



RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:
Travaux publics et Services gouvernementaux
Canada
Place Bonaventure, portail Sud-Est
800, rue de La Gauchetière Ouest
7^{ème} étage
Montréal
Québec
H5A 1L6
FAX pour soumissions: (514) 496-3822

REQUEST FOR PROPOSAL
DEMANDE DE PROPOSITION

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

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

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

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

Comments - Commentaires

Title - Sujet DÉVELOPPEMENT DES TECHN. SPATIALES	
Solicitation No. - N° de l'invitation 9F063-140572/B	Date 2016-02-02
Client Reference No. - N° de référence du client 9F063-140572	
GETS Reference No. - N° de référence de SEAG PW-\$MTB-575-13737	
File No. - N° de dossier MTB-4-37358 (575)	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2016-03-02	
Time Zone Fuseau horaire Heure Normale du l'Est HNE	
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: Jurca, Anca	Buyer Id - Id de l'acheteur mtb575
Telephone No. - N° de téléphone (514) 496-3378 ()	FAX No. - N° de FAX (514) 496-3822
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: AGENCE SPATIALE CANADIENNE GESTION DU DEV. TECHNOLOGIQUE 6767 ROUTE DE L AEROPORT ST HUBERT Québec J3Y8Y9 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

Travaux publics et Services gouvernementaux Canada
Place Bonaventure, portail Sud-Est
800, rue de La Gauchetière Ouest
7^{ème} étage
Montréal
Québec
H5A 1L6

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

This bid solicitation cancels and supersedes the Priority Technologies (PTs):

- **PT 18: Gallium Nitride (GaN) High Power Amplifier development for C and X-Band Applications; and**
- **PT 19: Multi-Channel SAR Receiver**

of the previous bid solicitation number 9F063- 140572/A dated March 10, 2015 with a closing of May 6, 2015 at 02:00PM.

A debriefing or feedback session will be provided upon request to bidders/offerors/suppliers who bid on the previous solicitation.

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PART 1 - GENERAL INFORMATION

1.1 Introduction

The bid solicitation is divided into seven parts plus annexes and attachments, 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, and the basis of selection;
- Part 5 Certifications: includes the certifications to be provided;
- Part 6 Financial and Other 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 following Annexes:

Annex A Statement of Work
Annex B Basis of Payment
Annex C Non-disclosure Agreement

The following Attachments:

Attachment 1 to Part 3 Technical and Managerial Bid Preparation Instructions
Attachment 1 to Part 4 Point Rated Evaluation Criteria

Project Title: Space Technologies Development

1.2 Summary

1.2.1 Description

Public Works and Government Services Canada (PWGSC) on behalf of Canadian Space Agency (CSA) located in St-Hubert, (Quebec), is seeking bids to develop and advance two (2) Priority Technologies that are in line with the Canadian Space Agency's (CSA) priorities and mission roadmaps. Priority Technologies are those that have been established by the CSA as the critical technologies to be developed to meet the objectives set forth by the Canadian Space Strategy.

For every Priority Technologies (PTs) the work solicited is the development and advancement of these technologies up to potentially Technology Readiness Level 5 (TRL 5) to reduce technical uncertainties and support approval and implementation of specific potential future space missions of interest to Canada.

Period of Contract: The period of contract will be 24 months for PT 18 and 18 months for PT 19.

Intellectual Property: The Intellectual property will vest with the contractor.

Security Requirements: There are no security requirements associated with this requirement.

Trade agreements: This requirement is not subject to the trade agreements.

1.2.2 Canadian Content

The requirement is limited to Canadian goods and/or services.

1.2.3 Controlled Goods Program

This procurement could be subject to the Controlled Goods Program. The *Defence production Act* defines Canadian Controlled Goods as certain goods listed in Canada's Export Control List, a regulation made pursuant to the Export and Import Permits Act (EIPA)."

1.3 Debriefings

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

1.4 Communications

As a courtesy and in order to coordinate any public announcements pertaining to any resulting Contract, the Government of Canada requests that successful Bidders notify the Contracting Authority, five (5) days in advance of their intention to make public an announcement related to the recommendation of a contract award, or any information related to the contract. The Government of Canada retains the right to make primary contract announcements.

PART 2 - BIDDER INSTRUCTIONS

2.1 Standard Instructions, Clauses and Conditions

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

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

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

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

Delete: 60 days
Insert: 240 days

2.2 Submission of Bids

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

Public Works and Government Services Canada
Quebec Region
Place Bonaventure, South-East Portal
800 de La Gauchetière Street West
7th Floor, Suite 7300
Montreal, Quebec, Canada
H5A 1L6

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

2.3 Former Public Servant

Contracts awarded to 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 before contract award. If the answer to the questions and, as applicable the information required have not been received by the time the evaluation of bids is completed, Canada will inform the Bidder of a time frame within which to provide the information. Failure to comply with Canada's request and meet the requirement within the prescribed time frame will render the bid non-responsive.

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 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

As per the above definitions, is the Bidder a FPS in receipt of a pension? **Yes () No ()**

If so, the Bidder must provide the following information, for all FPS in receipt of a pension, as applicable:

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

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with Contracting Policy Notice: 2012-2 and the Guidelines on the Proactive Disclosure of Contracts.

Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive? **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 adjustment 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 Applicable Taxes.

2.4 Enquiries - Bid Solicitation

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

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

2.5 Applicable Laws

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

2.6 Improvement of Requirement During Solicitation Period

Should bidders consider that the specifications or Statement of Work contained in the bid solicitation could be improved technically or technologically, bidders are invited to make suggestions, in writing, to the Contracting Authority named in the bid solicitation. Bidders must clearly outline the suggested improvement as well as the reason for the suggestion. Suggestions that do not restrict the level of competition nor favour a particular bidder will be given consideration provided they are submitted to the Contracting Authority at least ten (10) days before the bid closing date. Canada will have the right to accept or reject any or all suggestions.

2.7 Maximum Funding

The maximum funding available for each contract, one contract by category, resulting from the bid solicitation is indicated in Table 1: *List of Priority Technologies* (Applicable Taxes 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.

Rank	PT #	Priority Technology Title	Maximum funding (K\$)
1	PT 18	Gallium Nitride (GaN) High Power Amplifier development for C and X-Band Applications	800
2	PT 19	Multi-Channel SAR Receiver	800

Table 1: List of Priority Technologies

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

A Bidder can bid on more than one Priority Technology specified in Table 1: *List of Priority Technologies* of Part 2 – *Bidder Instructions* but must submit one separate bid for each Priority Technology. Canada requests that the bidder clearly identifies in the first page of its bid which Priority Technology he is bidding on. The Bidder must follow the same instructions described in this Request for proposal for each bid he submits.

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

Section I: Technical and Managerial Bid (1 hard copy and 1 soft copy on CD/DVD)

Section II: Financial Bid (1 hard copy and 1 soft copy on CD/DVD)

Section III: Certifications (1 hard copy)

- a) If there is a discrepancy between the wording of the soft copy and the hard copy, the wording of the hard copy will have priority over the wording of the soft copy;
- b) For the soft copies of Section I (Technical and Managerial Bid as well as the Executive Summary), all of the information must be contained in two files (one for the Technical and Managerial Bid and one for the Executive Summary). The only acceptable formats are: MS Word, PDF and HTML;
- c) For the soft copy of Section II (Financial Bid), all of the information must be contained in one file. The only acceptable formats are: MS Word, PDF and HTML;
- d) The soft copy of Section II must be submitted on a separate CD than the soft copy submitted for Section I;
- e) Prices must appear in Section II (Financial Bid) only. No prices must be indicated in any other section of the bid;
- f) The total number of pages for Section I should not exceed 50 pages (8.5 X 11 inches) (216 mm X 279 mm) paper excluding bid appendices;
- g) The bid should use a numbering system that corresponds to the bid solicitation;

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

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

Section I: Technical and Managerial Bid

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

Part 4: *Evaluation Procedures and Basis of Selection* contains additional instructions that bidders should consider when preparing their technical and managerial bid.

The structure and content requested for the Technical and Managerial Bid (Section I) are detailed in Attachment 1 to Part 3: *Technical and Managerial Bid Preparation Instructions*.

Section II: Financial Bid

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

- (a) A firm, all inclusive lot price for the Work, which must not exceed the maximum funding available for each contract resulting from the bid solicitation specified in Part 2, Table 1: *List of Priority Technologies*. The total amount of Applicable Taxes must be shown separately, if applicable.
- (b) Prices must be in Canadian funds, Applicable Taxes excluded and Canadian customs duties and excise taxes included.

3.1.2 Price Breakdown

Bidders are requested to detail the following elements for the performance of each task, milestone or phase of the Work, as applicable:

- (a) Labour: For each individual and (or) labour category to be assigned to the Work, indicate:
 - i) the hourly rate, inclusive of overhead and profit; and ii) the estimated number of hours.
- (b) Equipment: Specify each item required to complete the Work and provide the pricing basis of each one, Canadian customs duty and excise taxes included, as applicable.
- (c) Materials and Supplies: Identify each category of materials and supplies required to complete the Work and provide the pricing basis.
- (d) Travel and Living Expenses: Indicate the number of trips and the number of days for each trip, the cost, destination and purpose of each journey, together with the basis of these costs which must not exceed the limits of the Treasury Board (TB) Travel Directive. With respect to the TB Directive, only the meal, private vehicle and incidental allowances specified in Appendices B, C and D of the Directive <http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php>, and the other provisions of the Directive

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referring to "travellers", rather than those referring to "employees", are applicable. The Treasury Board Secretariat's Special Travel Authorities, http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.

- (e) Subcontracts: Identify any proposed subcontractor and provide for each one the same price breakdown information as contained in this article.
- (f) Other Direct Charges: Identify any other direct charges anticipated, such as long distance communications and rentals, and provide the pricing basis.
- (g) Applicable Taxes: Identify any Applicable Taxes separately.

Section III: Certifications and additional information

Bidders must submit the certifications required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

4.1 Evaluation Procedures

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

4.1.1 Technical and Management Evaluation

4.1.1.1 Point Rated Technical and Management Criteria

The Point Rated Technical and Management Criteria are described at Attachment 1 to Part 4: *Point Rated Evaluation Criteria*. Criteria not addressed will be given a score of zero.

4.1.2 Financial Evaluation

4.1.2.1 Mandatory Financial Criteria

The Bidder must submit a firm, all inclusive lot price for the Work, which must not exceed the maximum funding available for each contract resulting from the bid solicitation indicated in Part 2, Table 1: *List of Priority Technologies* (Applicable Taxes extra, as appropriate).

Bids which fail to meet the mandatory financial criteria will be declared non-responsive. Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available.

4.1.2.2 Evaluation of Price

The price of the bid will be evaluated in Canadian dollars, the Applicable Taxes excluded, FOB destination, Canadian customs duties and excise taxes included.

4.2 Basis of Selection – Highest Combined Rating of Technical Merit and Price

4.2.1 To be declared responsive, each bid must:

- (a) comply with all the requirements of the bid solicitation;
- (b) meet all mandatory evaluation criteria;
- (c) obtain the required minimum of 20 points, on a scale of 40 points, for the Evaluation Criterion #4: *Feasibility of proposed solution in meeting the technical objectives* indicated in Table 4A.1: *List of Evaluation Criteria and Associated Ratings*, of Attachment 1 to Part 4;
- (d) obtain the required minimum of 70 points, on a scale of 100 points, for the overall Technical Evaluation portion of the bid as indicated in Table 4A.1: *List of Evaluation Criteria and Associated Ratings*, of Attachment 1 to Part 4.

4.2.2 Bids not meeting (a) or (b) or (c) or (d) will be declared non-responsive;

4.2.3 The responsive bids will be grouped within the Priority Technology in which they belong (PT18 or PT 19) and each Priority Technology will be evaluated separately;

4.2.4 Responsive Bids, within each Priority Technology will be ranked according to their combined score made up of the overall technical score and pricing score.

For each responsive bid, the overall technical score and the pricing score will be added to determine its combined score.

Bids will be ranked starting from the Bid with the highest combined score down to the lowest combined score resulting in a Responsive Bid List;

4.2.5 For each responsive bid, the score obtained for each technical criterion will be added to determine its overall technical score (maximum of 100 points);

4.2.6 To establish the pricing score, the following equation will be used:

$$\text{pricing score} = \left(\frac{\text{max funding} - \text{bid price}}{\text{max funding}} \right) \times 50$$

the pricing score is limited to 10 points. It therefore follows that the maximum pricing score is awarded to bids with a price representing 80% of the maximum funding. Bids with a price lower than 80% funding will receive the maximum score of 10;

4.2.7 Neither the responsive bid obtaining the highest overall technical score nor the one with the highest pricing score will necessarily be accepted. The responsive bid with the highest combined score of technical merit and price will be recommended for award of a contract.

In the event that more than one responsive bid has the same combined score in a Priority Technology, the bid which obtained the highest overall technical score will be recommended for award of a contract.

In the event that there are no responsive bids in a particular Priority Technology, Canada may elect to award one more contract to responsive bid that finished second for other Priority Technology.

The table below illustrates an example where all three bids are responsive and the selection of the contractor is determined by adding the overall technical score and pricing scores, respectively. In this example, the maximum funding is 100 000\$ (100)

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Ex. Basis of Selection – Highest Combined Rating of Technical Merit and Price

Bidder	Bidder 1	Bidder 2	Bidder 3
Overall Technical Score	70	85	92
Bid Price	\$90 000	\$80 000	\$100 000
Calculation of Pricing Score	$((100-90)/100) \times 50 =$ 5	$((100-80)/100) \times 50 =$ 10	$((100-100)/100) \times 50 =$ 0
Combined Score	75	95	92
Overall Rating	3 rd	1st	2nd

PART 5 – CERTIFICATIONS AND ADDITIONAL INFORMATION

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

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

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

5.1 Certifications Precedent to Contract Award and Additional Information

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

5.1.1 Integrity Provisions – List of Names

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

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

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

5.1.2 Federal Contractors Program for Employment Equity - Bid Certification

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

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

5.1.3 Additional Certifications Precedent to Contract Award

5.1.3.1 Canadian Content Certification

This procurement is limited to Canadian goods and/or Canadian services.

The Bidder certifies that:

() a minimum of 80 percent of the total bid price consist of Canadian goods and/or Canadian services as defined in clause A3050T.

For more information on how to determine the Canadian content for a mix of goods, a mix of services or a mix of goods and services, consult Annex 3.6.(9), Example 2, of the Supply Manual

5.1.3.1.1 SACC *Manual* clause A3050T (2014-11-27) Canadian Content Definition.

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

5.1.3.3 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.

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PART 6 - FINANCIAL AND OTHER REQUIREMENTS

6.1 Financial Capability

SACC Manual clause A9033T (2012-07-16), Financial Capability

6.2 Controlled Goods Requirement (if applicable)

SACC Manual clause A9130T (2014-11-27), Controlled Goods Program – Bid

PART 7 - RESULTING CONTRACT CLAUSES

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

7.1 Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work in Annex A and the Contractor's technical and Managerial Bid entitled _____, dated _____ (*will be inserted at contract award*).

7.2 Work Authorization

Despite any other condition of the Contract, the Contractor is only authorized to perform the Work up to the "Work Authorization Meeting and Decisions" (see Annex A – Statement of Work, section A.7.2.3). Depending on the results of the review and evaluation of the Work, Canada will decide at its discretion whether to continue with the Work.

If Canada decides to continue with the Work, the Contracting Authority will advise the Contractor in writing to continue with the work in accordance with the Statement of Work. The Contractor must immediately comply with the notice.

If Canada decides not to proceed with the Work, the Contracting Authority will advise the Contractor in writing of the decision and the Contract will be considered completed at no further costs to Canada. In no event will the Contractor be paid for any cost incurred for unauthorized work.

7.3 Standard Clauses and Conditions

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

7.3.1 General Conditions

2040 (2015-09-03), General Conditions - Research & Development, apply to and form part of the Contract.

7.3.2 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

7.3.3 Non-disclosure Agreement

The Contractor must obtain from its employee(s) or subcontractor(s) the completed and signed non-disclosure agreement, attached at Annex C, and provide it to the Contracting Authority before they are given access to information by or on behalf of Canada in connection with the Work.

7.4 Term of Contract

7.4.1 Period of the Contract *(will be inserted at contract award)*

Period of Contract: The period of contract will be 24 months for PT 18 and 18 months for PT 19.

7.5 Authorities

7.5.1 Contracting Authority

The Contracting Authority for the Contract is:

Anca Jurca

Chief, Procurement
Public Works and Government Services Canada
Quebec Region
7th Floor
Place Bonaventure, South-East Portal
800 de La Gauchetière Street West
Suite 7300
Montreal, Quebec, H5A 1L6

Telephone: 514-496-3378
Facsimile: 514-496-3822
E-mail address: anca.jurca@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.

7.5.2 Technical Authority *(will be inserted at contract award)*

The Technical Authority for the Contract is:

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

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.

7.5.3 Contractor's Representative *(will be inserted at contract award)*

The Contractor's Representative for the Contract is:

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

Telephone: ____-____-____
Facsimile: ____-____-____
E-mail: _____

7.6 Proactive Disclosure of Contracts with Former Public Servants

By providing information on its status, with respect to being a former public servant in receipt of a [Public Service Superannuation Act](#) (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with [Contracting Policy Notice: 2012-2](#) of the Treasury Board Secretariat of Canada.

7.7 Payment

7.7.1 Basis of Payment

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid a firm price, as specified in the Contract for a cost of \$ _____ *(the amount will be inserted at contract award)*. Customs duties are included and Applicable taxes are extra, if applicable.

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

7.7.2 Method of Payment

7.7.2.1 Milestone Payments

Canada will make milestone payments in accordance with the Schedule of Milestones detailed in Annex B - Basis of Payment and the payment provisions of the Contract 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) all the certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives;
- (c) all work associated with the milestone and as applicable any deliverable required has been completed and accepted by Canada.

7.7.2.2 Schedule of Milestones

The schedule of milestones for which payments will be made in accordance with the Contract is detailed in Annex B.

7.8 SACC Manual Clauses

SACC Manual Clause A9117C (2007-11-30), T1204 - Direct Request by Customer Department

7.9 Invoicing Instructions - Progress Claim - Firm Price

1. The Contractor must submit a claim for progress payment using form PWGSC-TPSGC 1111 Claim for Progress Payment (<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) the description and value of the milestone claimed as detailed in the Contract.
2. Applicable Taxes 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 Applicable Taxes payable as it was claimed and payable under the previous claims for progress payments.
 3. The Contractor must prepare and certify **one (1) original and two (2) copies** of the claim on form PWGSC-TPSGC 1111, forward:
 - a) the **original and one (1) copy** to the Canadian Space Agency at the address shown on page 1 of the Contract under "Invoices" (Financial Services Section) for appropriate certification by the Project Authority identified herein after inspection and acceptance of the Work takes place;
- and,
- b) **one (1) copy of the original** progress claim to the Contracting Authority identified under the section entitled "Authorities" of the Contract.
4. The CSA's Financial Services Section will then forward the original and one (1) copy of the claim to the Contracting Authority for certification and onward submission to the Payment Office for the remaining certification and payment action.
 5. The Contractor must not submit claims until all work identified in the claim is completed.

7.10 Certifications

7.10.1 Compliance

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

in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

7.11 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*).

7.12 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 and 4003 (2010-08-16), Licensed Software;
- (c) the general conditions 2040 (2015-09-03) General Conditions - Research & Development;
- (d) Annex A, Statement of Work;
- (e) Annex B, Basis of Payment
- (f) Annex C, Non-disclosure Agreement;
- (g) the Contractor's bid dated _____ (insert date of bid) (If the bid was clarified or amended, insert at the time of contract award: "as clarified on _____" **or** ", as amended on _____" and insert date(s) of clarification(s) or amendment(s))

7.13 Foreign Nationals (Canadian Contractor)

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

7.14 Insurance

SACC Manual clause G1005C (2016-01-28), Insurance - No Specific Requirement

7.15 Controlled Goods Program (*if applicable*)

SACC Manual clause A9131C (2014-11-27), Controlled Goods Program

7.16 Directive on Communications with the Media

7.16.1. Definitions

"Communication Activity(ies)" includes: public information and recognition, the planning, development, production and delivery or publication, and any other type or form of dissemination of marketing, promotional or information activities, initiatives, reports, summaries or other products or materials, whether in print or electronic format that pertain to the present agreement, all communications, public relations events, press releases, social media releases, or any other communication directed to the general public in whatever form or media it may be in, including but without limiting the generality of the preceding done through any company web site.

7.16.2. Communication Activities Format

The Contractor must coordinate with the Canadian Space Agency (CSA) all Communication Activities that pertain to the present contract. All matters pertaining to Communication Activities are to be directed to CSA's Directorate of Communications and Public Affairs representative:

Nicole Gignac

Senior Communications Advisor
Canadian Space Agency
6767, route de l'Aéroport
Saint-Hubert, Québec J3Y 8Y9

Telephone: (450) 926-4423
Facsimile: (450) 926-4352
E-mail address: nicole.gignac@canada.ca

Subject to review and approval by the CSA, the Contractor may mention and/or indicate visually, without any additional costs to the CSA, the CSA's participation in the contract through one or both of the following methods at the complete discretion of the CSA:

- a. By clearly and prominently labelling publications, advertising and promotional products and any form of material and products sponsored or funded by the CSA, as follows, in the appropriate official language:

"This program/project/activity is undertaken with the financial support of the Canadian Space Agency."

"Ce programme/projet/activité est réalisé(e) avec l'appui financier de l'Agence spatiale canadienne."

- b. By affixing CSA's corporate logo on print or electronic publications, advertising and promotional products and on any other form of material, products or displays sponsored or funded by the Canadian Space Agency.

The Contractor must obtain and use a high resolution printed or electronic copy of the CSA's corporate identity logo and seek advice on its application, by contacting the Technical Authority, as mentioned in section 7.5.2 of this contract.

7.16.3. Communication Activity Coordination Process

The contractor must coordinate with the CSA's Directorate of Communications and Public Affairs all Communication Activities pertaining to the present contract. To this end, the contractor must:

- a. As soon as the Contractor intends to perform a Communication Activity, send a Notice to the CSA's Directorate of Communications and Public Affairs. The Communications Notice must include a complete description of the proposed Communication Activity. The Notice must be in writing in accordance with Article 44 of the General Conditions 2040 contract titled Notice. The Communications Notice must include a copy or example of the proposed Communication Activity.
- b. The contractor must provide to the CSA any and all additional document in any appropriate format, example or information that the CSA deems necessary, at its entire discretion to correctly and efficiently coordinate the proposed Communication Activity. The Contractor agrees to only proceed with the proposed Communication Activity after receiving a written confirmation of coordination of the

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File No. -N° du dossier
MTB-4-37358

Buyer ID - Id de l'acheteur
mtb575
CCC No./N° CCC -FMS No./N° VME

-
- Communication Activity from the CSA's Directorate of Communications and Public Affairs.
- c. Should the Contractor proceed with the Communication Activity without having previously received the written confirmation of coordination from the CSA's Directorate of Communications and Public Affairs, subject to giving Notice to the Contractor, Canada is entitled to exercise its right under section 155 of the *Financial Administration Act* and retain from payment to the Contractor or recover from the Contractor the amount of damages that may be due to Canada as a result of the release of information by the Contractor.

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ANNEX "A"

STATEMENT OF WORK

The Statement of Work, appended to the bid solicitation package, is to be inserted at this point and forms part of this document.

ANNEX "B"

BASIS OF PAYMENT

SCHEDULE OF MILESTONES

The schedule of milestones for which payments will be made in accordance with the Contract is as follows:

Milestone No.	Deliverable	Firm Amount	Delivery Date
1	Specify		
2	Specify		
3	Specify		
Etc			

Total Firm Price CAN \$ _____
(Taxes Extra, if applicable)

ANNEX "C"

NON-DISCLOSURE AGREEMENT

I, _____, recognize that in the course of my work as an employee or subcontractor of _____, I may be given access to information by or on behalf of Canada in connection with the Work, pursuant to Contract Serial No _____ between Her Majesty the Queen in right of Canada, represented by the Minister of Public Works and Government Services and _____, including any information that is confidential or proprietary to third parties, and information conceived, developed or produced by the Contractor as part of the Work. For the purposes of this agreement, information includes but not limited to: any documents, instructions, guidelines, data, material, advice or any other information whether received orally, in printed form, recorded electronically, or otherwise and whether or not labeled as proprietary or sensitive, that is disclosed to a person or that a person becomes aware of during the performance of the Contract.

I agree that I will not reproduce copy, use, divulge, release or disclose, in whole or in part, in whatever way or form any information described above to any person other than a person employed by Canada on a need to know basis. I undertake to safeguard the same and take all necessary and appropriate measures, including those set out in any written or oral instructions issued by Canada, to prevent the disclosure of or access to such information in contravention of this agreement.

I also acknowledge that any information provided to the Contractor by or on behalf of Canada must be used solely for the purpose of the Contract and must remain the property of Canada or a third party, as the case may be.

I agree that the obligation of this agreement will survive the completion of the Contract Serial

No: _____

Signature

Date

ATTACHMENT 1 TO PART 3

TECHNICAL AND MANAGERIAL BID PREPARATION INSTRUCTIONS

3A.1. Technical and managerial bid

The details provided in this Attachment complement the information introduced in paragraph 3.1 of Part 3: *Bid Preparation Instructions*.

The Bidder should present the information about the Technical and Managerial Bid for each Priority Technology in the following order:

1. Title / Project Identification Page (see 3A.2);
2. Executive Summary (see 3A.3);
3. Table of Contents (see 3A.4);
4. Project Definition and Plan (see 3A.5);
5. Bid Appendices (see 3A.6)

The structure of the Technical and Managerial Bid, and its subsections, are described below. Some of the subsection headings are followed by numbers in brackets. These numbers represent the Evaluation Criteria (see Table 4A.1 of Attachment 1 to Part 4) that are applicable to that specific section/subsection for each bid submitted by a Bidder.

3A.2 Title/Project Identification Page

The first page of the each bid submitted should state the following information.

- a) The Request For Proposal file number (Space Technologies 9F063-14-0909/B);
- b) The company's name and address;
- c) The title of the proposed Work (the use of acronyms in the title is discouraged, unless they are described);
- d) The Priority Technology (PT) addressed by the bid (refer to Part 2, Table 1: *List of Priority Technologies*);
- e) The current and targeted TRL (up to TRL 5) of the proposed technology (refer to Annex A, Appendix A-1 Technology readiness Levels (TRLs) for TRL descriptions); and
- f) A short extract from the Executive Summary (maximum **7 lines**) of the bid. The technology development being proposed and its relevance to targeted Priority Technology list should be described.

3A.3 Executive Summary

The Bidder must provide an Executive Summary. The Executive Summary is a stand-alone document suitable for public dissemination, for example, through the CSA web site. The Executive Summary should not exceed two pages in length (8.5" x 11") and should highlight the following elements:

- a) Work objectives;
- b) Main innovations;
- c) TRL development;
- d) Technical risks;
- e) Major milestones and deliverables; and
- f) Impact on the proposed technology and the associated targeted Future Mission(s).

Bidder shall provide the Executive Summary in Soft copy with the only acceptable format: MS Word, PDF or HTML in a separate unprotected file and not contain any proprietary markings.

3A.4 Table of Contents

The table of contents should be formatted such that its headings are linked to their respective location in the bid for ease of reference when using the bid's Soft copy version.

3A.5 Project Definition and Plan

This section should describe the project and plan as outlined in the following subsections.

3A.5.1 Understanding the technology (Evaluation Criterion 1)

(see section 4A.3.1 Criterion 1 Understanding the technology of Attachment 1 to Part 4)

This criterion assesses the degree to which the bid exhibits an understanding of the fundamental concepts of the technology, of its associated systems level design tradeoffs and of its usage in the proposed application. In order to do the assessment, the bidder should demonstrate a detailed understanding as well as broaden the fundamental concepts.

The understanding can be demonstrated by description of the overall problem and solution proposed by the bidder, an overview of the background context, such as results of literature searches, prior development, state-of-the-art, and a general description of the expected improvement, results and benefits, based on the technical objectives described in Annex A, Appendix A-5: *List of Priority Technologies and associated specific statement of works*

3A.5.2 Team Experience and Capability (Evaluation Criterion 2)

(see section 4A.3.2 Criterion 2 Team Experience and Capability of Attachment 1 to Part 4)

This criterion assesses the combined technical capability and experience of the key project Scientists/Engineers identified to carry out the work as well as the qualifications and experience of the Project Manager. In order to do the assessment, the bidder should:

- Provide an overview of its organisation. It should cover the following elements: the nature and structure of the Bidder's organization; the level of Canadian ownership; the location, size and general description of the plant facility; the size and composition of staff; the principal product or field of endeavour; the annual business volume and general nature of the company's client base; and a list of any applications for funding from other Government sources and/or Government contracts received for similar and/or related work. This section should identify the location where the Work will be performed.
- Identify the key members of the project's technical and management teams and state their specific roles, qualifications and experience for the work involved. The bidder should include an organization chart that illustrates the structure of the proposed project team. The project manager's track record in past projects must be detailed. Detailed resumes must be provided into an Appendix to Section I of the bid. Names of back-up personnel for key positions should also be included.

3A.5.3 Implementation Plan (Evaluation Criterion 3)

(see section 4A.3.3 Criterion 3 Implementation Plan of Attachment 1 to Part 4)

The Bidder should present an Implementation Plan that will effectively and efficiently direct the project to a successful completion. The Implementation Plan's presentation must be based on the recognized management tools most applicable to the proposed project, such as a scope planning (Work Breakdown Structure), and schedule development charts (Gantt, Program Evaluation and Review Technique -PERT, etc). Equivalent Bidder-developed, project-tailored tools/charts are also acceptable, provided that the information is complete.

3A.5.3.1 Work Breakdown Structure and Work Package Definition

This Implementation Plan subsection should define and specify the scope of Work to be executed according to the requirements of the Statement of Work, Contract Deliverables and Meetings (Annex A). Work Breakdown Structure (WBS) is a recognized scope definition technique, while Work Packages (WP) stem from the WBS. The WBS should flow down to a low enough level and the associated WP should be defined in sufficient depth in order for the Bidder to demonstrate the methodology that will be followed to perform the project.

Each WP should focus on specific activities that will form the total Work and, as a minimum, should define and describe the specific work to be carried out. It should also indicate: the person responsible, the WP's associated levels-of-effort and required resources, the schedule (start and finish dates), and the associated inputs and deliverable or output.

As a guideline, Figure 3A.1 presents a fictitious example of a WBS, while Table 3A.1 presents a fictitious example of a Work Package Definition Sheet. For each work packages the Bidder should provide a detailed statement of work and list the associated resources.

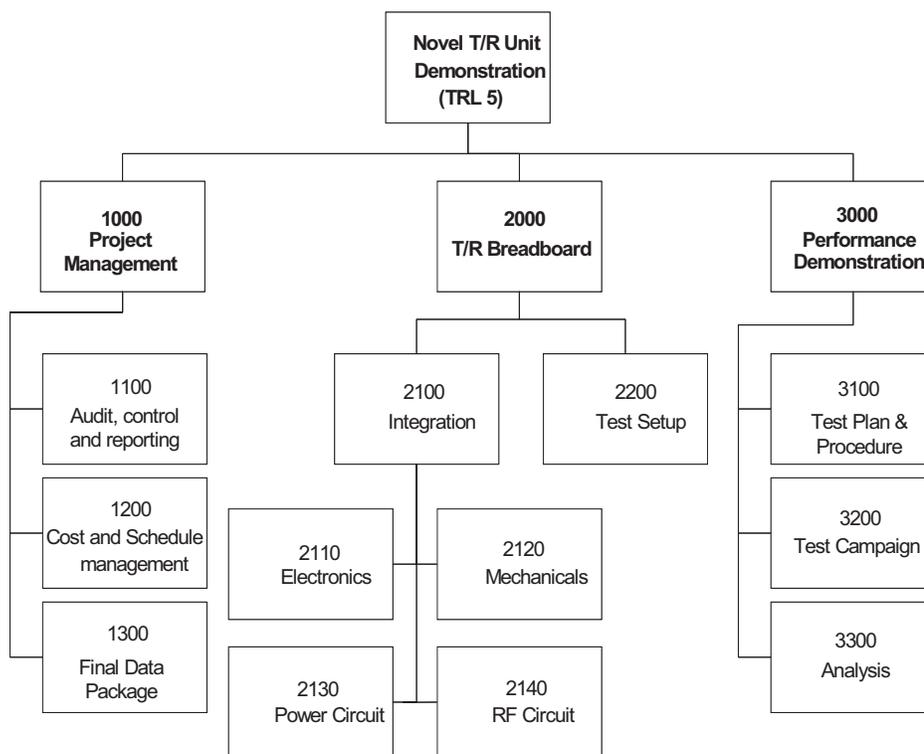


Figure 3A.1: Example of a Work Breakdown Structure

Project: T/R Unit Demonstration		
Work Pack Title:	TEST SETUP	WBS Ref: 2200
Sheet: 1 of 1	WP Estimated Value:	Do not indicate \$ value in Section I of the bid, indicate value only in Section II
Scheduled Start: T0 + 2 weeks	Accountable Manager:	Resource A
Scheduled End: T0 + 12 weeks	Resources:	Resource A, Resource B, Resource C
Estimated Effort: 80 hours		
<u>Objectives:</u>		
<ul style="list-style-type: none"> Deliver a functional test setup for the T/R unit 		
<u>Inputs:</u>		
<ul style="list-style-type: none"> Test plan and procedure Unit drawings Unit Interface Control Documents 		
<u>Tasks:</u>		
<ul style="list-style-type: none"> Review input documentation Define requirements Produce initial concept Design test setup Fabricate test setup Commission and debug 		
<u>Outputs and Deliverables:</u>		
<ul style="list-style-type: none"> Fully functional T/R unit test setup Test setup log manual Test setup user manual 		

Table 3A.1: Example of Work Package Definition Sheet

3A.5.3.2 Personnel Allocation

This Implementation Plan subsection should include a Responsibility Assignment Matrix (RAM) showing the level-of-effort for each individual team member or sub-contractor that has been allocated to each WP. The matrix should identify each individual by name and organisation, and provide the estimated time (number of hours or days) required to complete each task. Also, the RAM should identify the role of the individual, either being the accountable person for the WP (A), or being a participant (P). Bidders must provide letters of intent from involved sub-contractors or major contributors to the project. As a guideline, Table 3A.2 presents a fictitious example of a RAM. The RAM should be presented in both the technical bid and the financial bid.

WBS Number	Work Package Title	Resource A		Resource B		Resource C		Total
1.1	Project Management	A	200	P	25	P	25	250
1.2	Literature Survey	A	25	P	100	-	0	125
1.3	Requirements	P	50	A	100	P	100	250
1.4	Design	P	100	A	100	P	150	350
1.5	Build	-	0	P	200	A	150	350
1.6	Test and Analysis	A	100	P	200	P	200	500

P : Participant
A : Accountable

Total 475 725 625 1825

Table 3A.2: Example of Responsibility Allocation Matrix (RAM)

3A.5.3.3 Technical Risk Assessment/Analysis

The bidder should provide an assessment of the technical risks/uncertainties involved as well as the major assumptions upon which the work is based. In particular, this subsection should address any performance risks that pertain to the new technology. The risks should be identified and a Risk Mitigation Plan, that would include contingency plans, alternatives or other means of limiting adverse impacts of risks being realized, should be provided. As a guideline, Table 3A.3 presents a fictitious example of a Technical Risk Assessment Matrix, while Table 3A.4 presents an example of a Project Risk Profile Matrix.

Risk Event 1 (R1)	Limited availability of key documents	
Probability	Low	1/20 Past experience demonstrates important number of different sources for patents and articles covering this subject
Consequence to project	Low	\$5 000 - \$10 000 Cost growth Schedule delays
Risk Assessment	Low	\$250 - \$500 (R < 5% of overall project value, \$250K)
Mitigation Plan	Secure at least 2 sources for each type of document	
Contingency Plan	Use second source	

Table 3A.3: Example of a Technical Risk Assessment Matrix

Probability			
High			R2
Medium			
Low	R1		
	Low	Medium	High
	Consequence		

Table 3A.4: Project Risk Profile Matrix

It is understood that in order to develop advanced technologies, a certain amount of technical risk should be assumed. The extent to which higher technical risks are acceptable depends upon how well they have been identified, defined, assessed, planned for, and managed once realized. If the technical risks are poorly defined, or the risk mitigation is inadequately planned, then the project's evaluation score is likely to diminish.

3A.5.3.4 Managerial Risk Assessment

This Implementation Plan subsection should provide an assessment of the managerial risks involved, provide a Risk Mitigation Plan and identify critical issues that may jeopardize the successful completion of the Work within cost and schedule constraints. As a guideline, Table 3A.5 presents a fictitious example of a Managerial Risk Assessment Matrix. Additionally, Table 3A.6 presents an example of a Project Risk Profile Matrix.

Risk Event 2 (R2)	Late delivery of test equipment	
Probability	High	1/3 Past experience with provider demonstrated poor respect of schedule
Consequence to project	High	\$110 000 (cost of securing optional test facility) Significant cost growth Significant schedule delays
Risk Assessment	High	\$55 000 High (R > 25% of overall project value)
Mitigation Plan	Identify and secure equivalent equipment in immediate geographical region Ensure equipment will be available for needed time frame Memo of understanding with facility key managers	
Response Plan	Secure equipment with MOU Confirm time frame options with facility	

Table 3A.5: Example of a Managerial Risk Assessment Matrix

Probability			
High			R2
Medium			
Low	R1		
	Low	Medium	High
	Consequence		

Table 3A.6: Example of a Project Risk Profile Matrix

3A.5.3.5 Milestones and Deliverables

This Implementation Plan subsection should contain a definition of the milestones and describe in details all expected deliverables, including hardware, software, and relevant documentation (refer to Annex A for more details). When appropriate, the milestones and deliverables should contain all elements identified in the SOW (Table A-2 of Annex A and specific SOWs) and should relate to the corresponding WP definition in a manner enabling clear monitoring of progress (see paragraph 3A.5.3.1)

3A.5.3.6 Schedule

The Bidder should provide a project timetable that relates tasks, milestones and deliverables. A Gantt chart and/or PERT chart should be used to illustrate the schedule. The schedule should show significant details for events associated with achievement of major tasks, milestones and deliverables. Linkage between activities should also be identified in the schedule. For planning purposes, use a project start date of April 2016.

3A.5.3.7 Performance Evaluation Criteria (PEC)

The bidder should establish technical conditions and criteria to be met for each TRL targeted in the project as well as a list of objectively measurable or binary (yes/no) Performance Evaluation Criteria (PEC). These will be reviewed at the kick off meeting and serve to determine which criteria will be used for the work authorization decision and determine project success at the final review meeting.

3A.5.3.8 Project Control System

This Implementation Plan subsection should outline the methods and systems to be used to control and report on the various aspects of project (e.g. tasks, schedules, and costs for the Work). Additionally, the Project Control System should be capable of reporting the amount of work per WBS item for each individual on a monthly basis.

3A.5.3.9 Background Intellectual Property and Foreground Intellectual Property

This subsection should identify and describe all Background Intellectual Property (BIP) that is required to conduct and/or support the Work and all Foreground Intellectual Property (FIP) expected to arise from the proposed Work. BIP and FIP element should be described in sufficient detail so as to be clearly distinguishable. The expected format to provide this information is as per Tables 3A.7 and 3A.8.

1 BIP ID#	2 Project Element	3 Title of the BIP	4 Type of IP	5 Type of access to the BIP required to use/improve the FIP	6 Description of the BIP	7 Reference documentation	8 Origin of the BIP	9 Owner of the BIP
	Provide the system ID # or sub system in which BIP is integrated (e.g. camera, control unit, etc)	Use a title that is descriptive of the BIP element integrated to the work	Is the BIP in the form of an invention, trade secret, copyright, design?	Describe how the BIP will be available for Canada to use the FIP (e.g. BIP information will be incorporated in deliverable documents, software will be in object code, etc)	Describe briefly the nature of the BIP (e.g. mechanical design, algorithm, software, method, etc)	Provide the number and fill title of the reference documents where the BIP is fully described, The reference document must be available to Canada. Provide patent# for Canada if BIP is patented.	Describe circumstances of the creation of the BIP Was it developed from internal research or through a contract with Canada? If so, provide contract number.	Name the organization that owns the BIP. Provide the name of the subcontractor if not owned by the prime contractor.

Table 3A.7: Disclosure of Background Intellectual Property (BIP) expected to be required for the Contract

1 FIP ID #	2 Project Element	3 Title of FIP	4 Type of FIP	5 Description of the FIP	6 Reference documentation	7 BIP used to generate the FIP	8 Owner of the FIP	9 Patentability
Enter an ID # specific to each FIP element e.g.FIP-CON-99 where CON is the contract acronym	Describe the system or sub-system for which the FIP element was developed (e.g. a camera, ground control, etc)	Use a title that is descriptive of the FIP element.	Specify the form of the FIP e.g. invention, trade secret, copyright, industrial design	Specify the nature of the FIP e.g. software, design, algorithm, etc?	Provide the full title and number of the reference document where the FIP is fully described. The reference document must be available to Canada	BIP referenced in table 1 e.g. BIP-CON-2, 15	Specify which organization owns the FIP e.g. Contractor, Canada* or Subcontractor. Provide the name of the subcontractor if not owned by the prime contractor. Provide reference to contract clauses that support FIP ownership. Provide reference to WPDs under which the technical work has been performed.	In the case where the IP is owned by Canada, indicate with an "X", any IP elements described is patentable and complete Table 3 only for this IP.

Table 3A.8: Disclosure of the Foreground Intellectual Property (FIP) expected to be developed under the Contract

Use of graphical representations that include block diagrams is encouraged in order to demonstrate the relationships between the various elements of the BIP and the FIP. The BIP and the expected FIP will be reviewed at the Kick-Off Meeting, and updated at the end of the contract.

Bidder's realizations that are software oriented and propose to improve upon existing software programs/applications will be required to adhere to supplemental general conditions 4002 (Software Development or Modification Services) and 4003 (Licensed Software).

3A.5.4 Feasibility Of Proposed Solution In Meeting The Technical Objectives (Evaluation Criterion 4)

(see section 4A.3.4 Criterion 4 Feasibility Of Proposed Solution In Meeting The Technical Objectives, of Attachment 1 to Part 4)

The criterion assesses the overall feasibility of the proposed technical approach and the degree to which the solution will satisfy the technical objectives. In order to do the assessment, the bid should:

- Clearly describe the proposed solution in terms of its physical characteristics, functionality and performance. When applicable, the foreseen concept of operation should be introduced.
- Describe the physical principles under which the solution operates.
- Described critical design and fabrications steps.
- Clearly state the degree to which the solution satisfies the technical objectives sought in the specific statements of work.

3A.6. Bid Appendices

3A.6.1 Appendices Required with the Bid

The following item should be addressed in individual appendices as part of the bids:

- a) List of Acronyms: All the acronyms used in the Section I: Technical and Managerial Bid, should be explained;
- b) Resumes: The bid should include resumes of the proposed resources and these should be appended to Section I: Technical and Managerial Bid;
- c) Relevant Technical Papers Published by Team Members: Only literature that is relevant and that would be useful to support the bid;
- d) List of Contacts: The list of contacts should be appended to Section I: Technical and Managerial Bid, in a format suitable for distribution and should include all the Bidder's points-of-contacts involved in the bid development and/or during the Contract;

The following example format should be used:

Role	Name	Telephone	E-Mail
Project Manager			
Project Engineers/Head Investigator			
Contractor's Representative			
Claims(Invoicing) Officer			
Communications (for press release)			
Etc.			

Table 3A.9: Bidder's List of Contacts

Solicitation No. - N° de l'invitation
9F063-140572/A
Client Ref. No. - N° de réf. du client
9F063-14-0572

Amd. No. - N° de la modif.
File No. - N° du dossier
MTB-

Buyer ID - Id de l'acheteur
MTB575
CCC No./N° CCC - FMS No./N° VME

- e) Letters of intent: Letters of intent to participate must be provided by all sub-contractors or co-contributors to the project;
- f) Bidder's criteria Substantiation: For each of the applicable evaluation criteria, provide the substantiation and summarized cross-reference(s) to the bid.

ATTACHMENT 1 TO PART 4

POINT RATED EVALUATION CRITERIA

4A.1. TECHNICAL AND MANAGEMENT CRITERIA AND RATINGS

The Bidder must achieve the minimum score requirements as indicated in Table 4A.1: *List of Evaluation Criteria and Associated Ratings*. The bid will be evaluated according to the point-rated criteria as specified in Table 4A.1 and as described in section 4A.3: *Evaluation Criteria and Benchmark Statements*

Section 4A.3 "Evaluation Criteria and Benchmark Statements" of the current attachment contains a series of evaluation criteria, each supported by a set of 5 benchmark statements, where each corresponds to percentage of the maximum point rating.

As an example, the maximum point rating for the *Team Experience and Capability* criterion is 15 points. If a Bid receives a "75" for this criterion in the evaluation process, the score attributed will be:

$$75\% \text{ of } 15 \text{ points} = 11.25 \text{ points (score)}$$

Table 4A.1 identifies:

- a) The maximum point rating assigned to each criterion;
- b) The minimum point rating required for the criterion #4: *Feasibility of proposed solution in meeting the technical objectives*;
- c) The maximum point rating possible for the overall technical score; and
- d) The minimum point rating required for the overall technical score.

Technical Evaluation Criteria and Ratings	
	Ratings
1. Understanding the technology	15
2. Team Experience and Capability	15
3. Implementation Plan	30
4. Feasibility of proposed solution in meeting the technical objectives	40
	Minimum of 20 required
Maximum Overall Technical Score	100
Minimum Overall Technical Score Requirement	70

Table 4A.1: - List of Evaluation Criteria and Associated Ratings

4A.2. BIDDER'S CRITERIA SUBSTANTIATION

The Bidder is requested to provide a substantiation (supporting evidence), which should be submitted as an appendix to their Section I (see section 3A.6.1: *Appendices required with the bid* of Attachment 1 of Part 3: *Technical and Managerial Bid Preparation Instruction*).

For each of the applicable evaluation criteria, provide the substantiation and summarized cross-reference(s) to the bid.

The substantiation should be concise yet sufficiently comprehensive to ensure that the evaluators get a good overall appreciation of the bid's merit relative to the specific evaluation criterion. Cross-references to appropriate sections of the bid should be provided and the essence of the referenced information should be summarised in the substantiation.

For convenience, a Substantiation Table is provided in Table 4A.2 below. Enter each evaluation criterion section number, and the substantiation. It is expected that approximately half a page should be sufficient to make the Bidder's case for the rating chosen in the substantiation column.

Company:	
Project Title:	
Space Technologies Development - Technologies for Potential Space Missions	
Criteria	
Substantiation	
<i>Ex.: 1 (criterion number)</i>	<i>Understanding the technology - It is expected that 300 words or so should be sufficient to make your case.</i>

Table 4A.2: Substantiation Table

4A.3. EVALUATION CRITERIA AND BENCHMARK STATEMENTS

The evaluation criteria benchmark statements are used by the evaluators as guidelines to justify their score. Bidders should use them to appropriately focus the relevant information to be provided.

4A.3.1 CRITERION 1: UNDERSTANDING THE TECHNOLOGY

This criterion assesses the degree to which the bid exhibits an understanding of the fundamental concepts of:

- the technology;**
- the technology's associated systems level design tradeoffs;**
- the technology's usage in the proposed application.**

Score Benchmark Statements

- | | |
|-----|--|
| 0 | The bid does not exhibit an understanding of the fundamental concepts. |
| 25 | The bid demonstrates only a limited understanding of the fundamental concepts. |
| 50 | The bid demonstrates a general understanding of the fundamental concepts. |
| 75 | The bid demonstrates a detailed understanding of the fundamental concepts. |
| 100 | The bid broadens the review of technological concepts involved as well as of the associated systems level design tradeoffs and of the technology's usage in its application. |

4A.3.2 CRITERION 2: TEAM EXPERIENCE AND CAPABILITY

This criterion assesses the combined technical capability and experience of the key project Scientists/Engineers identified to carry out the work as well as the qualifications and experience of the Project Manager.

Score Benchmark Statements

- | | |
|-----|--|
| 0 | The bid does not demonstrate that the proposed team has technical capability and experience with closely related technologies. |
| 25 | The bid demonstrates that the proposed team is missing key technical capability and has limited experience with closely related technologies. The bid does not substantiate that the project manager has a track record of having successfully completed projects of similar scope and complexity to that required for this project. |
| 50 | The bid demonstrates that the proposed team has technical capability and experience with closely related technologies, but some capabilities are weak to form a comprehensive team. The project manager has a moderate track record of successfully having managed projects of a scope and complexity similar to that required for this project. |
| 75 | The bid demonstrates that the proposed team has worked with closely related technologies of comparable scope and complexity. The proposed team possesses all the technical capabilities and experience required to perform the Work. The project manager has a moderate track record of success in executing and managing projects of a scope and complexity similar to that required for this project. |
| 100 | The bid clearly substantiates that the proposed team is highly experienced in developing closely related technologies of comparable scope and complexity. The proposed team possesses all the technical capabilities required to perform the Work. The project manager has a successful track record in executing and managing projects of a scope and complexity similar to that required for this project. |

4A.3.3 CRITERION 3: IMPLEMENTATION PLAN

This criterion evaluates the project's underlying methodology and the thoroughness of the Implementation Plan. The plan will be evaluated for its completeness, credibility, effectiveness and efficiency.

The Implementation plan required content is specified in Section 3A.5.3 of Attachment 1 of Part 3.

Score Benchmark Statements

0	The bid has no concrete Implementation Plan and thereby instills no confidence that the project will successfully meet the project objectives.
25	The bid does not provide an adequate Implementation Plan as more than one of the elements are missing or are improperly addressed. Consequently, doubts remain regarding the likelihood of the project achieving successful completion.
50	The bid provides an Implementation Plan with some elements improperly addressed. Consequently, the likelihood of achieving successful completion is marginal OR the plan reveals serious inefficiencies.
75	The bid provides a credible Implementation Plan with all elements covered. Conditions and criteria to be met for each TRL are defined and elaborated. Consequently, the likelihood of achieving successful completion is good. The plan demonstrates a somewhat efficient implementation approach.
100	The bid provides a coherent and comprehensive Implementation Plan with all elements covered. Conditions and criteria to be met for each TRL are well defined and elaborated. The plan instills confidence that the project will achieve successful completion. The plan demonstrates an efficient implementation approach.

4A.3.4 CRITERION 4: FEASIBILITY OF PROPOSED SOLUTION IN MEETING THE TECHNICAL OBJECTIVES

The criterion assesses the overall feasibility of the proposed technical approach and the degree to which the solution will satisfy the technical objectives.

MINIMUM SCORE OF 50 REQUIRED

Score Benchmark Statements

0	The feasibility of the proposed solution or the capability to satisfy the objectives is not demonstrated.
25	The proposal presents a solution which is unlikely to meet the technical objectives.
50	The proposal presents an adequate solution that can meet the technical objectives.
75	The proposal presents a credible solution that will likely meet the technical objectives.
100	The proposal presents a sound and convincing solution that can undoubtedly meet the technical objectives.

ANNEX A

STATEMENT OF WORK

A.1 SPACE TECHNOLOGY DEVELOPMENT PROGRAM BACKGROUND

The Space Technology Development Program (STDP) mandate is to formulate, implement and manage contracted out research and development (R&D) projects in response to identified needs. Its objectives are to develop and demonstrate strategic technologies that have a strong potential for having a positive impact on:

- Reducing technical uncertainties for future Canadian space activities;

The STDP will therefore support the development of technologies to meet the current and future needs of the Canadian Space Program (CSP).

A.2 OBJECTIVES

The objective of this Statement of Work (SOW) is to develop 2 Space Technologies that are in line with the Canada Space Agency's (CSA) priorities and mission roadmaps. For every Priority Technology (PT) listed herein (see APPENDIX A-5 of ANNEX A), the work solicited is the development and advancement of these technologies up to potentially TRL 5 (Technology Readiness Levels), (see APPENDIX A-1 of ANNEX A) to reduce technical uncertainties and support approval and implementation of specific potential future space missions of interest to Canada.

A.3 SCOPE

This document provides the requirements and deliverables for projects selected to develop and advance technologies that are critical for the approval and implementation of potential or planned future Canadian space missions.

A.4 PRIORITY TECHNOLOGIES

Priority Technologies are those that have been established by the CSA as the critical or strategic technologies to be developed to meet the objectives of the CSA. The contracts to be awarded are to respond to one of the Priority Technologies Specific Statement of Work detailed in APPENDIX A-5 of ANNEX A.

A.5 DOCUMENT CONVENTIONS

A number of sections in this document describe controlled requirements and specifications and therefore the following verbs are used in the specific sense indicated below:

- a) "Shall" and "Must" are used to indicate a mandatory requirement;
- b) "Should" indicates a goal or preferred alternative rather than a requirement. Such goals or alternatives are to be treated on a 'best efforts' basis, and are subject to verification as requirements are. The actual performance achieved must be included in the appropriate verification report, whether or not the performance goal is achieved;
- c) "May" indicates an option;
- d) "Will" indicates a statement of intention or fact, as does the use of present indicative active verbs other than those listed at a-c above.

A.6 GENERIC TASK DESCRIPTION

This section presents the potential activities that might take place during typical STDP projects and are deemed appropriate within the required TRL range. Tasks will vary for different projects according to targeted TRLs and may include, but are not limited to, the standard project activities listed below in Table A-1: Guideline of Activities. Contractor should use the following guideline table to select the appropriate required activities in order to satisfy the conditions for the targeted TRLs. Technology Readiness Levels (TRLs) describe the standard language of the maturation process for technology development and evolution. TRLs are described in APPENDIX A-1 of ANNEX A.

List of Activities
Project Management *
• Meetings
• Progress Monitoring
• Finance Management
• Reporting
• Preparation of Final Data Package
• Risk Management
• Configuration management
Sub-Contractor Management
• Procurement Plan
Needs Analysis
• Mission Definition
• Definition of Mission Requirements
• Environment Definition
• Technology Drivers and Constraints
• Requirements
Obtain Current Mission Documentation, and Technology Requirements
Define further Technology Requirements in terms of functional and performance characteristics
Conceptual Design
• Functional Analysis and Allocation
• Develop Operations and Development Concepts
• Cost Estimates
• Schedule Estimates
• Risk Analysis
• System Studies and Trades
• Identify Driving Requirements and Associated Risks
• Modeling and Prototyping
Design and Development Plan
Analysis
Simulation
Documentation / technical writing
Concept Design Review
Preliminary Design Review

Table A-2 contains the list of meetings, expected items to be covered during those meetings, and the associated contract deliverables. In addition to the mandatory deliverables (CDRL 1 to 16), Priority Technology specific deliverables are identified in APPENDIX A-5 of ANNEX A Those should be identified in the bid.

CDRL No.	Deliverable	Due Date	Version
1	Meeting Agendas	Meeting – 2 week	Final
2	Kick-off Meeting Presentation	Meeting – 1 week	Final
3	Quarterly or Milestone/Progress Review Meeting Presentation	Meeting – 2 week	Final
4	Final Review Meeting Presentation	Meeting – 2 week	Final
5	Meeting Minutes	Meeting + 1 week	Final
6	Action Items Log (AIL)	Meeting + 1 week	Final
7	Monthly Progress Reports	7 th of each Month	Final
8	Milestone/Progress Technical Report	Meeting – 2 weeks	Final
9	Disclosure of Intellectual Property	End of contract – 2 weeks	Final
10	Executive Report	End of contract – 2 weeks	Final
11	Final Milestone/Progress Technical Report	End of contract – 2 weeks	Final
12	Prototypes *	At Final Review Meeting	Final
13	Equipment (purchased under the contract)	At Final Review Meeting	Final
14	Software	Meeting – 2 weeks	Final
15	Government Furnished Equipment/Data	At contract end	Final
16	Final Data Package	Final review meeting + 1 week	Final
17	Asset Declaration Form – Prototypes and Equipment (APPENDIX A-4 to ANNEX A)	End of contract – 2 weeks	Final

Table A-2: Schedule of Contract Items

* The decision regarding the delivery of any prototype is to be made by the CSA at the end of each contract completion.

A.7.1 DOCUMENTATION, REPORTING AND OTHER DELIVERABLES

This section contains the lists of deliverables and describes their respective content and format. All documents must be typed and all diagrams must be clearly drawn and labeled. The Contractor must submit an electronic copy of each of the deliverable documents. Each electronic file must be named in accordance with CSA directives and with the federal government legislation and policies on managing information so as to be easily identified. The following guidelines detail how to name electronic documents.

Priority Technology specific deliverables descriptions of content and format are presented in APPENDIX A-6 of ANNEX A, Data Item Descriptions.

Documents must contain 3 main components:

- Project Identifier,
- Contract Number, and
- Date Tracking Number.

WXYZ-TYPE-NUM-CIE_Contract Number_sent Date Tracking Number

Project Identifier

The project identifier must contain:

- WXYZ: a 4- to 8-letter acronym of the project;
- TYPE: a 2-letter acronym according to the Table A-3 below:

Acronym	Description
AG	Agenda
MN	Minutes of meeting
PT	Presentation
PR	Progress Report
TN	Technical Note

Table A-3: Letter Acronym Definition

- NUM: a three digit sequential number (e.g., 001, 002, etc.); and
- CIE: name of company (no space, no hyphen).

Contract Number

For example: _9F028-07-4200-03

Date Tracking Number

This is to reflect the submission date and must follow the Year-Month-Day format. For example: _sent 2012-10-25 (for 25 October 2012).

Non-Disclosure

The documents will not be placed in the public domain, except for the Executive Report (see A.7.1.3). The Contractor must indicate the following proprietary notices:

On the cover:

© Contractor, 20XX

RESTRICTION ON USE, PUBLICATION OR DISCLOSURE OF PROPRIETARY INFORMATION

This document is a deliverable under contract No. _____. This document contains information proprietary to Contractor, or to a third party to which Contractor may have legal obligation to protect such information from unauthorized disclosure, use or duplication. Any disclosure, use or duplication of this document or any of the information contained herein for other than the specific purpose for which it was disclosed is expressly prohibited except as Canada may otherwise determine. When the Intellectual Property (IP) is disclosed for government purposes, Canada will take every effort to protect information that is proprietary.

On all internal pages:

Use, duplication or disclosure of this document or any of the information contained herein is subject to the Proprietary Notice at the front of this document.

A.7.1.1 MONTHLY PROGRESS REPORT

On a monthly basis, no later than the seventh (7th) of each month, the contractor must provide monthly progress reports. It is requested that an electronic copy of this report be sent to the Project Authority (PA) and the Contracting Authority (CA). Acceptable electronic formats are: MS Word, PDF and HTML. Refer to Section A.7.1 for instructions on how to name electronic documents. Monthly Reports are used by the PA to monitor the work on a monthly basis, these reports should be kept as brief as possible but should discuss the progress of the work and should include, but not be limited to, the following information:

- Statement indicating whether or not the project is on schedule and, if not, an explanation for any delays and/or a recovery plan. The report must include an updated schedule showing progress of work and modifications, if any;
- Statement indicating whether or not the project is within budget and, if not, an explanation for the deviation from the budget and a proposed recovery plan. The report must include an updated cash flow table showing, for each activity/milestone/Work Package, with start and end dates as well as actual cash flow with actual start and end dates;
- Brief summary of the technical progress of the work for each work package, including:
 - Description of major items developed, purchased or constructed during the reporting period, and
 - List of internal engineering reports produced during the reporting period;
- Summary of the proposed work for the following month, including:
 - Description of major items to be purchased during the next reporting period, including any software packages;
- Summary of problems encountered, their impact on the project and the subsequent solutions proposed or effected; and
- Trip reports for each conference attended or facilities visited in the course of this contract (and only if funded by the contract).

An overall assessment of the project health must be provided at the start of each report. The aim is to have an overview of the project status.

The following information should be included in the following format:

Project Element	Status	Trend	Comment
Cost	Green	↑	
Schedule	Green	↓	
Results / PEC	Red	↔	
Programmatic	Yellow	↑	

The first column identifies the project performance metrics to be assessed, namely **Project Element**. The four metrics to assess are:

- Cost,
- Schedule,
- Results against Performance Evaluation Criteria (PEC), and
- Programmatic.

The Cost, Schedule and Results/PEC metric are quantitative indicators, while the Programmatic metric is qualitative.

The second column of the table is the status for each project element.

The following table provides a definition of the different status with respect to the first three Project Elements.

Status Indicator	Interpretation		
	Cost	Schedule	Technical
Green	On or under planned project total budget	On or ahead of baseline schedule	Meets Performance Evaluation Criteria (PEC)
Yellow	Between 0 and 5% overrun	Between 0 and 5% behind schedule	Does not meet PEC but has approved recovery plan
Red	Greater than 5% overrun	Greater than 5% behind	Does not meet PEC and does not have approved recovery plan

As for the Programmatic element, the status is evaluated based on the status of the three other elements. Although the Programmatic metric takes into account Cost, Schedule and Results/PEC indicators, it is mostly influenced by the most critical element at that point in time in the project.

The third column is an assessment of the trend the Project metric. The choices are:

Trend Indicator	Interpretation
↑	The status has improved since the last review
↓	The status has worsened since the last review
↔	The status has not changed since the last review

The Fourth column is to provide the opportunity to comment the status and trend of the project element or to provide a general statement.

A.7.1.2 MILESTONE/PROGRESS TECHNICAL REPORTS

The Contractor must submit to the PA, TA and CA at least two (2) weeks prior to the due date of Milestone and/or Progress Review Meetings, a draft Milestone and/or Progress Report. The PA will review the report and may request changes, as appropriate. The Contractor will then submit the revised version.

The Milestone and/or Progress Report, which must be protected, is to contain a complete description of the work undertaken and results obtained. As such it should include all pertinent technical documents that support engineering, fabrication and/or testing tasks. It should also include an updated version, if applicable, of the Technical and Managerial Plans initially submitted. Moreover, it must provide sufficient details of the work performed to date to enable the PA and TA to perform a full and accurate progress evaluation.

The description of the work undertaken and the results obtained should include:

- Review of technical results and accomplishments;
- Assessment of results with respect to the PEC provided in the bid (supported with the necessary design documents, engineering drawings, test plans, test results and the like);
- A clear identification of the technology advancements required to meet the objectives;
- A detailed description of all equipment purchased during this period;
- All other Contractor's findings prior to the milestones; and
- Changes to the team, Work Breakdown Structure (WBS), level-of-effort, schedule, resource assignment matrix,

A.7.1.3 EXECUTIVE REPORT

The Executive Report will be placed in the public domain (e.g., CSA's library, publication and/or website, to promote the transfer and diffusion of space technologies). The report must not exceed ten (10) pages. Any confidential information concerning potential spin-off and commercialization, or any information that would constitute a public disclosure of the FIP should be placed in the Technical Report.

A recommended structure for the Executive Report is as follows:

1. Covering page (as per APPENDIX A-2 to ANNEX A);
2. Introduction;

3. Technical Objectives;
4. Approach / Project Tasks;
5. Accomplishments;
6. Technology:
 - a) Description / Status of Technology (Initial TRL, Targeted TRL and Actual TRL at completion),
 - b) Innovative Aspects, and
 - c) Application Fields
7. Business Potential, Benefit and Impact on Company;
8. Ownership of Intellectual Property; and
9. Publications / References.

The CSA and the Contractor, or others designated by them, have the right to unrestricted reproduction and distribution of the Executive Report. The report must include the following proprietary notice ("Owner of FIP" being either the CSA or the Contractor):

Copyright ©20XX "Owner of FIP"

Permission is granted to reproduce this document provided that written acknowledgement to the "Contractor name" or the Canadian Space Agency is made.

A.7.1.4 TECHNICAL REPORT

The report will contain a detailed account of all work performed under the contract. This will enable a full and accurate evaluation of the work by the PA. The report should include, as appropriate, the following:

- a) Covering page (as per APPENDIX A-2 to ANNEX A);
- b) Executive Summary;
- c) Background information and references to relevant documentation;
- d) Review of results and accomplishments;

Where applicable, the following items should be included:

- A summary of the literature search, with copies of the main publications supplied in an appendix (without infringing upon any copyrights),
 - The system requirements specification and the interface requirements specification,
 - Feasibility studies and identification of technological risks, alternatives approaches, and trade-off analysis results,
 - Design documents,
 - Implementation documents,
 - Test plan and procedures, and
 - Concept demonstration results;
- e) Assessment of results with respect to the Performance Evaluation Criteria. This should support a statement qualifying and/or quantifying three aspects:

- Performance: the project successfully met and/or exceeded none/few/some/most or all the Performance Evaluation Criteria
 - Impact: the project identified none/few or several potential and/or actual impacts/benefits
 - Success: the project has none/some or significant potential of becoming, or already is, a success story
- f) Technology Readiness Assessment (TRL reached);
 - g) Detailed description of all equipment purchased during this period;
 - h) All other Contractor findings;
 - i) Recommendations including the potential for any further R&D of a follow-on nature;
 - j) Conclusion;
 - k) Supporting tables, technical drawings and figures;
 - l) Any additional relevant information deemed important by the Contractor.

A.7.1.5 CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY

At the end of the contract, a list and descriptions of all BIP required for CSA use of the FIP must be provided at the Final Review Meeting. A list and description of all FIP resulting from project work must also be provided. Furthermore, the Contractor will complete and submit as a stand-alone document entitled "Contractor Disclosure of Intellectual Property", provided in APPENDIX A-3 of ANNEX A. The Contractor must submit an electronic copy of the Contractor Disclosure of Intellectual Property.

A.7.1.6 PROTOTYPES AND EQUIPMENT

All prototypes developed during the Contract must be disclosed to Canada and reviewed by the PA who will advise on their final disposal and /or delivery.

The Contractor should also maintain a list of all non-consumable items procured or fabricated under the contract and/or provided by the government. The Contractor must complete and submit the Asset Declaration Form found in APPENDIX A-4 of ANNEX A. The Contractor will be notified as to how the assets (equipment) should be handled after the PA and TA have reviewed the list.

A.7.1.7 SOFTWARE

The Contractor must provide an electronic copy of all Contractor documents describing the software development cycle, including user, maintenance and operation manuals. The developed software must also be provided in the form of well-documented source code in computer compatible format, with run-time libraries and executable files.

A.7.2 MEETINGS

As per Table A-4 below, the Contractor will schedule and co-ordinate with all the stakeholders the following meetings:

- Kick-Off Meeting,
- Milestone Review Meetings,
- Progress Review Meetings
- Work Authorization Meeting, and

- Final Review Meeting.

Meeting	Date	Location
Kick-off Meeting	No later than 2 weeks After Contract Award (ACA)	Contractor's premises
Milestone Review Meetings	At least every 4 months or when specified in specific statement of work	At CSA's premises unless otherwise specified in specific statement of work
Progress Review Meetings	To be held if the maximum interval between Milestone reviews exceeds 4 months	Teleconference
Work Authorization Meeting	At the Contract Mid-point. May be held before if deemed critical/relevant. Occurs concurrently with a regular milestone review meeting.	
Final Review Meeting	End of Contract	CSA's premises

Table A-4: Meetings and Decision Schedule

For all meetings, the Contractor will:

- Suggest the meeting content and deliver the suggested meeting agenda to the PA and the TA at least ten working days before the meeting;
- Deliver to the PA and the TA, all required reports and technical documents relating to the work about which the meeting is about;
- Record the minutes of the meeting; and
- Deliver one (1) electronic copy of the minutes of the meeting to the PA five working days after the meeting.

In support of the project meetings, viewgraphs and supporting presentation materials should be prepared. One (1) electronic copy should be presented to the PA. Documented video materials should be prepared by the Contractor along with the supporting visual presentation material to support any demonstration of the technology. A copy of the supporting visual material should be delivered to the PA.

A.7.2.1 KICK-OFF MEETING

Within two weeks of the contract award (or at a date mutually agreeable to by the PA and the Contractor) a Kick-Off Meeting (KOM) must be held to:

- Submit and review the proposed **Performance Evaluation Criteria (PEC)**. This is a list of criteria that will be used throughout the project to evaluate the Contractor's technological progress. It will be provided in the Contractor's bid and accepted at the

KOM and reviewed at each Milestone/Progress Review Meeting as well as at the Contract Mid-point Work Authorization Meeting;

- Review contract deliverables;
- Review the requirements of the work;
- Review the work schedules;
- Review risk assessment and mitigation plan;
- Review Work Breakdown Structure and Work Packages;
- Review capability to deliver work packages at agreed cost and schedule;
- Discuss the BIP and review the provided list;
- Discuss the expected FIP and review the provided list (review Disclosure of FIP issues);
- Review basis of payment, and claim format;
- Review reporting requirements;
- Discuss any licensing issues; and
- Meet the personnel assigned to the work.

A.7.2.2 MILESTONE AND PROGRESS REVIEW MEETINGS

Milestone and Progress Review Meetings will be held periodically throughout the life of a Contract to provide formal opportunities for face-to-face information exchanges as well as for progress monitoring discussions and decision making. Nominally, a Milestone Review Meeting will be held at the end-point of each milestone. Between milestones, Progress Review Meetings should also be held if the maximum interval between Milestone reviews exceeds 4 months. These meetings will be scheduled by the Contractor and can be held by teleconference.

The Milestone Meetings and Progress Review Meetings are intended to provide an opportunity for the Contractor, the PA, the TA, and other invited attendees to review and discuss the following in detail:

- The contents of the Milestone and/or Progress Report;
- The current % of completion and accomplishments;
- The technical work of each task;
- The performance results with respect to the PEC;
- Discuss Work Authorization Decisions by CSA, if applicable;
- Discuss relevant results achieved;
- Project management issues; and
- Other items as deemed appropriate.

A.7.2.3 WORK AUTHORIZATION MEETING AND DECISIONS

A Milestone or Progress Review Meeting will also serve as a Work Authorization Meeting to be held approximately mid-way through the Contract (i.e., when approximately 50% of the contract value has been reached). This Work Authorization Meeting will serve as a basis for a decision to be made about whether or not to proceed with the follow-on activities of the Contract. This decision will be based primarily on the review of the achieved PEC in comparison with the PEC

accepted at the Kick-Off Meeting and/or as revised at previous Milestone or Progress Review Meetings.

A Work Authorization decision will also be taken at each Government Fiscal Year end (March 31st) if there is no Work Authorization Meeting or no Final Review Meeting scheduled in the month of March. This decision will be based on availability of Government funding at that time.

The Contractor may request Ad-hoc Meetings with CSA whenever required to resolve unforeseen and urgent issues. The CSA may also request such Ad-hoc Meetings with the Contractor. The selection of participants will depend on the nature of the issue.

The PA and the TA reserve the right to invite additional knowledgeable people (Public Servants or others under Non-disclosure Agreement) to Milestone/Progress Review Meetings. Key Contractor personnel involved in the work under review will attend Milestone/Project Review Meetings. The exact location, date and time of the Progress Review Meetings will be mutually agreeable to the PA and the Contractor, while meeting Section A.7.2 MEETINGS.

A.7.2.4 FINAL REVIEW MEETING

The Final Review Meeting will be held at the end of the contract. The specific intent of this meeting will be to discuss in detail the results obtained (as compared to the agreed-upon PEC) and the proposed follow-on activities.

The Final Review Meeting is intended to provide an opportunity for the Contractor, the PA, the TA, and other invited attendees to review and discuss in detail:

- The contents of the Final Data Package;
- The Executive and Technical Reports;
- Contractor Disclosure of Intellectual Property;
- Meeting presentation material;
- Prototypes, technical drawings, hardware, software, equipment, as applicable
- Asset declaration form; and
- Other items as deemed appropriate.

The Final Data Package is an assembly of final versions of all identified deliverables, plans and specifications, schematics, part lists and engineering data developed during the project.

The PA and the TA reserve the right to invite additional knowledgeable people (Public Servants or others under Non-disclosure Agreement) to the Final Review Meeting. Key Contractor personnel involved in the work under review should attend the Final Review Meeting. The exact location, date and time of the Final Review Meeting is to be mutually agreeable to the PA and the Contractor.

A.7.3 FORMS

The Report Documentation Page (see APPENDIX A-2 of ANNEX A) should be included in both the Executive Report and Technical Report.

The Contractor must complete and submit the Asset Declaration Form in APPENDIX A-4 of ANNEX A, for which CSA will issue inventory bar codes at the end of the contract. The Contractor will be notified as to how the assets (prototypes and equipment) should be handled after the PA and TA have reviewed the list.

Also, the Disclosure of Intellectual Property (APPENDIX A-3 of ANNEX A) must be completed by the Contractor.

List of Appendices

APPENDIX A-1	Technology Readiness Levels (TRLs)
APPENDIX A-2	Report Documentation Page
APPENDIX A-3	Contractor Disclosure of Intellectual Property
APPENDIX A-4	Asset Declaration Form - Prototypes and Equipment
APPENDIX A-5	List of Priority Technologies and associated specific statement of works
APPENDIX A-6	Data Item Descriptions

APPENDIX A-1

TECHNOLOGY READINESS LEVELS (TRLs)

Source: RD-1 (CSA-ST-GDL-0001 Revision A - Technology Readiness Assessment Guidelines)

Readiness Level	Definition	Explanation
TRL 1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development.
TRL 2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented and R&D started. Applications are speculative and may be unproven.
TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept	Active research and development is initiated, including analytical / laboratory studies to validate predictions regarding the technology.
TRL 4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that they will work together.
TRL 5	Component and/or breadboard validation in relevant environment	The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.
TRL 6	System/subsystem model or prototype demonstration in a relevant environment (ground or space)	A representative model or prototype system is tested in a relevant environment.
TRL 7	System prototype demonstration in a space environment	A prototype system that is near, or at, the planned operational system.
TRL 8	Actual system completed and "flight qualified" through test and demonstration (ground or space)	In an actual system, the technology has been proven to work in its final form and under expected conditions.
TRL 9	Actual system "flight proven" through successful mission operations	The system incorporating the new technology in its final form has been used under actual mission conditions.

Table A-1-1: Definition of Technology Readiness Levels

APPENDIX A-2

Canadian Space Agency Agence spatiale canadienne	REPORT DOCUMENTATION PAGE	
Report Date:		
Title:		
Author(s):		
Performing Organization(s) Name and Address(es):		
Contract # and Title:		
Sponsoring Agency Name(s) and Address(es): Canadian Space Agency 6767 Route de l'Aéroport Saint-Hubert, Québec, Canada J3Y 8Y9 Tel: (450) 926-4800		
Scientific Authority:		
Project Manager:		
Abstract:		
Key Words:		
Supplementary Notes:		
Distribution/Availability:		

Table A-2-1: Template for Report Documentation Page

APPENDIX A-3
Contractor Disclosure of Intellectual Property

Instructions to the Contractor

Identification

The Contractor must respond to the 7 following questions when Foreground Intellectual Property (FIP) is created under the Contract with the CSA.

1. Contractor Legal Name:
2. Project Title supported by the Contract:
3. CSA Project Manager of the Contract:
4. Contract #:
5. Date of the disclosure:
6. Will there be Contractor's Background Intellectual Property brought to the project:
 - Yes_ Complete Table 1 attached (Disclosure of Background Intellectual Property)
 - No
7. For Canada's owned IP, are there any IP elements that, to your opinion, would benefit from being patented by Canada?
 - Not applicable, FIP resides with the Contractor
 - Yes_ Complete Table 3 attached (Canada's Owned Additional Information)
 - No

For the Contractor <hr style="border: 0; border-top: 1px solid black; margin-bottom: 5px;"/> Signature	<hr style="border: 0; border-top: 1px solid black; margin-bottom: 5px;"/> Date
For the CSA Project Manager <hr style="border: 0; border-top: 1px solid black; margin-bottom: 5px;"/> Signature	<hr style="border: 0; border-top: 1px solid black; margin-bottom: 5px;"/> Date

BIP

- At the end of the Contract, the Contractor must review and update the BIP disclosure (Table 1) when applicable before closing of the Contract. Only the BIP elements that were used to develop the FIP elements should be listed.

FIP

- At the end of the Contract, the Contractor must complete Table 2 (Disclosure of the FIP developed under the Contract).
- If Canada is the owner of the FIP and identifies some FIP elements that would benefit from being patented by Canada, the Contractor must also complete Table 3 (Canada’s Owned FIP Additional Information).
- The Contractor must sign below and deliver the completed Contractor Disclosure of Intellectual Property to the CSA Project Manager of the Contract for his/her approval before closing the Contract.

General Instructions for BIP and FIP tables

- Tables must be structured according to the CSA IP form provided.
- Each IP element must have a unique ID # in order to easily link the elements of the different tables.
- Titles of IP elements must be descriptive enough for project stakeholders to get a general idea of the nature of the IP.
- Numbers and complete titles of reference documents must be included.

<u>Definitions</u>
<u>Intellectual Property (IP)</u> : means any information or knowledge of an industrial, scientific, technical, commercial artistic or otherwise creative nature relating to the work recorded in any form or medium; this includes patents, copyright, industrial design, integrated circuit topography, patterns, samples, know-how, prototypes, reports, plans, drawings, Software, etc.
<u>Background Intellectual Property (BIP)</u> : IP that is incorporated into the Work or necessary for the performance of the Work and that is proprietary to or the confidential information of the Contractor, its subcontractors or any other third party.
<u>Foreground Intellectual Property (FIP)</u> : IP that is first conceived, developed, produced or reduced to practice as part of the Work under the Contract.

Table 1. Disclosure of Background Intellectual Property (BIP) brought to the project by the Contractor

1 BIP ID#	2 Project Element	3 Title of the BIP	4 Type of IP	5 Type of access to the BIP required to use/improve the FIP	6 Description of the BIP	7 Reference documentation	8 Origin of the BIP	9 Owner of the BIP
Provide ID # specific to each BIP element brought to the project e.g. BIP-CON-99 where CON is the contract acronym	Describe the system or sub system in which BIP is integrated (e.g. camera, control unit, etc)	Use a title that is descriptive of the BIP element integrated to the work	Is the BIP in the form of an invention, trade secret, copyright, design?	Describe how the BIP will be available for Canada to use the FIP(e.g. BIP information will be incorporated in deliverable documents, software will be in object code, etc)	Describe briefly the nature of the BIP(e.g. mechanical design, algorithm, software, method, etc)	Provide the number and fill title of the reference documents where the BIP is fully described, The reference document must be available to Canada. Provide patent# for Canada if BIP is patented.	Describe circumstances of the creation of the BIP Was it developed from internal research or through a contract with Canada? If so, provide contract number.	Name the organization that owns the BIP. Provide the name of the subcontractor if not owned by the prime contractor.

Table 2. Disclosure of the Foreground Intellectual Property (FIP) developed under the Contract

1 FIP ID #	2 Project Element	3 Title of FIP	4 Type of FIP	5 Description of the FIP	6 Reference documentation	7 BIP used to generate the FIP	8 Owner of the FIP	9 Patentability
Enter an ID # specific to each FIP element e.g. FIP-CON-99 where CON is the contract acronym	Describe the system or sub-system for which the FIP element was developed (e.g. a camera, ground control, etc)	Use a title that is descriptive of the FIP element.	Specify the form of the FIP e.g. invention, trade secret, copyright, industrial design	Specify the nature of the FIP e.g. software, design, algorithm, etc?	Provide the full title and number of the reference document where the FIP is fully described. The reference document must be available to Canada	BIP referenced in table 1 e.g. BIP-CON-2, 15	Specify which organization owns the FIP e.g. Contractor, Canada* or Subcontractor. Provide the name of the subcontractor if not owned by the prime contractor. *If Canada is the owner of the FIP, complete Table 3 below Provide reference to contract clauses that support FIP ownership. Provide reference to WPDs under which the technical work has been performed.	In the case where the IP is owned by Canada, indicate with an "X", any IP elements described is patentable and complete Table 3 only for this IP.

Table 3. Canada's Owned FIP Additional Information

1 FIP ID #	2 Title of FIP	3 Aspects of FIP that are novel, useful and non obvious	4 Limitations or drawback of the FIP	5 References in literature or patents pertaining to the FIP	6 Has the FIP been prototyped, tested or demonstrated? (e.g. analytically, simulation, hardware)? Provide results	7 Inventor(s)	8 Was the FIP disclosed to other parties?
		How is the FIP addressing a problem (useful) and what is thought to be novel in this solution (novel)?	Describe the limitations of present apparatus, product or process	Provide references in published literature or patents relating to the problem or subject if any.	Describe briefly how the process, product or apparatus performed during testing or simulation. Provide reference document # where the performance is compiled if applicable.	Provide name and coordinates of the person(s) who created the FIP	Has any publication or disclosure of the FIP or any of its elements been made to third parties? If so, provide when, where and to whom.

APPENDIX A-4
ASSET DECLARATION FORM - PROTOTYPES AND EQUIPMENT

Equipment Declaration: The Contractor must fill out the following form so as to identify all equipment procured under this contract.

Equipment #	Equipment description	Inventory #	Acquisition Value	Currency	Acquisition date	Manufacturer	Country	Model #	Serial #

Table A-4-1: Equipment Declaration Form

Prototype List: The Contractor must provide a list of all prototypes developed under this contract.

Prototype Name	Prototype description

Table A-4-2: Prototype Declaration Form

The decision regarding the delivery of any prototype is to be made by the CSA at the end of each contract completion
 Note: Canada may reserve the right not to request compensation or replacement of government-furnished equipment (GFE) if the use of the said equipment is an integral part of the proposed research and development study or work.

APPENDIX A-5

LIST OF PRIORITY TECHNOLOGIES AND ASSOCIATED SPECIFIC STATEMENT OF WORKS

Rank	PT #	Priority Technology Title
1	PT 18	Gallium Nitride (GaN) High Power Amplifier development for C and X-Band Applications
2	PT 19	Multi-Channel SAR Receiver

Table A-5-1: List of Priority Technologies

Priority Technology 18 (PT 18)

Gallium Nitride (GaN) High Power Amplifier development for C and X-Band Applications

Gallium Nitride (GaN) High Power Amplifier development for C and X-Band Applications

List of Acronyms

AD	Applicable Document
BB	Breadboard
CAD	Computer aided design
CMOS	Complementary Metal Oxide Semiconductor
CSA	Canadian Space Agency
CW	Continuous wave
GaAs	Gallium Arsenide
GaN	Gallium Nitride
HPA	High Power Amplifier
HTCC	High Temperature Co-fired Ceramic
ITAR	International Trading in Arms Regulation (US)
JAXA	Japanese Aerospace Exploration Agency
LTCC	Low Temperature Co-fired Ceramics
MMIC	Monolithic Microwave Integrated Circuit
OBO	Output Back-Off
PRF	Pulse repetition frequency
RD	Reference Document
RCM	RADARSAT Constellation Mission
SA	Scientific Authority
SAR	Synthetic Aperture Radar
SiGe	Silicon-Germanium
TA	Technical Authority
TRL	Technology Readiness Level
US	United States of America
USD	US dollar

Applicable documents

This section lists documents that are required for the bidder to develop the proposal.

The applicable documents listed below can be obtained from the following File Transfer Protocol (FTP) sites: SU-AD-1 and SU-AD-2 can be obtained from

<ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/>;

SU-AD-3 can be obtained from <https://escies.org/webdocument/showArticle?id=167>;

AD No.	Document Number	Document Title	Rev. No.	Date
SU-AD-1.	CSA-ST-GDL-0001	CSA Technology Readiness Levels and Assessment Guidelines	B	Feb 14, 2014
SU-AD-2.	CSA-ST-FORM-0001	Technology Readiness and Risk Assessment (TRRA) Worksheet	E	July 29, 2013
SU-AD-3.	ECSS-Q-ST-30-11C	Derating - EEE components	1	4 Oct 2011

Reference documents

This section lists documents that provide additional information to the bidder, but are not required to develop the proposal.

RD No.	Document Number	Document Title	Rev. No.	Date
RD-1.	PMBOK Guide	A Guide to the Project Management Body of Knowledge, Project Management Institute, Incorporated	4th Edition	2008
RD-2.	ESTEC, TEC-SHS/5574/MG/ap	Technology Readiness Levels Handbook for Space Applications		March 2009
RD-3.	CSA-SE-STD-0001	CSA Systems Engineering Technical Reviews Standard	Rev. A	Nov 7, 2008
RD-4.	CSA-SE-PR-0001	CSA Systems Engineering Methods and Practices	Rev. B	Mar 10, 2010

RD-2 can be obtained from the following File Transfer Protocol (FTP) site:

<ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/>

RD-3 and RD-4 can be obtained from the following File Transfer Protocol (FTP) site:

<ftp://ftp.asc-csa.gc.ca/users/TRP/pub/SE-STD/>

Technology Description

The ever evolving needs for high communication data rates and high resolution SAR Earth Observation satellites at microwave frequencies are already pushing the limits of what performance can be achieved using conventional semiconductor materials such as Gallium Arsenide (GaAs) and Silicon Germanium (SiGe). Other semiconductor processes such as CMOS are not very well suited for operation in harsh environments, especially radiation.

Characteristics of GaN-based semiconductors, such as high power density, high operating voltage and temperature, accompanied by an inherent robustness to radiation damage make GaN devices a potentially outstanding choice for applications in the harsh environments encountered in space missions, be they communications, Earth observations or even planetary exploration.

Furthermore, GaN promises big improvements in the performance of wide bandwidth communications and radar systems because it can deliver up to 10 times as much power at microwave frequencies as the silicon germanium and gallium-arsenide semiconductors currently used in satellite radar systems and communication transmitters. Other non-space applications include automotive, aeronautical, defence and mining/oil.

Compared to other semiconductor technologies, amplifiers based on GaN offer:

- higher operating voltages,
- higher output power,
- higher efficiency
- increased reliability

The resultant circuit and system performance improvements include:

- greater bandwidth due to higher impedance match for a given output power
- improved system efficiency due to lower IR losses in dc feed networks.
- possibility of retrofitting TWT-based systems with high-voltage GaN SSPA
- more reliable, smaller SSPA

However this comes with associated challenges:

- higher heat flux density
- higher DC voltage operation
- lacking on-orbit heritage

Note: The ALOS-2 Earth Observation SAR satellite is equipped with L-band GaN-based TR modules. This is one of the first commercial space mission using GaN semiconductors. ALOS-2 was successfully launched on May 24 2014 with a 5-year design life.

<http://global.jaxa.jp/activity/pr/brochure/files/sat29.pdf>

Indeed, GaN device can be used at higher power and efficiency levels over wider bandwidths than currently possible with Gallium Arsenide (GaAs) based devices providing that associated thermal management challenges are overcome.

The development of broadband high-power, high efficiency components for Earth Observation and data relay applications using GaN components with efficient thermal management will no doubt be an asset for future space missions such as the follow-on to the current RADARSAT Constellation Mission (RCM).

This Statement of Work covers two significant challenges faced when considering using GaN for space missions: to develop building blocks for future radar applications and address thermal management challenges.

The first challenge is addressed in this SOW by the development, manufacture and test of C-band and an X-band High Power Amplifiers (HPAs).

Thermal challenges posed by high-power GaN devices and the possible associated increase in the operating temperature of surrounding components dictate the development of novel thermal management approaches. This is to be accomplished by evaluating materials and structures which will enable increased power density without impacting performance and reliability of the power amplifier.

The development of advanced GaN-based semiconductor functional building blocks is consistent with the goals and strategy of the CSA and will extend the capability of a signature technology. Establishing Canada as a leader in GaN microelectronics promises a rich scientific and commercial return, while securing Canada's highly visible and critical participation in the next era of space utilization.

Scope of Work

The scope of work defined here complements Section A.6 Generic Task Description of Annex A.

The contractor must perform, as a minimum, the work required to complete a first iteration HPA design for each frequency band and its associated thermal management approach. More than one HPA design iteration may be required in order to achieve the desired performance level. The designs must use an MMIC approach based on GaN and must be compatible with modern packaging technologies such as LTCC or HTCC. Some ancillary components of the HPA may be located off the actual HPA die (e.g. power supply bypass capacitors). It is highly preferable that the MMIC HPA design concepts and techniques be already well understood by the bidding team, such that the project can effectively deliver a HPA meeting most of the requirements on the first pass and reach a maturity level of TRL 5.

The scope of this SOW encompasses the following activities:

- Project management;
- Applicable technologies literature survey;
- Search for and selection of a suitable GaN MMIC foundry,
- Development of technical requirements and baseline configurations for thermal management approaches;
- Preliminary and detailed design;
- Procurement
- Manufacturing, Assembly and Verification of the HPA(s) and thermal design;
- Provision of all related documentation; and
- Provision of all related software.

The work can be subdivided into three parts:

- 1- HPA design and test (preferably more than one design per frequency band)
- 2- MMIC foundry selection and wafer procurement/fabrication ^{See note 1}
- 3- Thermal design, fabrication and test ^{See note 2}

These amplifiers are intended for use in future space missions and the design and component selection must follow quality assurance derating requirements as defined in SU-AD-3.

The Contractor must perform a Technology Readiness and Risk Assessment (TRRA) of key technologies foreseen to be used in the proposed system, in accordance with the requirements of SU-AD-1 and in SU-AD-2, and must describe the performance characteristics of the technology with respect to the specifications listed herein.

Note 1:

In selecting a suitable process and its associated foundry it must clearly be demonstrated in the proposal that the candidate process satisfies the following conditions:

- a) Be capable of providing sufficient gain and power to meet requirements at the operating frequency with some margin,
- b) Be qualified for space applications or be part of a declared commitment by the foundry, independent of the effort described in this document, to embark in a space qualification program for this process,
- c) The selected foundry/process, when used in space mission applications such as Earth Observation, is not subject to US ITAR regulations.

For budgetary considerations, the expected cost for a 100 mm development wafer should be in the range of \$150K to \$200K USD.

Note 2:

It would be highly desirable for the thermal design approach to be integrated with the GaN HPA breadboards and tested as a combination. For the purpose of this RFP, a breadboard is defined as a packaged, standalone totally enclosed amplifier, with RF connectors and DC connectors or solder terminals, and that can be mounted on a suitable heatsink and powered by an external power supply of suitable voltage and current ratings.

Functional characteristics and performance requirements

This section presents the GaN C-band HPA and the X-band HPA specifications. The designs must meet the minimum requirements and should satisfy expressed goals set forth in Tables 1 and 2 respectively.

Table 1 – C-band HPA Specifications

Parameter	Specification			Units	Notes
	Min.	Max.	Goal		
Output Power (P_{out}) See note 3	20 (43.0)			Watts (dBm)	@ 2 dB gain compression Continuous Wave (CW)
	40 (46)		50 (47.0)	Watts (dBm)	@ 2 dB gain compression Pulsed mode
Center Frequency (f_c)	5.405	5.405		GHz	
Bandwidth (BW)	100		300	MHz	Wider BW @ upper goal f_c
Linear Gain	14			dB	@ 10 dB OBO
Flatness		0.5	0.1	dB _{p-p}	@ 2 dB compression
Power-Added Efficiency (PAE)	40		60	%	@ 2 dB compression (die only)
Pulse mode parameters					
Pulse Repetition Frequency (PRF)	1	6		kHz	
Duty Cycle	2	25		%	

Note 3: At first approximation, the associated thermal flux at the chip mounting surface may range from 200 to 900 W/cm² depending on the fabrication process, MMIC layout, output power and associated PAE.

Table 2 – X-band HPA Specifications

Parameter	Specification			Units	Notes
	Min.	Max.	Goal		
Output Power (P_{out}) See note 4	20 (43.0)			Watts (dBm)	@ 2 dB gain compression Continuous Wave (CW)
	30 (44.8)		50 (47.0)	Watts (dBm)	@ 2 dB gain compression Pulsed mode
Center Frequency (f_c)	9.6		9.9	GHz	
Bandwidth (BW)	600		1200	MHz	Wider BW @ upper goal f_c
Linear Gain	12			dB	@ 10 dB OBO
Flatness		0.5	0.1	dB _{p-p}	@ 2 dB compression
Power-Added Efficiency (PAE)	40		60	%	@ 2 dB compression (die only)
Pulse mode parameters					
Pulse Repetition Frequency (PRF)	1	6		kHz	
Duty Cycle	2	25		%	

Note 4: At first approximation, the associated thermal flux at the chip mounting surface may range from 200 to 900 W/cm² depending on the fabrication process, MMIC layout, output power and associated PAE.

TRL timeline

The targeted TRL for this technology development is TRL 5 within the contract period.

Targeted missions

The targeted mission is RADARSAT Next Generation.

Specific Deliverables

The deliverables defined here complement Section A.7 Contract Deliverables and Meetings of Annex A

- Breadboard models (BB) of both the C-band and the X-band amplifiers and thermal management prototypes
- All CAD design files, custom software source code (if applicable), spreadsheets
- A minimum of 10 GaN HPA functional known good dies

ID	Due Date	Deliverable	Type
D1	M2	Requirements Document	Technical Document/Report
D2	M2	Preliminary Design Document	Technical Document/Report
D3	M3	Detailed Design Document	Technical Document/Report
D4	M2, M3, M4	Models and Analyses	Technical data and analysis

Schedule & Milestones

This technology development is up to 24 months duration.

The following milestone reviews should be planned by the contractor for each of the HPA C and X-band designs but may be combined into a single one covering both frequency bands.

Table 3 – Schedule & Milestones

Milestone	Meeting	Date	Location
M1 - KOM	Kick-off	Contract Start Date + 1 week	Contractor
TIM	Technical Interchange	As required	Teleconference
M2	Preliminary Design Review	Wafer Fab start Date - 4 weeks ^{See note 5, 6}	Contractor
M3	Critical Design Review	Wafer Reception Date + 8 weeks	Contractor
M4	Final Review	Contract End Date - 1 Week	CSA

Note 5: The HPA Preliminary Design Review Meeting should occur, and subsequent wafer procurement initiated, prior to the end of the first year of the contract (March 31).

Note 6: The HPA Preliminary Design Review Meeting should occur prior to but may coincide with the MMIC Design Review by the wafer supplier. In this case, CSA representatives must be invited to participate. This milestone must be successfully completed before the wafer fabrication can start.

All key participants under the contract, including at least one representative from each subcontractor (if applicable), must attend all the meetings. To reduce travel costs, some participants may attend the meeting via teleconference.

The specific intent of the Preliminary Design Review Meeting will be to review in detail the HPA design prior to submitting for fabrication by the foundry. The HPA MMIC design must be accepted as error-free, as confirmed by the supplier, prior to this meeting.

The specific intent of the Final Review Meeting will be to review in detail the results obtained. This meeting is intended to provide an opportunity for the Contractor, the Technical Authority (TA) and other invited attendees to review and discuss the project. Key Contractor personnel involved in the work under review must attend the meetings. The exact date and time of the review meeting will be mutually agreed to by the PA, the TA, and the Contractor.

Priority Technology 19 (PT 19)

Multi-Channel SAR Receiver

Multi-Channel SAR Receiver

Background

Traditional SAR systems have a fundamental limitation on the ratio of the swath size and azimuth resolution. All modes of operation of conventional SAR instruments typically end-up with a swath size to azimuth resolution of about 10 km/m with an absolute limit around 20 km/m.

In order to break this constraint, a SAR system with multiple apertures is required. RADARSAT-2 provides the ability to receive at each wing of the antenna separately, thus enabling modes with a swath size to azimuth resolution of about 30 km/m. However, the use of this mode is limited to a single transmit/receive polarization combination.

Operation using a wide swath and a relatively high resolution would be beneficial for several applications of interest to Canada. For example, it would enable the monitoring of a larger swath over the ocean for ship detection and ice monitoring. Fewer satellites would be required to achieve the same coverage but each satellite would need to be slightly more powerful.

The availability of multi-channel would also provide significant benefits for others applications such as GMTI, vessel velocity estimation, littoral zone ambiguity suppression and higher stripmap resolution.

One of the main technologies currently not available to enable complete multi-aperture operation is a receiver/transmitter design that can provide the required multi-channel operation. This receiver/transmitter design would interface with the antenna to generate a medium power pulse and would receive signals already amplified by LNAs from different sections (and different polarizations) of the antenna. This study will explore the possibility of designing a transmitter/receiver system that would enable the simultaneous reception of 4 to 8 channels to provide multi-aperture operation while keeping the ability to provide data in two receive polarizations.

Objectives

The objectives are:

- Provide a transmitter/receiver design for a C-band SAR satellite that is highly modular, scalable, and provides enhanced bandwidth.
- Increase the level of maturity of the multi-channel SAR system enough such that we can demonstrate the feasibility for future generations of radar satellite and develop a better understanding of the benefits and cost of a multi-channel system versus a larger number of lower performance satellites.

Tasks

The contractor must perform a trade-off study to select a design to breadboard. The trade-off study must clearly identify the strengths and weaknesses of each option in terms of:

- Scalability of the system to support multiple receiver channels;
- Flexibility of the system to support various combinations of separate apertures and polarizations;
- Ease of manufacturing and integration;
- Performance of the system (RF, Power, Mass, etc).

The contractor must develop a breadboard of the selected option. The breadboard must incorporate the following functions:

- Generation of an RF pulse;
- Reception of an RF signal and down-conversion to a digital signal;
- Provide an interface to synchronously control the signal generation and reception.

The breadboard does not have to implement redundancy or all the receive chains but the contractor must explain how an eventual implementation in the targeted space mission will be configured with the multiple receive chains and with redundant hardware. To demonstrate proper synchronization between the receive chains, the contractor must at least implement two receive chains. No specific thermal or mechanical requirements are provided at this point in time. However, the contractor must have an extensive understanding of the constraints imposed for space hardware and must demonstrate that credible solution exist to integrate the proposed technology into a design suitable for space.

The breadboard can be a mix of custom design and COTS module/demonstration boards. However, the contractor must demonstrate that it will be possible to design and manufacture a similar design using only parts suitable for a 7 to 10 year operation in space.

Optional Requirements are provided with two goals in mind:

- Explore different level of performance and scalability and better understand the impact of the level of performance requested.
- The full set of performance requirements for the unit would exceed the scope of work planned for this study. However, in some cases, knowledge of these requirements may impact the design choices for this study.

Given these goals, the Contractor must explain the impact of incorporating these optional requirements in the design. During the design, options that would enable the project to meet the Optional Requirements (with potentially additional work) must be given higher priority. In case where design options would have a significant limitation to implement the Optional Requirements in a subsequent phase, these options should be eliminated.

The contractor must develop a breadboard and implement a test procedure to evaluate the level of compliance with the Mandatory Requirements. Although at this early stage of development, some non-compliance may be shown by test, the contractor must at least demonstrate that:

- An RF pulse signal can be generated
- An RF signal can be received and digitized by multiple channels with a good coherency between the channels.
- Transmission and reception of signal can be controlled by a synchronous interface.

Non-compliance found during testing that does not impact the basic functionality described above can be accepted. However, before the non-compliance is accepted, the contractor must:

- Investigate the non-compliance and show that the non-compliance resolution is not trivial.
- Propose potential solutions to meet the requirements in future development.

The contractor must provide a development plan to qualify the design for space operation. The plan must include:

- The tasks required to qualify the design.
- A schedule
- Identification of the main technical risks
- An estimate of the cost to complete the tasks

Deliverables

The following deliverables must be produced by the contractors:

Deliverable	Meeting
Trade-off Analysis	Interim Review #1
Breadboard Design Document	Design Review Meeting (Interim Review #2)
Test Plan	Test Readiness Review Meeting (Interim Review #3)
Test Report	Final Review
Development plan	Final Review
Breadboard hardware, supporting software and firmware code.	Final Review

Meetings

The contractor must hold the following meetings:

Meeting	Description
KoM	Kickoff
Interim Review #1	Review the trade-off analysis and agree on the selected options to breadboard.
Design Review - Interim Review #2	Review of the breadboard design.
Test Readiness Review - Interim Review #3	Review of the breadboard status and test plan.
Final Review	Final Review. Review of the breadboard functionalities. Review of the test results and the Development plan.

Technical Requirements

Mandatory Requirements

The receiver/transmitter electronics must meet the following performance requirements:

ID	Description	Value	Comments
MCE-001	Center Frequency	5.405 GHz	
MCE-002	Bandwidth	10-100 MHz	At least 16 bandwidths shall be provided. The spacing in absolute value shall be smaller for low bandwidth and may be larger for the higher bandwidth.
MCE-003	Pulse duration	5 μ s to 50 μ s	
MCE-004	Pulse repetition Frequency	1000 Hz to 7000 Hz	
MCE-005	Noise signal strength	-75 dBm/MHZ to -85 dBm/MHz	
MCE-006	Instantaneous Dynamic Range	30 dB	For any combination of Noise Signal Strength and Bandwidth, the receiver must provide a dynamic range of at least 30 dB. The dynamic range is defined for a signal with a power equal to the noise level up to a signal 30 dB higher than the noise level.
MCE-007	Quantization Noise	-17.5 dB	The ratio of the quantization

			noise to the signal must be better than -17.5 dB over the Instantaneous Dynamic Range.
MCE-008	Waveform	Linear FM chirp (upchirp and downchirp)	Phase and amplitude pre-distortion shall be available at the output of the waveform generator.
MCE-009	Noise Figure	-12.5 dB	
MCE-010	Replica	The system must be able to measure a copy of the transmitted signal with each receive channel.	
MCE-011	Number of independent channels	4	
MCE-12	Channel combinations with 4 independent channels	The system must be able to support the following configurations: <ul style="list-style-type: none"> - All channels are assigned to a different section of the antenna with a single polarization (4 sub-apertures, 1 polarization). - Two channels are used for each side of the antenna collecting single or dual polarized data (2 sub-apertures, single or dual polarization). - Channel are combined together to generate a single aperture and single or dual polarization. 	This can be done either by combining the RF signal at the input or by combining the digitized signals.
MCE-013	The phase imbalance knowledge between channels	Smaller than 5°	At the output of the digitized data stream. It is acceptable to use the replica signal or other calibration method to meet this requirement.
MCE-014	The amplitude imbalance knowledge between channels	Smaller than 0.5 dB	At the output of the digitized data stream. It is acceptable to use the replica signal or other calibration method to meet this requirement.
MCE-015	Control Interface	The equipment must provide an interface suitable to control the parameters and bandwidth of each pulse in a synchronous fashion.	
MCE-016	Digital Output Interface	The equipment must provide an output data rate of at least 800 mbps.	The data will be acquired in a pulse fashion over a receive window. However, the data rate specified is for the output of the unit and is continuous. The unit will need to buffer one

			reception window of the incoming data at a higher rate and retransmit the data at a constant rate of 800 mbps. BAQ compression may be assumed to reduce the data rate. Some limitation on the combination of multiple channels, bandwidth and receive window duration are expected.
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Optional Requirements

The receiver/transmitter electronics should meet the following performance requirements:

ID	Description	Value	Comments
MCE-017	Amplitude flatness	Compatible with the use of the breadboard as a SAR receiver/transmitter	These are secondary objectives for this contract as the effort must be focused on the multi-channel aspect. Further development of this technology would need to meet these specs.
MCE-018	Phase flatness	Compatible with the use of the breadboard as a SAR receiver/transmitter	These are secondary objectives for this contract as the effort must be focused on the multi-channel aspect. Further development of this technology would need to meet these specs.
MCE-019	Amplitude stability	Compatible with the use of the breadboard as a SAR receiver/transmitter	These are secondary objectives for this contract as the effort must be focused on the multi-channel aspect. Further development of this technology would need to meet these specs.
MCE-020	Phase stability	Compatible with the use of the breadboard as a SAR receiver/transmitter	These are secondary objectives for this contract as the effort must be focused on the multi-channel aspect. Further development of this technology would need to meet these specs.
MCE-021	Number of independent channels	8	This goal is set to provide a better understanding of the impact of increasing the number of channels.
MCE-022	Channel combinations with 8 independent channels	The system should be able to support the following configurations: <ul style="list-style-type: none"> - 4 pairs of channels are assigned to a different antenna location, each collecting single or dual polarization data (4 sub- 	This can be done either by combining the RF signal at the input or by combining the digitized signals.

		<p>apertures, single or dual polarization).</p> <ul style="list-style-type: none"> - Two channels are used for each side of the antenna collecting single or dual polarized data (2 sub-apertures, single or dual polarization). - Channels are combined together to generate a single aperture and single or dual polarization. 	
MCE-023	Output Power	10 W	This is not the main goal of this development effort. Further development would need to consider the required output power.
MCE-024	Mass	40 kg including redundancy	Mass of the breadboard is not critical. However, consideration must be given to the mass of the final design.
MCE-025	Power	100 W	Power of the breadboard is not critical. However, consideration must be given to the power of the final design.
MCE-026	Arbitrary Waveform Generation	Support arbitrary waveform generation	
MCE-027	Digital Output Interface	The equipment should provide an output data rate of at least 1600 mbps.	The data will be acquired in a pulse fashion over a receive window. However, the data rate specified is for the output of the unit and is continuous. The unit will need to buffer one reception window of the incoming data at a higher rate and retransmit the data at a constant rate of 1600 mbps. BAQ compression may be assumed to reduce the data rate. Some limitation on the combination of multiple channels, bandwidth and receive window duration are expected.
MCE-028	Bandwidth	10-300 MHz	At least 20 bandwidths should be provided. The spacing in absolute value should be smaller for low bandwidth and may be larger for the higher bandwidth.
MCE-029	Pulse duration	5 μ s to 100 μ s	

APPENDIX A-6: DATA ITEMS DESCRIPTIONS (DIDS)

DID-0003 – PROGRESS REPORT

DID-0004 – DETAILED PROJECT SCHEDULE

DID-0006 – MEETING AGENDA

DID-0007 – MINUTES OF MEETINGS

DID-0008 – ACTION ITEMS LOG

DID-0009 – REVIEW DATA PACKAGES

DID-0010 – END ITEM DATA PACKAGE (EIDP)

DID-0011 – SOFTWARE END ITEM DATA PACKAGE

DID-0215 – VERIFICATION AND COMPLIANCE MATRICES

DID-0217 – TECHNOLOGY READINESS WITH TRRA WORKSHEETS AND ROLLUP

DID-0218 – TECHNOLOGY ROADMAP WORKSHEET

DID-0236 – ENGINEERING MODELS AND ANALYSES

DID-0260 – DESIGN DOCUMENT

DID-0262 – VERIFICATION PLAN

DID-0263 – VERSION DESCRIPTION DOCUMENT

DID-0280 – TEST PROCEDURE

DID-0285 – TEST REPORT

DID-0301 – OPERATING PROCEDURES AND USERS GUIDE

DID-0003 – Progress Report

PURPOSE:

The Progress Report records the status of the work in progress during the previous calendar period. The Progress Report is used by the Government to assess the Contractor's progress in performance of the work.

PREPARATION INSTRUCTIONS:

The Progress Report must comprise, but not limited to, the following sections:

- 1) Statement indicating whether or not the project is on schedule and, if not, an explanation for any delays and/or a recovery plan. The report must include an updated schedule showing progress of work and modifications, if any;
- 2) Statement indicating whether or not the project is within budget and, if not, an explanation for the deviation from the budget and a proposed recovery plan. The report must include an updated cash flow table showing, for each activity/milestone/Work Package, start and end dates as well as actual cash flow with actual start and end dates;
- 3) Brief summary of the technical progress of the work for each work package, including:
 - a) Description of major items developed, purchased or constructed during the reporting period, and
 - b) List of internal engineering reports produced during the reporting period;
 - c) PEC requirements trends, estimates and current margins,
- 4) Summary of the proposed work for the following month, including:
 - a) Description of major items to be purchased during the next reporting period, including any software packages, and
 - b) Estimated date of completion for the next milestones;
- 5) Summary of problems encountered, their impact on the project and the subsequent solutions proposed or implemented;
- 6) Trip reports for each conference attended or facilities visited in the course of this contract (and only if funded by the contract);
- 7) Subcontractor events (reviews, milestones, etc.), status and issues; and
- 8) Risk posture analysis: Risk status report including previous issues resolved, status on on-going risks (changes and impacts), and identification of new risks, their impact and proposed mitigation action.

An overall assessment of the project health must be provided at the start of each report. The aim is to have an overview of the project status. Table A-1 shows the information required and in what format.

Table A-1: - Project Health Status

Project Element	Status	Trend	Comment
Cost	Green	↑	
Schedule	Green	↓	
Results / PEC	Red	↔	
Programmatic	Yellow	↑	

The first column identifies the project performance metrics to be assessed, namely Project Element. The four metrics to assess are:

- Cost,
- Schedule,
- Results against PECs, and
- Programmatic.

The Cost, Schedule and Results/PEC metric are quantitative indicators, while the Programmatic metric is qualitative.

The second column of the table shows the status for each project element. Table A-2 provides a definition of the different possible statuses for each of the first three Project Elements.

Table A-2: - Status Indicators Definitions

Status Indicator	Interpretation		
	Cost	Schedule	Technical
Green	On or under planned project total budget	On or ahead of baseline schedule	Meets PEC
Yellow	Between 0 and 5% overrun	Between 0 and 5% behind schedule	Does not meet PEC but has approved recovery plan
Red	Greater than 5% overrun	Greater than 5% behind	Does not meet PEC and does not have approved recovery plan

As for the Programmatic element, the status is evaluated based on the status of the three other elements. Although the Programmatic metric takes into account Cost, Schedule and Results/PEC indicators, it is mostly influenced by the most critical element at that point in time in the project. The third column in Table A-2 is an assessment of the trend the Project metric.

Table A-3 shows the available choices.

Table A-3: - Trend Indicators Definitions

Trend Indicator	Interpretation
↑	The status has improved since the last review
↓	The status has worsened since the last review
↔	The status has not changed since the last review

The fourth column in Table A-1 is to provide the opportunity to comment the status and trend of the project element or to provide a general statement.

DID-0004 – Detailed Project Schedule

PURPOSE:

To provide a schedule planning and control system for the project and to provide visibility to the CSA into the program progress and status.

PREPARATION INSTRUCTIONS:

The project schedule must be based on the CWBS, in the form of a Gantt chart. The project schedule must be detailed enough to show each CWBS task to be performed, and must provide the following information:

- 1) dependencies,
- 2) resource requirements,
- 3) the start and end date of each task (baseline and actual),
- 4) task duration,
- 5) completion status in percentage;
- 6) deadlines and milestones, and
- 7) critical path.

The schedule must show dependencies between the Contractor and other organizations.

The tasks related to deliverables must be limited to three months in the project schedule. When applicable, the Contractor must divide longer tasks into smaller significant tasks.

Tasks that are not related to any specific deliverable, such as Project Management and Quality Assurance activities, must be grouped separately from the groups of deliverables, and must be shown at the top of the chart. The schedule must be provided in its native tool format; MS project or PS8 are the two accepted formats, as well as in PDF.

DID-0006 – Meeting Agenda

PURPOSE:

To clarify the purpose and content of a meeting.

PREPARATION INSTRUCTIONS:

The meeting agendas must contain the following information, as a minimum.

1) DOCUMENT HEADER:

- a) Title;
- b) Type of meeting;
- c) Project title, project number, and contract number;
- d) Date, time, and place;
- e) Chairperson;
- f) Mandatory and desirable attendance; and
- g) Expected duration.

2) DOCUMENT BODY:

- a) Introduction, purpose, objective;
- b) Opening Remarks: CSA;
- c) Opening Remarks: Contractor;
- d) Review of previous minutes and all open action items;
- e) Project technical issues;
- f) Project management issues;
- g) Other topics;
- h) Review of newly created/closed action items, decisions, agreements and minutes; and
- i) Set or confirm dates of future meetings.

DID-0007 – Minutes of Meetings

PURPOSE:

The minutes of reviews or meetings provide a record of decisions and agreements reached during reviews/meetings.

PREPARATION INSTRUCTIONS:

Minutes of meeting must be prepared for each formal review or meeting and must include the following information, as a minimum:

- 1) Title page containing the following:
 - a) Title, type of meeting, date, time and duration.
 - b) Project title, project number, and contract number,
 - c) Space for signatures of the designated representatives of the Contractor, the CSA and the Public Works and Government Services Canada (PWGSC), and
 - d) Name and address of the Contractor;
- 2) Purpose and objective of the meeting;
- 3) Location;
- 4) Agenda (DID-0006);
- 5) Summary of the discussions, decisions and agreements reached;
- 6) List of the attendees by name, position, phone numbers and e-mail addresses as appropriate;
- 7) Listing of open action items and responsibility for each action to be implemented as a result of the review;
- 8) Other data and information as mutually agreed; and
- 9) The minutes must include the following statement:

“All parties involved in contractual obligations concerning the project acknowledge that minutes of a review/meeting do not modify, subtract from, or add to the obligations of the parties, as defined in the contract.”

DID-0008 – Action Items Log

PURPOSE:

The Action Item Log (AIL) lists, in chronological order, all items on which some action is required, allows tracking of the action, and in the end provides a permanent record of those Action Items (AI).

PREPARATION INSTRUCTIONS:

The Action Item Log (AIL) must be in a tabular form, with the following headings in this order:

- 1) Item Number;
- 2) Item Title;
- 3) Description of the action required;
- 4) Open Date;
- 5) Source of AI (e.g. PDR meeting, RID, etc.);
- 6) Originator;
- 7) Office of Prime Interest (OPI);
- 8) Person responsible (for taking action);
- 9) Target/Actual Date of Resolution;
- 10) Progress update;
- 11) Rationale for closure;
- 12) Status (Open or Closed); and
- 13) Remarks.

The date in column 9) will be the target date as long as the item is open, and the actual date once the item is closed.

DID-0009 – Review Data Packages

PURPOSE:

The Review Data Package is a collection of all documents to be presented by the Contractor for all formal Technical Reviews:

PREPARATION INSTRUCTIONS:

Each Review Data Package must contain the documents identified in the CDRL as due for that review, plus the presentations made at the meeting, the agenda, the minutes, and the AI list.

DID-0010 – End Item Data Package (EIDP)

PURPOSE:

Data to document the design, fabrication, assembly, integration and testing of the deliverable hardware.

PREPARATION INSTRUCTIONS:

An EIDP must be prepared for each deliverable assembly. The EIDP must be delivered in electronic format with a search function or interface. Upgrade changes performed as a result of the first phase deployment must be clearly identified. The contents of the package must include, but not be limited to, the following information:

- 1) All hardware prototype and GSE including cables
- 2) As-Built data: "As-Built" hardware documentation is a compilation of items describing exactly the configuration of a fabricated serialized assembly including:
 - a) Part number and revision letter of each item
 - b) Part description (title) of each item
 - c) Electronic part reference designation
 - d) Manufacturer
 - e) Procurement specification or Source Control Drawing (SCD) number and SCD revision letter.
- 3) A complete list of the tests performed including a compilation of test data and test results for each test.
- 4) A list of open work/tests
- 5) Listing of the As-Designed drawings & parts list, with reconciliation of As-Designed vs. As-Built for any deltas between them, for each indentured line item of the end item deliverable.
- 6) A summary and copies of all deviations and waivers applicable to the deliverable items.
- 7) A one time delivery, with updates as required:
 - a) A complete and up-to-date top assembly drawing of each type of delivery.
 - b) Complete and up-to-date mechanical and electrical Interface Control Documents (ICDs) (interface drawings and specifications), for each delivery.
 - c) For electronic assemblies, a complete set of circuit schematics and circuit data sheets available for review at the Contractor's premises.

DID-0011 – Software End Item Data Package

PURPOSE:

Data to document the design, development, assembly, integration and testing of the deliverable software.

PREPARATION INSTRUCTIONS:

An EIDP must be prepared for each deliverable software. The contents of the package must include, but not be limited to, the following information:

- 1) As-built product identification, including:
 - a) Identification of software release by program ID, phase, version, date, and build,
 - b) Operating system name and version,
 - c) Programming language name, compiler name, and version,
 - d) Supporting development environment name and version (if any);
- 2) Final VDD;
- 3) List all required software related documentation (under CM control), including the software design documentation, users' manuals, test procedures, scripts and test results;
- 4) All software source codes, executables, configuration and parameter files, reloadable FPGA configuration files;
- 5) All third party software; third party software must be accompanied by a license that allows the software to be archived and copied as necessary for all future CSA operations;
- 6) A list of all COTS software and computers purchased under this contract;
- 7) All COTS software purchased under this contract (original disk or file with license to CSA), GSE software etc.; and
- 8) A list of all open/closed anomalies or liens against this delivery. All flagged or major anomalies should be closed prior to the delivery.

All software must be delivered on media that is directly compatible with the delivered hardware. One set of software must be installed on the delivered hardware. A second set must be supplied on a CD-ROM or DVD disk.

DID-0215 – Verification and Compliance Matrices

PURPOSE:

The Verification and Compliance Matrix shows the details of the compliance of the system and the verification thereof through the life of the project with respect to each system requirement. It is a living document that is updated at each review with new data. The matrix is tightly coupled with the Verification Plan because it provides the detailed linkage of verification activities to the specific requirements they address. However, it is a separate document from the Verification Plan.

PREPARATION INSTRUCTIONS:

The Requirements Verification and Compliance Matrices must contain, for each requirement:

- 1) The requirement document number and requirement identifier,
- 2) The requirement description,
- 3) Other relevant requirement references,
- 4) Verification method;
- 5) Requirement compliance based on verification data presented at the current phase,
- 6) For quantitative requirements, the actual predicted or achieved performance and the margin over the requirement,
- 7) Link to the verification data that justifies the compliance and the quantitative value (document, page and paragraph),
- 8) Comments, for example on plans to rectify non-compliances.

DID-0217 – Technology Readiness with TRRA Worksheets and Rollup

PURPOSE:

Referring to AD-2, the Technology Readiness and Risk Assessment (TRRA) Guidelines (CSA-ST-GDL-0001), the TRRA describes in a systematic and objective fashion, at a specific point in time (milestone) in the development process, the technological readiness of a system for a particular spaceflight mission or environment, the criticality of the constituent technologies, and the expected degree of difficulty to achieve the remaining technology development steps.

The TRRA provides for all the Critical Technology Elements (CTEs) of the proposed concept, as per the Product Breakdown Structure (PBS), a high-level summary of the maturity of the technologies and the technology development risks.

Agreement on the appropriate PBS level and identification of the CTEs is required prior to the TRRA.

PREPARATION INSTRUCTIONS:

The Technology Readiness and Risk Assessment must be carried out in accordance with the CSA Technology Readiness Levels and Assessment Guidelines using the CSA provided worksheets: the Critical Technologies Elements Identification Criteria Worksheet (CSA-ST-FORM-0003), the Technology Readiness and Risk Assessment Worksheet (CSA-ST-FORM-0001) for each CTE and rollup using the Technology Readiness and Risk Assessment Data Rollup Tool (CSA-ST-RPT-0002). All the completed worksheets must be provided to CSA.

DID-0218 – Technology Roadmap Worksheet

PURPOSE:

The Technology Roadmap provides an overview of the required technology developments to meet mission needs and the plan and timeline to reach TRL 6 and 8.

PREPARATION INSTRUCTIONS:

The Technology Roadmap must be done using the format of the Technology Roadmap Worksheet (CSA-ST-RPT-0003).

DID-0236 – Engineering Models and Analyses

PURPOSE:

To support the design, establish feasibility of the design to meet the requirements in the design phases, and in some cases provide verification of compliance to requirements where this cannot be demonstrated directly by test or inspection.

PREPARATION INSTRUCTIONS:

GENERIC FORMAT AND CONTENT FOR ALL ANALYSES

All CAD models developed must be delivered as appropriate. Models must be delivered in the following formats:²

- a) Mechanical design: STEP AP203 (.stp)
- b) Electrical design: .dsn, .sch, Pspice and Gerber formats
- c) Software design: UML 2.0 or XML (Extensible Markup Language)

In cases where a different tool is used from the one CSA uses, the model and outputs must be supplied in native format in addition to the required format. For generic modeling and analyses that don't use a specialty tool, CSA will accept Matlab, Excel and MathCad format data. Where a highly specialized tool is used, the delivery format must be negotiated with the TA. Translation from the Contractor's tool to the required format is only acceptable where the results can be repeated in CSA's tool. Translation that corrupts the model, loses data, or produces data that is interpreted differently, is not acceptable.

Analysis documents must contain all analysis work that is performed in support of the design. The analysis material must be sufficiently detailed so that, in combination with the delivered models, CSA or an external reviewer can reproduce the results. The analysis must establish feasibility and verification of the design to meet the requirements.

The data must include references to sources such as equations, material values, parameters and properties.

Each report must contain the following information, as a minimum:

- 1) Objectives of the analysis;
- 2) Reference to the relevant requirements;
- 3) Description of the analysis tools used;
- 4) Description of the model developed to aid the model user (if applicable);
- 5) Identification of the assumption(s) made;
- 6) Description of the main analysis steps and intermediate results;
- 7) Results of the analysis and compatibility with the requirements;
- 8) Identification of potential problem areas and presentation of alternative design solutions; and
- 9) Conclusion.

Delivered models must contain at least example outputs so that the user can check their function, and should contain the main outputs used in the analysis documents.

² All 2-D drawings must be submitted in PDF format, with the capability to zoom

DID-0260 – Design Document

PURPOSE:

To describe the features and capabilities of the item as designed. The item could be a system or subsystem.

PREPARATION INSTRUCTIONS:

The Design Document acts as an “answer” to the Requirements Document for the system or subsystem: the requirements state what is needed, and the Design Document describes what is provided to meet these needs. The Design Document serves as the main reference text for users after delivery of the item, describing the full range of performance and functional capabilities of the item, as verified during the test/verification program.³

Each document must contain, as a minimum:

- 1) Scope
 - a) System Overview
 - b) Document Overview
- 2) System Design
 - a) Functional Block Diagram
 - b) External Interfaces
 - c) Subsystems descriptions
 - d) Internal Interfaces
 - e) Functional description
- 3) Mechanical description
- 4) Electrical description
- 5) Operating modes and states
- 6) Environmental considerations derived from the environment requirements as specified in this SOW.
- 7) Acronyms

³ All 2-D drawings must be submitted in PDF format, with the capability to zoom

DID-0262 – Verification Plan

PURPOSE:

The verification process is defined by the Verification Plan. The plan also defines the planning policies, methods of controls, and organizational responsibilities. From the Verification Plan, the verification procedures are developed. The procedures provide the instruction, including configurations, constraints, and prerequisites, for obtaining data that show compliance with the requirements.

PREPARATION INSTRUCTIONS:

The Verification Plan must:

- 1) define the verification activities that will prove that the system and subsystems meet the all the imposed requirements including functional, performance, interface, environmental, etc.,
- 2) define all verification activities at each phase of the project, including test, analysis, and inspection,
- 3) describe the methods and techniques to be used to measure, evaluate, and verify the system. This is to include characterization of the system behaviour that is not controlled by requirements but is important for understanding of the system, and establishing the actual values of parameters that exceed requirements,
- 4) use an appropriate combination of simulation and analytical tools, mock-ups, laboratory models, engineering models and prototype models,
- 5) define the requirements for supporting facilities, analysis tools and test equipment, both existing and needing to be constructed. Assumptions on the use of Government-Furnished Equipment (GFE) in testing are to be documented, including:
 - a) the specific equipment and materials needed,
 - b) the configuration of the equipment to be used,
 - c) any requirements on modification or upgrade of the GFE,
 - d) the location in which it is to be used,
- 6) define the schedule for verification activities and the schedule requirements for the Government furnished facilities (e.g. David Florida Laboratory).

Requirements on GFE must be highlighted or summarized so that an integrated request can be given to the provider.

For each defined test and analysis activity, the plan must contain:

- 1) a description of the activity,
- 2) the objective, including requirements to be verified,
- 3) supporting hardware and software,
- 4) assumptions and constraints that apply to the activity,
- 5) plans to install, setup, and maintain items in the test or analysis environment,
- 6) a description of the data recording, reduction, and analysis activities to be carried out during and after the activity.

VERIFICATION METHODS DEFINITIONS

The verification program must be accomplished by employing one or more of the methods described in the following sub-sections.

Test

Verification by test is the actual operation of the system, in clearly defined environmental conditions, to evaluate its performance.

Functional Tests

Functional testing is an individual test or series of electrical or mechanical performance test(s) conducted on the system's hardware and/or software at conditions equal to or less than design specifications. Its purpose is to establish that the system performs satisfactorily in accordance with design and performance specifications. Functional testing is generally performed at ambient conditions.

Functional testing is performed before and after each environmental test or major move in order to verify system performance prior to the next test/operation.

Environmental Tests

Environmental testing is an individual or series of test(s) conducted on the system's hardware to ensure that the rover hardware must perform satisfactorily in an analog environment. Examples of environmental tests are vibration, acoustic, thermal, vacuum and EMC. Environmental testing may or may not be combined with functional testing depending on the objectives of the test.

Analysis

Verification by analysis is a process used in lieu of, or in addition to, testing to verify compliance to specification requirements. (e.g. stress, thermal, materials). The selected techniques may include systems engineering analysis (structural, environmental, electrical, etc.), statistics and qualitative analysis, computer and hardware simulations, and analog modelling.

Analysis may be used when it can be determined that:

- a) Rigorous and accurate analysis is possible;
- b) Test is not feasible or cost-effective;
- c) Similarity is not applicable; and
- d) Verification by inspection is not adequate.

Demonstration

Verification by demonstration is the use of actual demonstration techniques in conjunction with requirements such as serviceability, accessibility, transportability and human engineering features. In general, demonstration is specified as the method of verification for physical attributes which have no numerical requirements associated with them. This includes qualitative features such as comfort, accessibility, suitability and adequacy. Demonstration may also be specified for presence or compatibility of shipping containers, handling fixtures, etc.

Inspection

Verification by inspection is the physical evaluation of equipment and associated documentation to verify design features. Inspection is used to verify construction features, workmanship, dimensions and physical condition, such as cleanliness, surface finish and locking hardware. Often inspections are conducted in conjunction with a test or as part of assembly operations documented by manufacturing instructions (MIS).

Validation of Records

Validation of records is the process of using manufacturing records at end-item acceptance to verify construction features and processes for the system hardware. Verification of records is specified whenever it is necessary to compare two or more documents to each other in order to assess compliance with a requirement. Common examples of the way verification of records is used include:

- a) Examining drawings for features required by specifications;
- b) Examining parts lists for ESD sensitive components;
- c) Comparing two or more drawings to assess a mechanical interface;
- d) Checking personnel records for proper training;
- e) Checking facilities records for environmental exposure;
- f) Examining vendor data supplied with parts or materials; and
- g) Verification that analyses meet safety specifications.

Similarity

Verification by similarity is the process of assessing by review of prior test data or hardware configuration and applications that the article is similar or identical in design and manufacturing process

to another article that has previously been qualified to equivalent or more stringent specifications.

Review of Design Documentation

Verification by review of design documentation is the process of reviewing the design against the requirements, which as stated may or may not contain specifics to be met by a test, analysis, etc. but must be present in the design. This method is used during the preliminary design and critical design reviews of the development phase.

DID-0263 – Version Description Document

PURPOSE:

To identify the contents of a software Configuration Software Configuration Item (CSCI) release and to record the details of all aspects of the system, support software and hardware required to regenerate this CSCI.

PREPARATION INSTRUCTIONS:

The VDD must contain the following information, as a minimum:

- 1) Version Description
 - a) Inventory
 - i) CSCI Source File Listing
 - ii) Documentation. This section must list all relevant documents revisions associated with this build version (requirements, ICDs,...)
 - b) Changes Incorporated. This section must list all new functionalities that were added, and/or all problems that were corrected in this version. A list of all modified and created files with the rationale must be included.
- 2) Version Description - Support Items
 - a) Hardware Tools
 - b) Development Platform Hardware Requirements
 - c) Software Tools
 - d) Build Procedures and Development Environment Setup Information.
The procedure must provide step by step actions with screen shots whereas appropriate to document the complete build process.
 - e) Installation Procedures
 - f) Validation Test Scripts, Data and Results
- 3) Known Errors and Possible Problems
- 4) Notes

DID-0280 – Test Procedure

PURPOSE:

To define the procedure to be followed for each test to be performed.

PREPARATION INSTRUCTIONS:

This DID is applicable to systems, hardware and software.

The test procedures must contain the following information, as a minimum:

1. SCOPE
This section must include a brief description of the test and the objectives of the test.
2. TEST REQUIREMENTS
This section must define the measurements and evaluations to be performed by the test.
3. TEST ARTICLE
This section must define in detail the test article configuration that is to be tested.
4. TEST FACILITIES
This section must identify the test facilities to be used, including their physical location, coordinates and contact points.
5. PARTICIPANTS REQUIRED
This section must provide a listing of the individuals (position titles, trade or profession) required to conduct or witness the test.
6. TEST SET-UP AND CONDITIONS
This section must include description/sketches of test articles in test configuration illustrating all interfacing test/support equipment. Instrumentation/functional logic must be shown where applicable. The section must include any environmental and cleanliness requirements.
7. INSTRUMENTATION, TEST EQUIPMENT AND TEST SOFTWARE
This section must provide a listing of the instrumentation, test equipment and software that is to be used during the test.
8. PROCEDURE
This section must define the step-by-step procedure to be followed, starting with the inspection of the test article, and describing the conduct of the test up to and including post-test inspection. Each test activity must be defined in sequence and task-by-task, including test levels to be used and measurements/recordings to be made. It must include any necessary malfunction and abort procedure.
9. DATA ANALYSIS
This section must define the methods to be used in the analysis of the results, along with the uncertainty range in the results. Data presentation format must be defined.
10. ACCEPTANCE/REJECTION CRITERIA TABLE
This section must provide data sheets needed during execution of the test specifying acceptance/rejection criteria, including identification of the associated requirements from the Requirements Documents or Specifications. These sheets will be in a tabular form allowing columns for measured values and deviations to be recorded. A computer printout generated by test software is acceptable provided it supplies the same information, however the test criteria must be stated in the Test Procedure.

DID-0285 – Test Report

PURPOSE:

To document the results of all tests done on a hardware unit or software CSCI.

PREPARATION INSTRUCTIONS:

This DID is applicable to systems, hardware and software.

The test report must document all tests performed to verify that the unit or software will meet the functional and operational requirements specified in the Requirements Documents or Specifications applicable to the unit.

The Test Report must contain, the following information, as a minimum:

1. **APPLICABLE DOCUMENTS**
This section must include test procedures and system requirements/specifications being tested.
2. **TEST ARTICLE OR SYSTEM UNDER TEST:**
This section must define in detail the test article configuration tested.
3. **PURPOSE:**
This section must describe the purpose of the test and the specific requirements/specifications that it is intended to verify.
4. **SUMMARY OF TEST RESULTS**
This section must present a summary of test results, including non-conformances, where applicable.
5. **TEST FACILITIES**
This section must identify the test facilities used, including their physical location, coordinates and contact points.
6. **TEST SET-UP AND CONDITIONS:**
This section must include descriptions/photos/sketches of test articles in test configuration illustrating all interfacing test/support equipment. Instrumentation/functional logic must be shown where applicable. The section must describe the environmental and cleanliness conditions present, as well as operating conditions (e.g. supply voltage).
7. **INSTRUMENTATION, TEST EQUIPMENT AND TEST SOFTWARE:**
This section must provide a listing of the instrumentation, test equipment and software used during the test.
8. **DETAILED TEST RESULTS:**
This section must record actual test data obtained on tabular sheets prepared in the Test Procedure (or software-generated) during the test performance, and deviations from the criteria.
9. **TEST DATA ANALYSIS:**
This section must document analyses required to relate the detailed results to the requirements to be verified.
10. **NON-CONFORMANCES:**
This section will provide all Non-Conformance Reports generated during the tests. The Non-Conformance Reports will be dated and stipulate the latest dispositions.
11. **CONCLUSIONS AND RECOMMENDATIONS:**
This section must identify deficiencies, limitations or constraints and propose alternative design solutions to be evaluated in order to resolve problems encountered in testing.

DID-0301 – Operating Procedures and Users Guide

PURPOSE:

To provide detailed step-by-step procedures and guidance for the operation of the system (payload or rover). In the case of the rover, this must include procedures for the rover by itself as well as when integrated.

PREPARATION INSTRUCTIONS:

General Requirements

The Operating Procedures and Users Guide must be provided in Microsoft Word. Drawings and pictures must be included in these Word documents, not in separate documents.

The Operating Procedures and Users Guide must contain an appendix that analyses End-to-End Operations Workflow, including the real-time operations as well as the offline pre-and post-missions analysis work and the operator training process, including training session preparation, execution and the use of tools to evaluate operator performance and achieve their certification.

The Users' Guide must contain the following information:

- 1) Description and principles of operation, including configuration for:
 - a) Transportation
 - b) Field Deployments (if different)
- 2) Assembly procedure (if required):

NOTE: this is internal to a rover or a payload, NOT the installation of a payload on a rover; the latter is to be presented in the Integration Procedures.

 - a) Mechanical Interfaces (including cooling/heating connections)
 - b) Electrical Interfaces
 - c) Command and Data Handling (C&DH) Interfaces
 - d) Scenario Setup Instructions (software & hardware)
 - e) Scenario Analysis Instructions
- 3) Disassembly procedure
- 4) Operational modes
- 5) Operational procedures:
 - a) Identification of all operations for which the system was designed
 - b) Specification of all constraints pertinent to each procedure, with references to technical documents for justification
 - c) Power On/Off and initiation of the software and termination of system operation
 - d) Calibration
 - e) Routine operating procedures
 - f) Monitoring of the operation of the system including: fault identification, evaluation, and conditions requiring computer shutdown
 - g) Detection, analysis and correction of anomalous behaviour
 - h) References to baseline configuration database for each parameter used in each procedure
 - i) Operating rules
- 6) C&DH Procedures
 - a) Methods of commanding the system and/or experiment (computer, manual, other)
 - b) Methods of collecting and disposing of H&S data
- 7) Software User Procedure
 - a) information and user instructions necessary for user interaction with the CSCI(s) including:
 - i) step-by-step operating procedures, including the use of all pre and post missions analyses tools, and operator training, evaluation and certification tools,
 - ii) identification of all options available to the user,
 - iii) initialization procedures,
 - iv) required user inputs and options,
 - v) identification and description of system inputs and effects on user interface,

- vi) termination methods and indicators,
 - vii) restart procedures, and
 - viii) expected outputs.
- b) a listing of all error messages including definition and action to be taken.
- 8) Maintenance Procedures and Troubleshooting
- a) Recovery from faults or interrupts including restart and the collection of information concerning the fault
 - b) Description of diagnostic features available to the operator of the system including: available tools, and step-by-step diagnostic procedures
 - c) Trouble-shooting table
 - d) Periodic maintenance required, including tasks and frequencies
 - e) Test equipment and special tools required

Operational Data Base

The Operational Data Base (ODB) must contain definitions for the following data:

- 1) Telemetry database format;
- 2) Telecommand database format;
- 3) System (rover or payload) Baseline Configuration:
 - a) Definition of all parameters determining on-board database configuration at any time, including conversions and constraints, as installed in real-time, planning, and analysis platforms;
- 4) Remote Control Station (RCS) Baseline Configuration:
 - a) Definition of all parameters determining the RCS database configuration at any time, including conversions and constraints;
 - b) Values of all system (rover or payload) related parameters in the ODB pertinent to procedure execution and on-board system maintenance;
 - c) Constraints on telemetry values for status and health verification; and
 - d) Software configuration status for the system (rover or payload) and the RCS.