordinated manner, and with autonomous control of the platforms and load, has the potential to enable robust and agile heavy lift without the need for specific pilot skills nor the design of massive, heavy and complex aerial platforms. DRDC Valcartier has undertaken a project to advance the maturity of technologies that will enable this capability and to position itself to provide expert advice to Canadian Forces (CF) decision makers on emergent technology relating to autonomous networked aerial systems.

This new capability in autonomous multi-vehicle aerial lift would allow the burden on human operators (lessen requirements in skills and in number of operators, reduced exposure to risks, and reduced fatigue) and the requirements for a single unmanned platform to be relaxed. The capability developed will have the distinguishing feature of enabling the use of existing unmanned platforms for robust and precise heavy lift, without the need to buy or develop more expensive, complex and high-maintenance platforms. The use of multiple, coordinated unmanned aerial vehicles provides agility by means of a greater range of lift options, flight maneuvers, and load attitudes in addition to enabling improved fuel efficiency, especially when the full payload capability of a larger vehicle is not required.

Before loads are carried off the ground and are precisely delivered by means of one or more air platforms, a thorough investigation is required for reasons of safety, effectiveness, and cost. Designing a multi-vehicle heavy-lift system requires the acquisition of new knowledge in (1) multi-vehicle autonomous systems operating in adverse weather conditions and possibly under degraded conditions, (2) tether/sling load dynamics, (3) precision sling/payload positioning and capture, (4) coordinated multi-tethered air vehicles guidance and navigation, and (5) inter-vehicle aerodynamic coupling effects. This contract addresses the first four items. There is a need to contract work on the design and experimental fronts to help defence scientists advance their comprehension of autonomous air lift, and hence to better advise the CF.

## 1.4 Acronyms

6DOF: 6 Degrees of Freedom

AAL: Autonomous Air Lift

ALPS: ALV/Load Positioning Sensor

ALV: Autonomous Lift Vehicle

APLOGS: Automatic PayLoad monitoring and Grappling System

C2GNS: Coordinated Control, Guidance and Navigation System

CF: Canadian Forces

COTS: Commercial-Off-The-Shelf

DRDC: Defence Research and Development Canada

EO: Electro Optic

FSM: Finite State Machine

GNC: Guidance, Navigation, and Control

GPS: Global Positioning System

GSCA: Grappling Supervisory and Control Algorithm

IALE: Inter-ALV positioning for sling Load Equalization

I2EAR: DRDC Valcartier Indoor Integrated Environment for Autonomous multi-vehicle Research facility

IMU: Inertial Measurement Unit

MUR: Miniature Unmanned Rotorcraft

OS: Operating System

RCP: Rapid Control Prototyping

RF: Radio Frequency

RSRPS: Robust Stabilization and Relative Positioning System

RTW: Real-Time Workshop

## 2. SCOPE OF THE WORK

### 2.1 General

The contractor will provide services across Tasks 1 to 6, as outlined below. These tasks are firm, and some can be performed concurrently.

Tasks 2 to 4 pertain to the design of the GNC system for autonomous air lift (AAL). Experimental demonstration of the GNC system is done in Task 5. The design and the results obtained are documented in Task 6.

For Tasks 2 to 5, the contractor will adhere to a rapid control prototyping (RCP) process starting with the formulation of Simulink models and culminating with onboard electronics implementation and flight experiments: from Simulink blocks, to executable C-code on the Linux operating system (OS) on the digital hardware onboard autonomous lift vehicles, or ALVs, of MUR type. Furthermore, the systems designed and tested in Tasks 2 to 5 will

- rely on commercial-off-the-shelf (COTS) Matlab, Simulink, RTW, and Quarc environments for their design, tuning, implementation and real-time operation,
- be implemented in real-time on a Linux OS on the digital hardware onboard the MURs,
- be capable of on-the-fly re-tuning of their parameters during flight (through the ground station).

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The GNC system will be designed for AAL conducted with a single ALV and a formation of networked ALVs (with a minimum of three MURs). In the design, the contractor will exploit modern concepts and theories in systems, control, signal processing, information, and optimization, as described in Tasks 2 to 4; mainly, the system will rely on a finite state machine to manage the feedback control laws under several modes (nominal and degraded conditions, AAL modes such as take-off and landing, positioning of ALVs for load engage/disengage, and level flight) and on a hierarchical architecture. The GNC system will provide, at a minimum, the following functions:

- Single- and multiple-ALV coordinated control, guidance and navigation (C2GNS in Task 4),
- Robust stabilization and relative positioning for ALVs and sling load (RSRPS in Task 2),
- Grappling supervisor with precision ALV/load sensing for the engage/disengage phase (APLOGS in Task 3 and RSRPS in Task 2).

The contractor should provide support to DRDC Valcartier scientists for the use of tools, algorithms, software and hardware developed, used or bought during the course of the contract. The support to DRDC scientists is related to the tasks of the contract.

2.2 Firm Tasks 1 to 6 are described as follows.

### **Task 1: Scientific literature review**

#### **Task 1.1:**

To review open scientific literature and government reports from the year 2000 to present. From this review, identify (1) the control and systems theoretic techniques/theories used for platform and tethered payload motion control, guidance and navigation (list them, and refer to the main bibliographic items for each), (2) the features and limitations provided by the control and systems theoretic techniques/theories researched, (3) the measures of performance used to determine if the air lift of operation is successful (either in analysis, in simulations or in actual flight experiments), and (3) the pros/cons of using a single air vehicle versus the use of two to four vehicles collaborating in flight to achieve AAL. The pros/cons of single vehicle and multiple vehicles air lift must be corroborated with open scientific literature references.

#### **Task 1.2:**

To identify (1) the specific rotorcraft and airship type platforms used for air lift, (2) the benefits and limitations of air lift carried out with rotorcraft and airship type platforms, (3) the scenarios where these types of platforms have been deployed or are envisaged to be deployed, (4) the type/size/mass of loads for which they have been used, and (5) the devices and components used onboard those platforms for air lift (at a minimum, briefly describe the salient feature of the hook-up mechanisms employed, the type/number of tethers, the manner in which the tethers are hooked to the payload, and the sensors and actuators used for air lift).

All of these identified air lift characteristics must be corroborated with references to the open scientific literature.

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**Task 2: Robust stabilization and relative positioning system for AAL**

A two-tier feedback control system available onboard the MURs will (1) robustly stabilize each air vehicle with/without a single payload, and (2) provide load equalization or balancing among a formation of networked ALVs (in case of multi-MUR AAL).

The feedback control system will be designed for the following cases (1) single-MUR without sling load, (2) single-MUR with sling load, and (3) multi-MUR with sling load.

The contractor will adhere to the parameters of the I2EAR facility (DRDC Valcartier Indoor Integrated Environment for Autonomous multi-vehicle Research) so that the algorithmic concepts of the contractor seamlessly integrate with the components/systems found in the DRDC Valcartier I2EAR facility using RTW- and Quarc-compliant Simulink models.

**Task 2.1:**

To investigate through kinematic and dynamic analyses the performance of (1) a single ALV without load, and (2) a single ALV with a single sling load. The contractor will focus on the coupled open loop interactions between a single MUR and a sling load. The analysis will rely on a mathematical, rigid body approach that is compatible with Matlab, Simulink, RTW, and Quarc environments to permit integration with control development environments.

If the contractor chooses to acquire COTS MURs, it must be compatible with the parameters of the I2EAR facility using RTW- and Quarc-compliant Simulink models. The contractor may elect to use the existing MURs available on-site only at DRDC Valcartier. For this contract, a minimum of three MURs are required. The contractor must equip the MURs with a frame or structure enabling air lift of a sling load, with a number of tethers/slugs and a configuration of tethers pertaining to a single ALV and a formation of ALVs, following the results obtained in Task 1.

The contractor will develop a 6DOF RTW-compliant Simulink model of the MUR using appropriate parameter identification techniques, if required. The contractor will determine the limitations in the performance of the models and will suggest a way ahead. The lessons learned will be tabulated and motivations for multi-MUR modeling will be listed with reference to results obtained and limitations observed with a model for the single ALV with a single sling load.

Design, analysis and simulations of the model will be fully documented as part of the work by the contractor by means of a Word or LaTeX report.

**Task 2.2:**

The contractor will design an onboard robust stabilization and relative positioning system (RSRPS) from control and system theoretic principles, leveraging the model developed in Task 2.1. At the lowest level of the hierarchy (tier 1), RSRPS must locally stabilize the air vehicles and payload for stationary and flying modes. RSRPS will dampen load oscillations, vibrations and sway. At tier 2, RSRPS will provide load equalization or balancing in terms of relative ALV/load positions for all phases of AAL (load engage/disengage, with/without payload), and do so despite (1) uncertainties in the aerodynamics and disturbances affecting the platforms and payload and their control system, such as light wind conditions, and (2) changes in tether tension that may arise due to payload swing and motion of the other ALVs. The relative positions of the air vehicles and payload calculated by RSRPS must be such that sling load balancing, or equalization, is obtained.

RSRPS will exploit onboard sensor information (as provided by the system devised in Task 3), and inertial positioning from GPS compatible data of GPS satellites or pseudo-GPS data from the vision-based tracking system in the I2EAR facility.

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For the design of RSRPS, the contractor must explore paradigms and concepts in

- nonlinear and robust control,
- adaptive control,
- optimal control,
- discrete-event systems,
- cooperative control,
- optimization with uncertain information,
- finite state machines,
- robust formation control theory (leader-to-follower and leaderless),
- consensus-seeking techniques,
- artificial intelligence,
- fault-tolerant control (team, individual),
- estimation and filtering,
- nonlinear robust control,
- multilateration, and
- digital signal processing,

and apply those domains of research to the robust stabilization of MURs/load, and multi-MUR load equalization. The contractor will select the most appropriate paradigms and concepts based at a minimum on the following considerations: real-time operation, level of robustness and fault tolerance, level of integration with other subsystems and functions, and ease of integration on the DRDC Valcartier facility. The application of those domains by the contractor must be such as to ensure efficient and robust relative positioning of a formation of MURs. RSRPS will exploit the information obtained from the onboard ALV/load positioning sub-system, the onboard inter-ALV positioning sub-system, the 3-axis load monitoring sensor, the ALV inertial measurement units (IMUs) and the inertial positioning system (from APLOGS). The contractor will develop a hierarchical control architecture and will carry out integration of the various feedback loops.

Inter-ALV positioning for sling load equalization, or IALE, is a function done by RSRPS. IALE will embody design principles that are applicable to a full-scale IALE. The IALE function will have the following characteristics:

- provides repeatable relative position data for multiple ALV within specified tolerances,
- is functional in day/night and all weather conditions,
- does not rely on GPS data,
- is resistant to extraneous or superfluous random signals from environment, and
- is scalable to an arbitrary number of ALVs.

Once designed, the performances of RSRPS must be compared with those found in Task 1, as obtained from the scientific literature, and any discrepancy must be clearly identified and explained.

### **Task 2.3:**

To investigate analytically the performances obtained with the designed two-tier RSRPS, in closed-loop with the low-level systems, including the plant model developed in Task 2.1. The contractor will use mathematical models, systems and control theoretic principles, and the Simulink models developed in Tasks 2.1 and 2.2 to conduct the analysis. The contractor will focus on the motion of the MURs and the payload. The analysis will rely on a mathematical approach. The contractor will propose theorems, lemmas and proofs with respect to the expected performance of RSRPS, giving conditions of robust stability and quantifying closed-loop behavior of the ALVs and load by means of performance indicators. The contractor will determine the limitations in the performance of the single-MUR RSRPS for AAL, and multiple MUR RSRPS for AAL, and will suggest a way ahead. The lessons learned will be tabulated with reference to results obtained and limitations observed.

Design, analysis and tests on RSRPS will be fully documented as part of the work by the contractor by means of a Word or LaTeX report.

### **Task 3: Automatic payload monitoring and grappling system**

An automatic payload monitoring and grappling system (APLOGS) will supervise the load engaging/disengaging phases of flight, control the mechatronic device used for grappling, and monitor the load status (passing payload information to RSRPS). APLOGS will comprise:

- a 3-axis load monitoring sensor,
- a mechatronic grappling sub-system, and
- a supervisory control sub-system to supervise and control the load engage and disengage sequences, with precision ALV/load sensing for positioning integrated with RSRPS (done in Task 2.2).

The contractor will adhere to the parameters of the I2EAR facility so that the algorithmic concepts of the contractor seamlessly integrates with the components/systems found in the DRDC Valcartier I2EAR facility using RTW- and Quarc-compliant Simulink models.

#### **Task 3.1:**

To develop the grappling supervisory and control algorithm (GSCA). For the design, the contractor must explore paradigms and concepts in

- nonlinear and robust control,
- supervisory control,
- Kalman filters,
- fault detection,
- information fusion,
- image processing techniques,
- statistical predictive rendering,
- multiple sonar sensor-based GNC,
- vision-based guidance and navigation,
- feature extraction,
- optic flow,

and apply those domains of research to monitor and control the load engage/disengage sequences, for both single ALV/single sling load and multi-ALV/single sling load AAL. During the particular phase of load engagement, local precision maneuvering will be needed. RSRPS will command the grappling supervisory and control algorithm, and the option of carrying part of the real-time processing for precision positioning as an RSRPS function will be investigated by the contractor.

#### **Task 3.2:**

To develop a grappling concept that embodies mechatronic principles that are applicable to a full-scale grappling sub-system. The concept should have the following characteristics

- be electrically activated through GSCA,
- be mechanically simple and robust,
- provide positive engagement and disengagement with the load,
- permit engagement of the load attachment within the specified capture volume,
- provide feedback signals to GSCA/RSRPS of successful load engagement or disengagement, and status (nominal or degraded) pertaining to components/devices.

**Task 3.3:**

To develop a 3-axis load monitoring sensor that embodies design principles that are applicable to a full-scale sensor. The sensor will generate data for GSCA/RSRPS, at an update rate compliant with that used for the operation of GSCA/RSRPS, and will have the following characteristics :

- be mechanically simple and robust,
- provide linear and repeatable response of load magnitude and direction in 3-axes corresponding to the North-East-Down coordinate system,
- provide electrically compatible signals with the MUR avionics running the GSCA,
- be able to support the design load at the airframe/sensor body interface with a factor of safety of 2.0,
- be able to support the design load at the sensor element/sling attachment interface with a factor of safety of 1.1 before breaking away,
- provide an sling attachment ring to enable a moment-free connection with the sling.

**Task 3.4:**

To develop a ALV/load positioning sensor (ALPS) concept that embodies design principles that are applicable to a full-scale ALPS sub-system. The contractor will acquire commercial sensors for integration with the ALV, if not already available. For the design of the ALPS, and its integration with GSCA/RSRPS, the contractor must explore paradigms and concepts in

- machine vision,
- echolocation with sonar arrays,
- multilateration,
- sensor arrays,
- digital signal processing, and
- EO or RF beacons.

ALPS will have the following characteristics:

- provides repeatable position data for the grapple and load attachment point within specified tolerances,
- does not rely on GPS data,
- is resistant to extraneous or superfluous random signals from environment,
- provides a feedback signal to GSCA/RSRPS when the grapple and load attachment are within the specified capture volume, for digital processing purposes, and
- provides electrically compatible signals with the ALV avionics running GSCA/RSRPS.

Design, analysis and simulations of the GSCA-ALPS-RSRPS functions will be fully documented as part of the work by the contractor by means of a Word or LaTeX report.

#### **Task 4: Coordinated control, guidance and navigation for autonomous air lift**

A coordinated control, guidance and navigation system (C2GNS) will be designed. C2GNS, which sits at the highest level of the GNC system hierarchy, will coordinate the various control laws for the full panoply of AAL modes, by means of a finite state machine, and will guide and navigate the single ALV and the formation of networked ALVs by means of individual vehicle and teaming vehicle systems and control concepts.

The contractor will adhere to the parameters of the I2EAR facility so that the algorithmic concepts of the contractor seamlessly integrate with the components/systems found in the DRDC Valcartier I2EAR facility using RTW- and Quarc-compliant Simulink models.

##### **Task 4.1:**

To design a finite state machine (FSM), as part of C2GNS, to coordinate the various control laws and modes of operation for (1) single-MUR without sling load, (2) single-MUR with sling load, and (3) networked multi-MUR with sling load (a minimum of three MURs is required for multi-ALV AAL). FSM will dynamically determine the current mode of operation characterizing AAL, for both nominal and degraded conditions, and will command appropriate RSRPS parameters and functions. For its operation, FSM will exploit some of the lower level information pertaining to the states of the vehicles, the RSRPS and GSCA systems, the grappling and tether components, and the payload.

The GNC system will be designed by the contractor to operate under nominal and degraded conditions. The nominal condition occurs when all systems and components are operating as expected. Degraded conditions indicate the occurrence of any of the following events, and combinations thereof:

- ALV platform and payload perturbations,
- failure of at least one ALV motor, in the case of a multi-motor ALV,
- loss of 10% and 50% effectiveness in at least one ALV motor, in the case of a multi-motor ALV,
- simulated wind effects,
- loss of onboard sensor information,
- inoperable grapple mechanism,
- loss of effectiveness in grapple mechanism (if more than one anchor point, then failure of one anchor),
- break of at least one sling,
- a collision,
- sudden load drop,
- sudden occurrence of payload oscillations and vibrations, and
- fault, failure, or damage to the ALV platforms, the onboard sensors, the onboard actuators, the communication network, or the tethers.

The modes handled by FSM will include (but are not limited to): take-off, landing, nominal/degraded conditions, forward flight, maneuvering, load engage, load disengage, hovering, approach to load, return to base, on-the-fly commander command, and precision maneuvering. The contractor will design a FSM that commands the guidance and navigation of an individual ALV and a formation of ALVs for AAL (done in Task 4.2).

The contractor will ensure distributed implementation of the GNC system onboard the networked MURs.

**Task 4.2:**

To design the guidance and navigation system for an individual ALV and a formation of ALVs for AAL, as part of C2GNS. C2GNS will be integrated by the contractor with APLOGS and RSRPS. The integration will be done as RTW- and Quarc-compliant Simulink models.

The guidance and navigation system will steer the ALVs (as a single entity and as a 3-vehicle formation as a minimum requirement) by commanding the lower level functions of the GNC system such that the ALVs and payload move to the destination along trajectories that minimize fuel expenditure, and payload vibrations and oscillations. C2GNS will ensure a safe separation among vehicles and collision avoidance, using feedback from onboard sensors and the vision-based tracking system available in the I2EAR facility. The contractor will develop a guidance and navigation system for an individual ALV and a formation of ALVs from the following domains:

- minimum-time and minimum-fuel optimal trajectory generation concepts,
- robust tracking and following paradigms, and
- vibration-reduction techniques,
- robust formation control and morphing concepts,

for implementation within the components/systems found in the DRDC Valcartier I2EAR facility using RTW- and Quarc-compliant Simulink models.

## Concepts of

- waypoint navigation,
- optimal trajectory generation for single ALV and ALV formations,
- optimization under uncertainty for formation flying ALVs,
- supervisory control,
- heuristics for real-time operation,
- fault-tolerant control, and
- control system adaptation under significant changes in dynamics

will be investigated by the contractor for the design of C2GNS.

**Task 4.3:**

The contractor will integrate the various functions/sub-systems/components of the GNC system from the designs carried out in Tasks 2.2, 3, 4.1, and 4.2. The contractor will follow a hierarchical architecture for the integration. The contractor will test the operation of the various components using baseline case studies. The contractor will document the results obtained.

**Task 4.4:**

To prove mathematically by means of theorems, lemmas and proofs the robustness (to wind, uncertainties, and degraded conditions and various modes as detailed in Task 4.1) and the stability of a single ALV and a multi-ALV formation for AAL, and to predict mathematically the performance of the AAL for the overall hierarchical system in terms of the following measures of performance (to a minimum):

- energy consumption,
- load delivery time,
- commanded versus actual flight paths,
- presence of collisions,
- detection of positive load engagement or disengagement,
- monitoring of sling/actuator faults and sensor anomalies,
- and individual/team actions to compensate for the degraded conditions.

To investigate analytically the performances obtained for flights under nominal operation and degraded conditions. Nominal operation and degraded conditions are defined in Task 4.1.

Furthermore, analysis of cases where engaging the load is difficult due to the inability to locate the load, or the inappropriate positioning of the load and load attachment will be studied and handled by the overall GNC system. The contractor will determine the extent to which multi-ALV AAL has answered the limitations found with single-ALV AAL, and will suggest a way ahead in the final report.

Design and mathematical analysis of the C2GNS will be fully documented as part of the work by the contractor by means of a Word or LaTeX report.

### **Task 5: Demonstration of autonomous airlift at the DRDC Valcartier I2EAR facility**

#### **Task 5.1:**

The single ALV with a single load in closed-loop with the C2GNS, APLOGS and RSRPS concepts must be validated by the contractor by means of experiments. The ALV platform, which will be a MUR under closed-loop control, must be capable of

- lifting a payload of minimum 150g, which is attached via at least a single sling or tether (of adjustable length) to the rotorcraft frame, at an altitude of a minimum of 2 meters,
- taking the payload to a static ground target destination which is at least 3 meters away from the original payload ground location,
- flying at a minimum speed of 0.5 m/s with and without payload,
- sustaining flight for a minimum of 10 minutes with and without payload, and
- robustly maintaining pre-programmed hover and tracking curvilinear trajectories in 3D, with and without payload, and minimizing payload oscillations/sway for various masses of payload (1/2, 1/3 and full payload mass), while enabling decay of the oscillations/vibrations over time in near-optimal fashion.

The autonomous airlift concept employing a single MUR must enable stabilized

- (1) approach maneuver to pre-selected/calculated waypoint locations, hover, automatic load engagement, transition to forward flight, and pre-selected drop-off locations, and
- (2) hover at pre-selected drop-off locations, automatic load disengagement, and transition to forward flight back to home location.

The contractor will validate the effectiveness of C2GNS-APLOGS-RSRPS for single ALV and single sling load by means of indoor flight experiments with the following scenarios at a minimum:

- Pre-programmed payload location and drop-off destination,
- Pre-programmed payload location and drop-off destination and one of the degraded conditions from the list provided in Task 4.1,
- Pre-programmed payload location and drop-off destination, and test of a sequence of events containing a minimum of two degraded conditions from the list described in Task 4.1,
- No pre-programmed payload location and drop-off location, but instead (1) high-level command from ground station stating the drop-off destination during MUR flight (on-the-fly assignment), and (2) tests without degraded conditions (nominal condition), and tests with a single degraded condition and a sequence of a minimum of two degraded conditions from the list given in Task 4.1.

The contractor will determine quantitatively:

- the extent of the robustness of C2GNS-APLOGS-RSRPS with and without payload, and during transitions,
- the efficiency of FSM to handle the various modes stated in Task 4.1,
- the extent of the oscillations/vibrations of the payload for specific flight paths,
- the settling time, and amplitude of error between commanded flight trajectory and actual flight trajectory,
- and will collect information on the performance obtained with the proposed C2GNS-APLOGS-RSRPS when faced with the degraded conditions of Task 4.1, and when transiting from one mode to another; that is, the contractor will investigate ALV and payload motion during mode changes.

### Task 5.2:

A multi-ALV rotorcraft team carrying a single sling load in closed-loop with the C2GNS, APLOGS and RSRPS concepts must be validated by the contractor. A minimum of 3 MURs in closed-loop with the GNC system must be capable of

- lifting a payload of minimum 450g, which is attached via at least a single sling or tether (of adjustable length) to each rotorcraft frame, at an altitude of a minimum of 2 meters,
- taking the payload to a static ground target destination which is at least 3 meters away from the original payload ground location,
- flying at a minimum speed of 0.5 m/s with and without payload,
- sustaining flight for a minimum of 10 minutes with and without payload, and
- robustly maintaining pre-programmed hover and tracking curvilinear trajectories in 3D, with and without payload, and minimizing payload oscillations/sway for various masses of payload (1/2, 1/3 and full payload mass), while enabling decay of the oscillations/vibrations over time in near-optimal fashion.

The autonomous airlift concept employing a team of coordinated, networked MURs must enable stabilized

- (1) approach maneuver to pre-selected/calculated waypoint locations, hover, automatic load engagement, transition to forward flight, and pre-selected drop-off locations, and
- (2) hover at pre-selected drop-off locations, automatic load disengagement, and transition to forward flight back to home location,
- (3) station keeping with commanded formation geometries (or relative positioning of the ALVs) that ensure load equalization or balancing.

The contractor will validate the effectiveness of C2GNS-APLOGS-RSRPS for a team of ALVs connected to a single sling load by means of indoor flight experiments with the following scenarios at a minimum:

- Pre-programmed payload location and drop-off destination,
- Pre-programmed payload location and drop-off destination and one of the degraded conditions from the list provided in Task 4.1,
- Pre-programmed payload location and drop-off destination, and test of a sequence of events containing a minimum of two degraded conditions from the list described in Task 4.1,
- No pre-programmed payload location and drop-off location, but instead (1) high-level command from ground station stating the drop-off destination during flight (on-the-fly assignment), and (2) tests without degraded conditions (nominal condition), and tests with a single degraded condition and a sequence of a minimum of two degraded conditions from the list given in Task 4.1.

The contractor will determine quantitatively:

- the extent of the robustness of C2GNS-APLOGS-RSRPS with and without payload, and during transitions,
- the efficiency of FSM to handle the various modes stated in Task 4.1,
- the extent of the oscillations/vibrations of the payload for specific flight paths,
- the settling time, and amplitude of error between commanded flight trajectories and actual flight trajectories,
- and will collect information on the performance obtained with the proposed C2GNS-APLOGS-RSRPS when faced with the degraded conditions of Task 4.1, and when transiting from one mode to another; that is, the contractor will investigate the motion of the ALVs and the payload during mode changes.

The contractor will determine the extent of the precision of C2GNS-APLOGS-RSRPS obtained with (1) inertial tracking, and (2) onboard sensing only. The extent of the oscillations/vibrations/sway of the payload for specific flight paths, and the frequency at which load engagement is achieved will be examined by the contractor. The contractor will perform flight tests to

- (1) validate the operation of the whole GNC system for AAL done with a single ALV and with a multi-ALV formation (with a minimum of 3 MURs),
- (2) determine the extent of the robustness and precision of the GNC system,
- (3) identify ways to refine and tune C2GNS-APLOGS-RSRPS so that the oscillations/vibrations/sway of the payload are minimized for a set of flight paths which comprises to a minimum rectilinear and curvilinear motion, and during flight modes with/without slind load and during the transitions,
- (4) compare single ALV AAL versus multi-ALV AAL.

## **Task 6: Documentation of systems design and results obtained**

### **Task 6.1:**

To prepare the final report. The report will include a description of the components of the single-MUAV and three-MUAV AAL systems, the approaches used in design, the limitations of the proposed concepts, the results obtained by simulations and experiments, and the concluding remarks and recommendations for future work. Taxonomy of performances under the variety of scenarios investigated will be proposed.

## **3. REPORTS AND OTHER DELIVERABLES**

### **3.1 General**

All reports must be provided in at least 3 (printed and bounded) copies. A PDF version and the source code of each report (in Latex or Word) must also be provided. The language of correspondence is English. Reports must be formatted in accordance with DRDC standard. The standard can be obtained through the project's technical authority. For letter reports, an electronic copy using a pre-approved format will be provided to the technical authority.

All models, scripts, and algorithms must be supplied in Matlab-Simulink RTW- and Quarc-compliant format. Furthermore, all document reports, in hard-copy and in electronic form, software, source code, products, modified and/or revised during the course of this contract, must be delivered to the technical authority by the end of the contract.

Mathematical models, algorithms, tools, techniques and electronic files developed and/or modified during the course of the contract will be delivered to DRDC Valcartier prior to the end of the contract.

### 3.2 Description of the deliverables

The main deliverables from this contract are listed below and must be added to the Section's document management system as per the instructions to be provided by the technical authority.

#### **Deliverable 1:**

Report providing an identification of air lift characteristics obtained from the scientific literature, with the details for the elements described in Tasks 1.1 and 1.2.

Due: start date + 2 months

#### **Deliverable 2.1:**

A rigid body model of the MUR/single sling load system. The model will be delivered by the contractor in a RTW-compliant Simulink format. The deliverable pertains to Task 2.1. A description of the Simulink model will be delivered as a separate Microsoft Word document. The report will contain the equations, theory, techniques, and approaches used and open loop analysis of behaviour.

Due: start date + 6 months

#### **Deliverable 2.2:**

The two-tier RSRPS system for a single MUR and a formation of MURs lifting a single payload will be delivered by the contractor in the form of a model in RTW- and Quarc-compliant Simulink format. The deliverable pertains to Task 2.2. A description of the Simulink model will be delivered as a separate Microsoft Word document.

Due: start date + 14 months

#### **Deliverable 2.3:**

Report on the RSRPS system. The report will contain the equations, theory, techniques, and approaches used to design the RSRPS system, and a mathematical analysis of performance of RSRPS, as detailed in Task 2.3.

Due: start date + 16 months

#### **Deliverable 3.1:**

The APLOGS system delivered as a model in RTW- and Quarc-compliant Simulink format, and the associated hardware/mechatronic devices appropriate for the MURs used in the DRDC Valcartier I2EAR facility. The APLOGS will fulfil the requirements described in Task 3. A description of the Simulink model will be delivered as a separate Microsoft Word document.

Due: start date + 16 months

#### **Deliverable 3.2:**

Integration of APLOGS with RSRPS as a set of models and/or subsystems/blocks in RTW- and Quarc-compliant Simulink format appropriate for the MURs used in the DRDC Valcartier I2EAR facility. The deliverable pertains to Tasks 3.1-3.4. A description of the Simulink models will be delivered as a separate Microsoft Word document.

Due: start date + 16 months

#### **Deliverable 3.3:**

Report on the performance obtained with the integration of APLOGS-RSRPS systems. The report will contain the equations, theory, techniques, and approaches used to analyse the systems. The deliverable pertains to Tasks 3.1-3.4.

Due: start date + 18 months

**Deliverable 4.1:**

The C2GNS system delivered as a set of models in RTW- and Quarc-compliant Simulink format, fulfilling the requirements stated in Tasks 4.1 and 4.2. The contractor will also deliver the models used to emulate degrade conditions and test the C2GNS system, according to Task 4.1. A description of the Simulink models will be delivered as a separate Microsoft Word document.

Due: start date + 24 months

**Deliverable 4.2:**

Report on the C2GNS system. The report will contain the equations, theory, techniques, and approaches used to design the C2GNS system, as detailed in Tasks 4.1 and 4.2.

Due: start date + 24 months

**Deliverable 4.3:**

Integrated GNC system from the designs carried out in Tasks 2.2, 3, 4.1 and 4.2. The system will be delivered by the contractor as a set of RTW- and Quarc-compliant Simulink models for single MUR and 3-MUR AAL. A description of the Simulink models will be delivered as a separate Microsoft Word document.

Due: start date + 26 months

**Deliverable 4.4:**

Report on the predicted performance of the integrated GNC system, focusing on its robustness and stability. The report will contain the equations, theory, techniques, performance measures (as detailed in Task 4.4), theorems, lemmas, assumptions, and conditions for an effective operation under nominal and degraded conditions.

Due: start date + 28 months

**Deliverable 5.1:**

Report on (1) the experimental validation tests and (2) quantitative analysis done by the contractor on the single MUR and sling load in closed-loop with the proposed GNC system concept. The report will contain information on C2GNS-APLOGS-RSRPS system feasibility and performance on the DRDC Valcartier I2EAR facility. The contractor will provide (1) a demonstrator, in the form of RTW- and Quarc-compliant Simulink models integrated with the DRDC Valcartier I2EAR facility, (2) will provide a report on the effectiveness obtained with the proposed GNC system for the scenarios described in Task 5.1 and tested at the DRDC Valcartier site, (3) make a presentation on this demonstrator, and (4) provide the documentation detailing the functioning of the demonstrator and a brief user guide describing how to run the demonstrations. The contractor will deliver the code, algorithms, and scripts used for the integration, the real-time simulations and the flight experiments in RTW- and Quarc-compliant Matlab-Simulink and other formats.

Due: start date + 30 months

**Deliverable 5.2:**

Report on (1) the experimental validation tests and (2) quantitative analysis done by the contractor on the multi-MUR and sling load in closed-loop with the proposed GNC system concept. The report will contain information on C2GNS-APLOGS-RSRPS system feasibility and performance on the DRDC Valcartier I2EAR facility. The contractor will provide (1) a demonstrator, in the form of RTW- and Quarc-compliant Simulink models integrated with the DRDC Valcartier I2EAR facility, (2) will provide a report on the effectiveness obtained with the proposed GNC system for the scenarios described in Task 5.2 and tested at the DRDC Valcartier site, (3) make a presentation on this demonstrator, and (4) provide the documentation detailing the functioning of the demonstrator and a brief user guide describing how to run the demonstrations. The contractor will deliver the code, algorithms, and scripts used for the integration, the real-time simulations and the flight experiments in RTW- and Quarc-compliant Matlab-Simulink and other formats.

Due: start date + 30 months

**Deliverable 6:**

Comprehensive final report.

Due: start date + 30 months,

It must contain the information pertaining to:

- AAL objectives, mission scenarios, events, systems, platforms, mechatronic devices, slings, load attachments, payload, sensors,
- Theoretical concepts, algorithms, and mathematical techniques, as well as practical approaches used for the design and the analysis of the proposed GNC concepts for AAL, requirements, survey of methods, and taxonomy of performances,
- Evaluation of GNC concepts for AAL with respect to commercial-off-the-shelf capabilities and existing systems and devices,
- Description of experimental tests, validation tests, mathematical analysis, post-test analysis, methodology used to evaluate the GNC functions, performance metrics, and results,
- Analysis,
- Description of software, code, models, and user guide.

The contractor should provide support to DRDC Valcartier scientists for the use of tools, algorithms, software and hardware developed, used or bought during the course of the contract.

### 3.3 Publications

Any manuscript for publication in magazines, newspapers or other, including presentation summaries or other types of publication, must be submitted to the Technical Authority for revision and approval at least ninety (90) days before the date of the presentation or publication. An explicit reference regarding Canada funding must be included, and it must be clearly mentioned that the content is the authors' responsibility. The Technical Authority will provide a written objection if there are specific elements (e.g. audience) that are not in the Canada's best interests. If the Technical Authority objects in writing, he/she should send the written objection to the organization responsible for publication (the newspaper or conference).

#### 4. CONTRACTOR SUPPLIED MATERIAL

The contractor, on approbation by the technical authority, must purchase and deliver at DRDC Valcartier Material to carry out Tasks 1 to 6. The material can be any of the following: Miniature Unmanned Rotocraft (MURs) (of dimensions below 1.5 meter), software for the Guidance, Navigation and Control (GNC) of the MURs, viewing or rendering software, hardware electronics, cameras, sonars, other sensors, and mechatronic components. The purchase of the equipment can be done at anytime during the project. All material bought for this contract will be delivered to DRDC Valcartier by the end of the contract. The equipment purchased under this contract will remain the property of Canada at the end of the project.

#### 5. MEETINGS

For all type of meetings, the minutes and the agenda will be prepared by the contractor. The contractor must provide the agenda to the technical authority at least 24 hours before the meetings.

A kick-off meeting will be held in person at DRDC Valcartier.

Once every two months, in-person progress meetings, workshops or demonstrations will be held at DRDC Valcartier. The frequency of the meetings may be increased if deemed necessary, upon request from the contractor or from the technical authority. Monthly teleconferences will be held to ensure satisfactory work progress.

An in-person meeting will also be convened at the end of each task to review the progress, achievement of the objectives, and review of the work plan for the subsequent task.

#### 6. WORK LOCATION

Part of the work will be carried out on site at Defence Research and Development Canada – Valcartier, located at 2459 Pie-XI Blvd. North, Quebec City, Quebec. More specifically, Tasks 2.3, 3.4, 4.3, 5.1 and 5.2 will be carried out at the DRDC Valcartier I2EAR facility. Such on-site experiments are essential for the study of AAL: (1) to prove the feasibility of the design with DRDC Valcartier's in-house analytical tools, systems, software, and test platforms, (2) to verify the correct functioning of the AAL system with the other available onboard unmanned air vehicles, (3) to study the performance of the overall team of unmanned air vehicles under controlled conditions of operation, and (4) to ensure an appropriate integration of all the components/systems/devices/platforms.

More specifically, the following tasks must be mainly carried out at DRDC Valcartier I2EAR facility :

- a) The analysis, real-time simulations, and integration tasks (task 2.3) with a minimum stay of 4 months.
- b) The tasks of analysis and simulations of the GSCA-ALPS-RSRPS functions (task 3.4) with a minimum stay of 4 months.
- c) The task of integration (task 4.3) with a minimum stay of 4 months.
- d) The tasks of integration, real-time simulations, and experiments of the MUR platform with C2GNS, APLOGS, and RSRPS (task 5.1) with a minimum stay of 6 months.

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File No. - N° du dossier

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qcl032

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- 
- e) The tasks of integration, real-time simulations, and experiments of the MUR platforms with C2GNS, APLOGS, and RSRPS (task 5.2) with a minimum stay of 6 months.

**ANNEX B****BASIS OF PAYMENT***(to be completed by Canada at the contract award)*

1. **LABOUR:** at the following firm rates (profit must be included in the hourly rates, GST/HST excluded)

Labour Category and proposed ressources	Firm Hourly Rate		
	Contract Periods		
	A Date of Award to 2012-03-31	B 2012-04-01 to 2013-03-31	C 2013-04-01 to the end of the contract period
Labour Category : _____			
Name of the proposed ressource : _____	\$ / hour	\$ / hour	\$ / hour
Labour Category : _____			
Name of the proposed ressource : _____	\$ / hour	\$ / hour	\$ / hour
Labour Category : _____			
Name of the proposed ressource : _____	\$ / hour	\$ / hour	\$ / hour

Est.: \$ \_\_\_\_\_

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**The total estimated cost for the equipment (item 2), the rentals (item 3) and the materials and supplies (item 4) should not exceed \$40,000.00 (GST/HST extra).**

**2. EQUIPMENT:** at laid down cost without markup

Description	Firm unit price	Qty.
(a)	\$	
(b)	\$	
(c)	\$	
(d)	\$	
(e)	\$	

Est.: \$ \_\_\_\_\_

**3. RENTALS:** at actual cost without markup

Description	Firm unit price	Qty.
(a)	\$	
(b)	\$	
(c)	\$	

Est.: \$ \_\_\_\_\_

**4. MATERIALS AND SUPPLIES:** at laid down cost without Markup

Description	Firm unit price	Qty.
(a)	\$	
(b)	\$	
(c)	\$	
(d)	\$	
(e)	\$	

Est.: \$ \_\_\_\_\_

**5. TRAVEL AND LIVING EXPENSES:****Est.: \$ \_\_\_\_\_**

The Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal, private vehicle and incidental expenses provided in Appendices B, C and D of the Treasury Board Travel Directive ([http://www.tbs-sct.gc.ca/pubs\\_pol/hrpubs/TBM\\_113/td-dv\\_e.asp](http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/TBM_113/td-dv_e.asp)), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees" are applicable. All travel must have prior authorization of the Technical Authority. All payments are subject to government audit.

**6. SUBCONTRACTS:** at actual cost without markup

Subcontract 1		Name of the subcontractor :
Items	Description	Firm unit price
1. Labour		
2. Equipment		
3. Rentals		
4. Materials and supplies		
5. Travel and living		
6. Other direct charges		

**Est.: \$ \_\_\_\_\_****7. OTHER DIRECT CHARGES:** at actual cost without markup**Est.: \$ \_\_\_\_\_**

**Estimated Cost to a Limitation of Expenditure: \$ \_\_\_\_\_**  
**(GST/HST extra)**

With the exception of the firm rates, the amounts shown in the various items specified above are estimates only. Minor changes to these estimates will be accepted for billing purposes as the Work proceeds, provided that these changes have the prior approval of the Technical Authority, and provided that the estimated cost does not exceed the aforementioned Limitation of Expenditure.

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W7701-103543/A

Amd. No. - N° de la modif.

File No. - N° du dossier

QCL-1-34002

Buyer ID - Id de l'acheteur

qc1032

CCC No./N° CCC - FMS No/ N° VME

W7701-10-3543

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## **ANNEX C**

### **SECURITY REQUIREMENTS CHECK LIST**

The Security Requirements Check List (SRCL) (Annex C) appended to the bid solicitation package is to be inserted at this point and forms part of this document

## ANNEX D

### CONTRACTOR DISCLOSURE OF FOREGROUND INFORMATION

Please see reference applicable in your contract to look into **Article 1 - Interpretation of 2040 General Conditions** to obtain the complete definition of the term Foreground Information and thus to help you to determine the information which must be revealed. <http://sacc.pwgsc.gc.ca/sacc/query-e.jsp>.

The Contractor shall respond to the following questions:

1. Contract No.:
2. What is the descriptive title of the FIP (Foreground Intellectual Property)?
3. Abbreviated description of the FIP and, if applicable, of the different systems and sub-systems.
4. What is or was the objective of the project?
5. Explain how the FIP meets the objective of the project (for example: the advantage of the new solution, what problem did the FIP resolve or what benefits did the FIP deliver).
6. Under which category (ies) would you best describe the FIP and why: Patents, Inventions, Trade Secrets, Copyright, Industrial Designs, Rights in Integrated Circuit Topography, Know-how, Other?
7. Describe the features or aspects of the FIP that are novel, useful and not obvious.
8. Has the FIP been tested or demonstrated? If yes, please summarise the results.
9. Has any publication or disclosure to others been made? If so, to whom, when, where and how?
10. Provide names and addresses of the inventors.
11. Provide an explicit and detailed description of the FIP developed during the contract (Refer to pertinent section of the technical report, if necessary).

Please specify name and position of person approving / authorizing this disclosure. This person is to sign and date the disclosure.

\_\_\_\_\_  
Name:  
Title:

\_\_\_\_\_  
Date

(Internal DRDC Valcartier)

\_\_\_\_\_  
Nom  
Titre : (Technical authority)

\_\_\_\_\_  
Date



Contract Number / Numéro du contrat <b>W7701-03593</b>
Security Classification / Classification de sécurité

**SECURITY REQUIREMENTS CHECK LIST (SRCL)  
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)**

**PARTIE A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE**

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine	DND	2. Branch or Directorate / Direction générale ou Direction	DRDC
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3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant
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4. Brief Description of Work / Brève description du travail  
Study of Guidance, Navigation and Control Concepts for Autonomous Airlift

5. a) Will the supplier require access to Controlled Goods? / Le fournisseur aura-t-il accès à des marchandises contrôlées?  No / Non  Yes / Oui

5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? / Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques?  No / Non  Yes / Oui

6. Indicate the type of access required / Indiquer le type d'accès requis

6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? / Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) / (Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c)  No / Non  Yes / Oui

6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. / Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé.  No / Non  Yes / Oui

6. c) Is this a commercial courier or delivery requirement with no overnight storage? / S'agit-il d'un contrat de messagerie ou de livraison commerciale sans entreposage de nuit?  No / Non  Yes / Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada <input type="checkbox"/>	NATO / OTAN <input type="checkbox"/>	Foreign / Étranger <input type="checkbox"/>
---------------------------------	--------------------------------------	---

7. b) Release restrictions / Restrictions relatives à la diffusion

No release restrictions / Aucune restriction relative à la diffusion <input type="checkbox"/>	All NATO countries / Tous les pays de l'OTAN <input type="checkbox"/>	No release restrictions / Aucune restriction relative à la diffusion <input type="checkbox"/>
Not releasable / À ne pas diffuser <input type="checkbox"/>		
Restricted to: / Limité à: Specify country(ies) / Préciser le(s) pays: <input type="checkbox"/>	Restricted to: / Limité à: Specify country(ies) / Préciser le(s) pays: <input type="checkbox"/>	Restricted to: / Limité à: Specify country(ies) / Préciser le(s) pays: <input type="checkbox"/>

7. c) Level of Information / Niveau d'information

PROTECTED A / PROTÉGÉ A <input type="checkbox"/>	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ <input type="checkbox"/>	PROTECTED A / PROTÉGÉ A <input type="checkbox"/>
PROTECTED B / PROTÉGÉ B <input type="checkbox"/>	NATO RESTRICTED / NATO DIFFUSION RESTREINTE <input type="checkbox"/>	PROTECTED B / PROTÉGÉ B <input type="checkbox"/>
PROTECTED C / PROTÉGÉ C <input type="checkbox"/>	NATO CONFIDENTIAL / NATO CONFIDENTIEL <input type="checkbox"/>	PROTECTED C / PROTÉGÉ C <input type="checkbox"/>
CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>	NATO SECRET / NATO SECRET <input type="checkbox"/>	CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>
SECRET / SECRET <input type="checkbox"/>	COSMIC TOP SECRET / COSMIC TRÈS SECRET <input type="checkbox"/>	SECRET / SECRET <input type="checkbox"/>
TOP SECRET / TRÈS SECRET <input type="checkbox"/>		TOP SECRET / TRÈS SECRET <input type="checkbox"/>
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>



**PART A (continued) / PARTIE A (suite)**

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets?  No  Yes  
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?  Non  Oui

If Yes, indicate the level of sensitivity:  
Dans l'affirmative, indiquer le niveau de sensibilité :

9. Will the supplier require access to extremely sensitive INFOSEC information or assets?  No  Yes  
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?  Non  Oui

Short Title(s) of material / Titre(s) abrégé(s) du matériel :

Document Number / Numéro du document :

**PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)**

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis

- |   |   |   |  |
|---|---|---|--|
| <input checked="" type="checkbox"/> RELIABILITY STATUS<br>COTE DE FIABILITÉ | <input type="checkbox"/> CONFIDENTIAL<br>CONFIDENTIEL           | <input type="checkbox"/> SECRET<br>SECRET           | <input type="checkbox"/> TOP SECRET<br>TRÈS SECRET               |
| <input type="checkbox"/> TOP SECRET - SIGINT<br>TRÈS SECRET - SIGINT        | <input type="checkbox"/> NATO CONFIDENTIAL<br>NATO CONFIDENTIEL | <input type="checkbox"/> NATO SECRET<br>NATO SECRET | <input type="checkbox"/> COSMIC TOP SECRET<br>COSMIC TRÈS SECRET |
| <input type="checkbox"/> SITE ACCESS<br>ACCÈS AUX EMPLACEMENTS              |   |   |  |

Special comments:

Commentaires spéciaux :

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.

REMARQUE: Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work?  No  Yes  
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?  Non  Oui

If Yes, will unscreened personnel be escorted?

Dans l'affirmative, le personnel en question sera-t-il escorté?  No  Yes  
 Non  Oui

**PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)**

(INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS)

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises?  No  Yes  
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?  Non  Oui

11. b) Will the supplier be required to safeguard COMSEC information or assets?  No  Yes  
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?  Non  Oui

**PRODUCTION**

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises?  No  Yes  
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?  Non  Oui

**INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)**

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data?  No  Yes  
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS?  Non  Oui

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency?  No  Yes  
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?  Non  Oui



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Security Classification / Classification de sécurité

PART C - (continued) / PARTIE C - (suite)

For users completing the form manually use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.

Les utilisateurs qui remplissent le formulaire manuellement doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form online (via the Internet), the summary chart is automatically populated by your responses to previous questions.

Dans le cas des utilisateurs qui remplissent le formulaire en ligne (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Summary chart table with columns for Category, Protected, Classified, NATO, and COMSEC. Rows include Information/Assets, Production, IT Media/Support, and IT Link.

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED? La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

Form with checkboxes for No/Non and Yes/Oui.

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification". Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED? La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

Form with checkboxes for No/Non and Yes/Oui.

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments). Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).



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**PART D - AUTHORIZATION / PARTIE D - AUTORISATION**

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées): C.A. Rabbath  
 Title - Titre: Defence Scientist  
 Signature: *[Signature]*

Telephone No. - N° de téléphone: 418-844-4000 x4756  
 Facsimile No. - N° de télécopieur: 418-844-4502  
 E-mail address - Adresse courriel: camille-alain.rabbath@drdc-rddc.gc.ca  
 Date: 1 december 2010

14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées): **Tippy Graham, DEM Secur 3**  
 Title - Titre: Senior Security Analyst  
 Signature: *[Signature]*  
 Tel: 613-949-1035 / Fax: 613-949-1069

Telephone No. - N° de téléphone: 613-949-1035  
 Facsimile No. - N° de télécopieur: 613-949-1069  
 E-mail address - Adresse courriel: tippy.graham@forces.gc.ca  
 Date: 5 April 2011

15. Are there additional Instructions (e.g. Security Guide, Security Classification Guide) attached? / Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?  
 No / Non  Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées): Marie-Michèle Boudrias  
 Title - Titre: Agent des approvisionnements  
 Signature: *[Signature]*

Telephone No. - N° de téléphone: 418-649-2806  
 Facsimile No. - N° de télécopieur: 418-648-2209  
 E-mail address - Adresse courriel: marie-michele.boudrias@tpsgc.gc.ca  
 Date: 2011-07-14

17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées): Ryan Deane  
 Title - Titre: CONTRACT SECURITY OFFICER  
 Signature: *[Signature]*

Telephone No. - N° de téléphone: 613-941-5026  
 Facsimile No. - N° de télécopieur: 613-954-4171  
 E-mail address - Adresse courriel: RYAN.DEANE@TAGSC-PRGSC.GC.CA  
 Date: 2011-04-12

*May  
 CIAP  
 1 Dec 2010*