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## APPENDIX A

### Terrestrial Snow Mass Mission Phase 0

### Statement of Work (SOW)

**Date: October 2018**

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# TABLE OF CONTENTS

	PAGE
<b>1 INTRODUCTION.....</b>	<b>2</b>
1.1 SCOPE .....	2
1.2 BACKGROUND.....	2
1.3 SUMMARY OF THE PROPOSED MISSION CONCEPT FROM 2017-2018 CONCEPT STUDY .....	3
1.4 DOCUMENT CONVENTIONS .....	4
<b>2 DOCUMENTS .....</b>	<b>5</b>
2.1 APPLICABLE DOCUMENTS (AD).....	5
2.2 REFERENCE DOCUMENTS (RD).....	5
<b>3 REQUIREMENTS.....</b>	<b>7</b>
3.1 GENERAL .....	7
3.2 OBJECTIVES .....	7
3.3 DETAILED TASKS .....	8
3.3.1 <i>Mission Concept Refinement</i> .....	8
3.3.2 <i>Mission Concept for a low-cost precursor Mission</i> .....	10
3.3.3 <i>Requirements and Concept of Operations</i> .....	10
3.3.4 <i>Mission Planning and Development</i> .....	11
3.4 DELIVERABLES .....	13
3.5 SCHEDULE .....	14
3.6 MEETINGS.....	14
3.7 DOCUMENTATION AND NAMING CONVENTION .....	14
3.8 PROJECT MANAGEMENT REQUIREMENTS.....	15
3.8.1 <i>Team Organization</i> .....	15
3.8.2 <i>Communications and Access</i> .....	15
3.8.3 <i>Project Meetings</i> .....	15
3.8.4 <i>Agendas, Minutes and Action Item Log</i> .....	17
3.8.5 <i>Project Reporting</i> .....	18
3.8.6 <i>Documents Deliverables</i> .....	18
3.8.7 <i>Subcontract Management</i> .....	19
3.8.8 <i>Product Assurance</i> .....	19
3.9 INTELLECTUAL PROPERTY .....	19
<b>4 GOVERNMENT FURNISHED EQUIPMENT AND INFORMATION .....</b>	<b>20</b>
<b>APPENDIX A CONTRACT DATA REQUIREMENTS LIST (CDRL) .....</b>	<b>22</b>
<b>APPENDIX B DATA ITEMS DESCRIPTIONS (DIDS).....</b>	<b>23</b>
<b>APPENDIX C ACRONYMS AND ABBREVIATIONS .....</b>	<b>38</b>

# 1 INTRODUCTION

## 1.1 SCOPE

This Statement of Work (SOW) defines activities of the Options Analysis Phase (Phase 0) for high-resolution measurement of terrestrial snow water equivalent (SWE).

## 1.2 BACKGROUND

Current SWE products are unable to deliver information at the spatial resolution and within the accuracy necessary to meet requirements for operational environmental monitoring, services, and prediction at Environment and Climate Change Canada (ECCC). SWE is a required observational input to land surface data assimilation systems under development within the Meteorological Research Division of ECCC, for eventual operational implementation at the Meteorological Service of Canada. These modeling systems are fundamental to skilled numerical weather prediction and hydrological modeling. Enhanced snow information is also required to address priorities across Government departments (such as the Northern Strategy) and to meet international obligations (for example the World Meteorological Organization Global Cryosphere Watch).

Ku-band radar is a promising technology for terrestrial snow applications because of sensitivity to SWE through the volume scattering properties of dry snow. Specific frequencies within the Ku-band range also exhibit a range of sensitivity to snow microstructure. These differing sensitivities make the use of two distinct frequencies appealing for interpreting the backscattering signal from snow. While other remote sensing approaches such as LiDAR and L-band InSAR have proven effective for snow depth and SWE retrievals respectively, they fail to provide the wide swath and repeat coverage required for land surface and hydrological modeling applications. In addition to the retrieval of SWE, Ku-band radar measurements can support land surface modeling within operational forecast systems through assimilation of backscatter, and address additional parameters unrelated to snow, including sea ice and ocean winds.

The CoReH20 Phase 0 and Phase A activities motivated significant progress on technical instrument development, objective characterization of snow microstructure in the field, and backscatter modeling for snow [RD-7]. While not selected beyond phase A, the need to retrieve snow mass information remains timely, significant technical progress occurred, and the scientific and user communities were aligned in recognition of the potential impact from a spaceborne snow mass mission. There is both a strong legacy and current capacity in the Canadian scientific community in the fields of snow remote sensing, electromagnetic modeling, snow measurement science, and distributed land surface and hydrological modeling. This community participated in Phase A of CoReH20, and remains actively in collaboration with international colleagues, in the context of on-going snow radar initiatives at ESA and NASA JPL.

In 2015, an activity was initiated by ECCC and CSA to develop a mission concept to monitor snow. The first part of the activities was to finalize the mission objectives and in particular the measurement objectives, which was led by ECCC, with support from academic and Other Government Departments (OGD) partners. The focus was primary products related to snow mass, but the consultation also included secondary products related to sea ice, land ice and ocean vector winds that are expected to be derivable from the same measurements. The second part was developing concepts for a mission to fill the current operational gap in terrestrial snow information.

The third part of the work is a separate set of activities also lead by ECCC that was dedicated to the analysis of experimental datasets and modelling studies in support of algorithms/products that was used to confirm the feasibility and performance of the proposed mission concept.

The output of these studies were used to update the Mission Objectives Document (MOD), which will be used as the basis for the driving requirements of this study [AD-1]. The MOD also highlights recent advancements in the algorithms used to retrieve SWE. The concept study led to the definition of a high duty cycle dual Ku-band SAR instrument. The next section summarizes the proposed concept. Detailed information on the mission concept will be available to the Contractor after contract award.

### 1.3 SUMMARY OF THE PROPOSED MISSION CONCEPT FROM 2017-2018 CONCEPT STUDY

A dual-frequency Ku-band synthetic aperture radar, providing 250 m spatial resolution measurements with at least 4 looks across a wide swath was identified. A 817 km dusk-dawn orbit has been proposed, to allow operation along the same ground track as MetOp-SG-B, exploiting measurement synergies with the MWI passive microwave radiometer and SCA C-band scatterometer. After analyzing various configurations, a ScanSAR TOPS imaging mode with 500 km nominal swath width and sequential frequency operation at 13.5 GHz (Ku1) and 17.2 GHz (Ku2) was identified. The main specifications of this concept are summarized in Table 1.3-1.

**Table 1.3-1: Main specifications of the 2017-2018 concept study**

Parameter	Value	Remarks
Frequency	Dual-band operation, 13.5 and 17.2 GHz	Maximises SWE retrieval capability and snow microstructure characterisation
Polarizations	VV+VH	Dual-pol negates effects of horizontal layering in the snowpack to improve SWE retrieval; cross-polarized backscatter benefits the detection of extreme high ocean winds
Swath Width	500 km	Facilitates revisit performance of better than 5 days
Imaging Resolution	250m x 250m	Spatial resolution capability of the system in range and azimuth at Level 1b, supports requirements for generation of higher Level end user products
Number of Looks	>4	Provides multi-looking to enhance radiometric quality
Orbital Height	817 km	Aligned to MetOp-SG orbit height
Incidence Angle	23° - 50°	Provides coverage to enable 500 km swath
NESZ – 13.5 GHz	<-26 dB (VV & VH)	Low NESZ ensures high sensitivity measurement of strong backscatter for dry snow, and detection of wet snow cover with weak backscatter.
NESZ – 17.2 GHz	<-25 dB (VV & VH)	
Azimuth and Range DTAR	<-20 dB	Typical DTAR to adequately control ambiguities
Radiometric stability	<0.5 dB	Required temporal consistency of observations
Radiometric absolute accuracy	0.5 - 1 dB	Enables accurate retrieval of SWE

Important characteristics of the proposed SAR payload are the following:

- Ku1 and Ku2 frequencies from a single antenna aperture using a common front end
- 5.0 m x 0.8 m, non-deploying array with 192 T/R modules
- RF peak power of 2880 W with a transmit duty cycle of 10%
- 500 km achieved using ScanSAR TOPS (18 subswaths for each frequency)
- 325 kg payload (1100 kg spacecraft)
- Up to 40% operational duty cycle

#### **1.4 DOCUMENT CONVENTIONS**

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

- a) “Shall” or “Must” is used to indicate a mandatory requirement;
- b) “Should” indicates a goal or preferred alternative. Such goals or alternatives must be treated as requirements on a best efforts basis, and verified as for other requirements. The actual performance achieved must be included in the appropriate verification report, whether or not the goal performance 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.

In the following, the term 'Contractor' is used to describe the team that will conduct the study, which could be a mixed team drawn from Canadian Industry, Universities or Research Institutes.

## 2 DOCUMENTS

### 2.1 APPLICABLE DOCUMENTS (AD)

The following documents of the exact issue date and revision level shown are applicable and form an integral part of this document to the extent specified herein.

**Table2.1-1: Applicable Documents**

RD No.	Document Number	Document Title	Rev. No.	Date
AD-1		A Terrestrial Snow Mass Mission – Mission Objectives Document <a href="ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TSMM/">ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TSMM/</a>	2.1	October 2018

### 2.2 REFERENCE DOCUMENTS (RD)

The following documents provide additional information or guidelines that either may clarify the contents or are pertinent to the history of this document.

**Table2.2-1: Reference Documents**

RD No.	Document Number	Document Title	Rev. No.	Date
RD-1.	PMBOK Guide	A Guide to the Project Management Body of Knowledge	4 <sup>th</sup> Ed.	2008
RD-2.	CSA-SE-STD-0001	CSA Systems Engineering Technical Reviews Standard <a href="ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/">ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/</a>	A	2008-11-7
RD-3.	CSA-ST-GDL-0001	CSA Technology Readiness Levels and Assessment Guidelines <a href="ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/">ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/</a>	C	March 31, 2017
RD-4.	CSA-ST-FORM-0001	Technology Readiness and Risk Assessment (TRRA) Worksheet <a href="ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/">ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/</a>	F	
RD-5.	WMO/TD-No. 1405	Integrated Global Observing Strategy (IGOS) Cryosphere Theme Report		August 2007
RD-6.		Perspectives for a European Satellite-based Snow Monitoring Strategy – White paper		April 10, 2014
RD-7.	ESA SP-1324/2	Report for Mission Selection: CoReH20, European Space Agency, Noordwijk, The Netherlands.		2012

RD No.	Document Number	Document Title	Rev. No.	Date
RD-8.		Rott, H., S. Yueh, D. Cline, C. Duguay, R. Essery, C. Haas, F. Heliere, M. Kern, G. Macelloni, E. Malnes, T. Nagler, J. Pulliainen, H. Rebhan, and A. Thompson. <i>Cold regions hydrology high resolution observatory for snow and cold land processes</i> . Proceedings of the IEEE. 98 (5): 752-765.		May 2010



## **3 REQUIREMENTS**

### **3.1 GENERAL**

The Contractor must manage the project to effectively achieve project performance, scope, quality, cost and schedule requirements of this SOW. The Contractor must provide the management, technical leadership and support necessary to ensure effective and efficient performance of all project efforts and activities.

The Contractor must report project costs, schedule, technical, performance and risks issues as defined herein.

### **3.2 OBJECTIVES**

The objectives of this study are to:

- Update and refine the mission concept for a Terrestrial snow mass mission to address the modifications to the MOD [AD-1] and the issues raised by the previous concept study;
- Develop a new concept for a low-cost precursor mission;
- Develop requirements and concept of operations;
- Refine the Mission Development Plan, including costs and risks;
- Successfully complete applicable Mission Requirements Review (MRR) Exit Criteria [RD-2].

### **3.3 DETAILED TASKS**

#### **3.3.1 *Mission Concept Refinement***

The Contractor shall review the Mission Objectives Document [AD-1] and provide a list of recommendations including: missing information, incoherence, recommendation on objectives that appear over constrained and may limit the Contractor design choice.

The Contractor shall report their findings at the TIM#1. The findings may be incorporated in the MOD after review by CSA and the Science Team (chaired by the ECCC science lead; currently being formed).

The Contractor must refine the mission design analysis performed in the previous study and document the main new elements of the proposed concept in a Delta Mission Conceptual Design Document.

As a minimum, updates to the following elements must be included in the concept design (when applicable):

- 1) Payload Description
- 2) Spacecraft Layout
- 3) Constellation or Formation-Flying Description (if applicable)
- 4) Coverage Analysis (including orbit description)
- 5) Spacecraft Main Engineering Budgets, including: mass, power, data rates, on-board storage, ADCS, propulsion.
- 6) Ground Segment and Operations
- 7) Data Products and Data Latency
- 8) Calibration and Validation
- 9) Space-to-Ground Link
- 10) Launch Options
- 11) Compliance to Mission Objectives
- 12) Product Assurance Requirements

The mission concept must focus on the primary mission objectives for snow mass measurement, but the Contractor must also report on the secondary mission objectives that can be met with the proposed concept, and report on possible options or extensions to the baseline mission to meet secondary objectives as well.

Following the completion of the previous concept study, some questions have been raised and the contractor must produce the required analysis for the following specifics items:

- 1) The mission preliminary analysis leads to a very high duty cycle for the instrument therefore driving the instrument and spacecraft design. Additional analysis must be performed to optimize the coverage and eliminate when appropriate redundant coverage over the area of interest to reduce duty cycle.
- 2) If the requirement for a high duty cycle is confirmed, a detailed thermal analysis of the proposed concept must be performed to confirm the feasibility of the concept since the average power dissipation is significantly higher than usual.
- 3) The accommodation and deployment (as applicable) of the solar array must be analyzed in detail.
- 4) Because of the wide coverage with moderate resolution and high duty cycle, management of the data volume will be important. A detailed analysis of the data volume must be performed and solution(s) identified.
- 5) The initial concept requires a high power/high duty cycle instrument. It is likely that outside the period of operation, heaters will be required to maintain a stable temperature. In this context, the potential to use a low power/low data rate mode to meet some of the secondary objectives outside of the snow AOI while keeping the temperature of the instrument stable must be analyzed.
- 6) The initial concept relies on the use of a novel dual-frequency radiator and Transmit-Receive Modules (TRMs). The contractor must revisit this assumption and confirm by analysis/simulation that suitable options are available or could be developed to achieve the required performance by the mission.
- 7) The initial concept constrains the SAR orbit to be coordinated with MetOp-SG orbit, which is expected to be re-evaluated for Phase 0. The Contractor shall assess the amount of possible synergistic measurements with MWI when not constraining the orbit. The contractor shall also assess the advantages of not constraining the altitude of the orbit to the one of MetOp-SG-B in the mission design. Following re-evaluation of this need by the Science Team, the contractor shall update the Mission Conceptual Design Document to account for any relaxation in the coordination of the MetOp-SG orbit.
- 8) The Snow Water Equivalent retrieval algorithm has advanced considerably as described in the MOD since the CoreH2O phase A. However, there is a need to quantify the impact of the NESZ on the SWE retrieval performance. The contractor shall work in cooperation with the Science Team to define the appropriate model to use.
- 9) The updated MOD include a new need for a higher resolution stripmap mode. The analysis required to add such mode to the concept must be accomplished.

The results of these particular investigations and other required analysis must be documented in the Delta Mission Conceptual Design Document and presented at the Mission Concept Review.

### **3.3.2 Mission Concept for a low-cost precursor Mission**

The Contractor must develop a mission concept to meet the Reduced Scope Mission Objectives in the MOD [AD-01] and document the results in a separate section of the Delta Mission Conceptual Design Document.

The mission concept must focus on the primary mission objectives for snow mass measurements, but with a reduced scope as described in [AD-1]. The mission concept presented must enable to advance both the science and the technology required to advance the complete mission designed during the preceding task (Section 3.3.1). The Contractor must propose design alternatives to minimize cost and report on the compliance to the Reduced Scope Mission Objectives if these options are implemented. A target cost will be provided to the Contractor prior to this task. As a minimum, the three potential options to be investigated are a reduced swath width and duty cycle system, the use of a reflector antenna and the use of a single frequency.

As a minimum, the following elements must be included in the concept design:

- 1) Payload Description
- 2) Spacecraft Layout
- 3) Formation-Flying with other instrument Description (if applicable)
- 4) Coverage Analysis (including orbit description)
- 5) Spacecraft Main Engineering Budgets, including: mass, power, data rates, on-board storage, ADCS, propulsion.
- 6) Ground Segment and Operations
- 7) Data Products and Data Latency
- 8) Calibration and Validation
- 9) Space-to-Ground Link
- 10) Launch Options
- 11) Compliance to Reduced Scope Mission Objectives
- 12) Product Assurance Requirements

The results of this mission concept for a low-cost precursor must be presented at the Interim Review.

### **3.3.3 Requirements and Concept of Operations**

The Contractor shall flow-down the Mission Objectives and associated Observation Requirements into preliminary Mission and System Requirements. The document must either be separated in two sections for the complete mission and the precursor mission or implement a classification mechanism to help identify which requirements apply to each option.

The list must be broken-down as per the main elements of the mission and essentially be a first draft of the main sub-system requirements, with enough details to establish a credible and costed development plan.

Each requirement in the list must be traceable to a User Requirement. If it cannot be traced directly, it must be justified with respect to mission constraints, CSA objectives or regulations. Furthermore, this list must include Current Best Estimates of performance for the current mission concept and statements of compliance.

The list must be provided in Excel Format. A draft list must be provided for the complete mission option before the Mission Concept Review. A second draft including the precursor mission option must be provided before the Interim Review.

Within two weeks after the Interim Review, the Contractor will be informed of the selected mission option (full mission or low-cost precursor) for the remaining tasks.

After comments are provided, the Contractor shall produce the final version of the Mission and System Requirements List and present it at the Mission Requirements Review (MRR). The levels of details shall be sufficient to ensure that exit criteria for a MRR are met [RD-2].

A preliminary Concept of Operations must also be developed to meet these requirements. Specifically, the Concept of Operations is expected to establish the feasibility of: command and control, housekeeping and payload data acquisition, downlinking, turnaround time, processing, analysis and distribution, and payload calibration. It must be documented in a preliminary Concept of Operations document and presented at the MRR.

### **3.3.4 Mission Planning and Development**

Based on the agreed preliminary list of Mission Requirements, the Contractor shall update the Mission Conceptual Design Document as required and prepare the Mission Planning and Development Report that will be presented at the MRR.

The Mission Planning and Development Report includes as a minimum (for the selected mission option):

- 1) Mission Schedule (Section 3.3.4.1);
- 2) Development and Manufacturing Approach (Section 3.3.4.2);
- 3) Technology development required to bring the technology readiness to the appropriate level at the appropriate time consistent with mission schedule (Section 3.3.4.3);
- 4) Mission Cost Estimate (Section 3.3.4.4);
- 5) Mission Risk Assessment (Section 3.3.4.5).

#### **3.3.4.1 Overall Mission Schedule**

The Contractor must suggest a preliminary mission schedule for the overall life cycle of the mission. The timeline must include key milestones such as Preliminary Design Review, Critical Design Review and Launch. See [RD-2] for a full description of all the possible reviews, which may vary depending on the nature of the mission architecture.

#### **3.3.4.2 Development and Manufacturing Approach**

The Contractor must provide an overview of the development and manufacturing approach, specifying the major tasks required in the development and manufacturing cycles and the general strategy best suited for this approach. Identification of the potential long-lead items is also necessary.

The Contractor must provide an estimate of the anticipated percentage of the development activity that will be performed in Canada relative to the overall cost of the development activity. The Contractor must present what options could be undertaken to maximize the Canadian development activity and their corresponding impacts and benefits.

#### **3.3.4.3 Technology Readiness and Risk Assessment (TRRA)**

The Contractor must identify the required technology development requirements to bring the technology to the proper TRL at the appropriate time to meet the mission schedule.

The TRRA process and the TRL definitions are provided in [RD-3]. The Contractor must also include a preliminary Critical Technologies Development Plan [RD-4], which must include functional and performance requirements, and a roadmap (mapping TRL to a timeline coordinated with the mission development schedule) for each Critical Technology.

The Critical Technologies Development Plan must be provided as a section of the Mission Planning and Development Report.

#### **3.3.4.4 Mission Cost Estimate**

The Contractor must provide a Mission Cost Estimate, for all phases leading to the development, implementation, operation and disposal.

Along with the cost estimate, a detailed bottom-up justification for those costs must be included with estimates for manpower, material and procurement for Phase A and B.

#### **3.3.4.5 Mission Risk Assessment**

The Contractor must provide a Mission Risk Assessment. The Contractor must identify programmatic and technical elements of the proposed concept and concept of operations that may have impact on the development, the manufacturing, assembly and integration and operation of the mission. For each of these risk, the Contractor must identify the likelihood and the qualitative impact. The Contractor must provide for each of these risks the recommended mitigation strategy.

### 3.4 DELIVERABLES

The deliverables for the activity are listed in Table 3.4-1.

**Table 3.4-1 Deliverables**

<b>Reports and Documents</b>	<b>Due Date</b>
Delta Mission Conceptual Design Document	Mission Concept Review [MCR] – 2 weeks
Mission and System Requirements List (draft #1)	Mission Concept Review [MCR] – 2 weeks
Updated Delta Mission Conceptual Design Document	Interim Review [IR] – 2 weeks
Mission and System Requirements List (draft #2)	Interim Review [IR] – 2 weeks
Mission and System Requirements List	Mission Requirements Review [MRR] – 2 weeks
Preliminary Concept of Operations	Mission Requirements Review [MRR] – 2 weeks
Mission Planning and Development Report	Mission Requirements Review [MRR] – 2 weeks
<b>Minutes/ Presentations</b>	
Kick-off Meeting Presentation	Meeting Date – 1 week
TIM #1 Presentation (including recommendations on MOD)	Meeting Date – 1 week
Mission Concept Review Presentation	Meeting Date – 1 week
Interim Review Presentation	Meeting Date – 1 week
TIM #2 Presentation	Meeting Date – 1 week
Mission Requirements Review Presentation	Meeting Date – 1 week
Final Review Presentation	Meeting Date – 2 week
Minutes of all Meetings	Meeting Date + 1 week
Action Item Log for Reviews and Teleconference	Meeting Date + 1 day
<b>Final Data Package</b>	2 weeks before Contract End Date
Final Version of all documents	
Executive Report	
BIP and FIP Disclosure Report	
Technical Notes	As required.
Software used for performance analysis	

### 3.5 SCHEDULE

The work described in this SOW shall be completed within 13 months.

### 3.6 MEETINGS

Table 3.6-1 lists the meetings planned for this activity.

**TABLE 3.6-1 MEETINGS**

<b>Meeting</b>	<b>Date</b>	<b>Location</b>
Kick-off Meeting [KOM]	ARO + 2 weeks	Contractor
Technical Interchange Meeting #1 [TIM#1]	ARO + 2 months	Teleconference
Mission Concept Review [MCR]	ARO + 4 months	CSA (St-Hubert)
Interim Review [IR]	ARO + 6 months	Teleconference
Technical Interchange Meeting #2 [TIM#2]	ARO + 8 months	Teleconference
Mission Requirements Review [MRR]	ARO + 10 months	ECCC (Toronto)
Final Review [FR]	ARO + 12 months	CSA (St-Hubert)

### 3.7 DOCUMENTATION AND NAMING CONVENTION

Documentation, reporting and other deliverables shall be according to instructions provided in Appendix B of this SOW, which also provides naming convention. Presentation material shall be in Power Point format. Documents provided in Adobe PDF format shall not be protected against copy of text and figures.

Documents shall be delivered in the original software application format. One electronic copy of each deliverable document shall be transferred to the CSA to the address and in the format specified in DID-0000, Appendix B. No paper copy is to be delivered.

All simulation scenarios that have been considered (e.g. with STK) shall be delivered in CD-ROM or DVD-ROM format.

All documents shall be provided 10 working days prior to the specified Review/Meeting unless otherwise indicated.



## **3.8 PROJECT MANAGEMENT REQUIREMENTS**

The Contractor is responsible for establishing and maintaining a project management control system necessary to meet the requirements provided in the next sub-sections.

### **3.8.1 Team Organization**

The Contractor shall set up and maintain a project organization specific to this project. The Contractor shall provide and maintain a current Project Organizational Chart showing personnel assignments by name and function, and showing subcontractor-reporting relationships.

The Contractor shall nominate a Project Manager, who will be responsible for all aspects of the work carried out by the Contractor and will act as single point of contact within its project organization for communications between the Contractor and the Technical Authority (TA). In the absence of the single point of contact, the Contractor shall designate an alternate to maintain continuity of communication between the Contractor and the TA.

The Contractor shall also identify other key personnel who are considered essential to the performance of the contract. The Contractor shall assign personnel with appropriate qualifications and experience to all posts within the project organization.

The Contractor shall include, within its program management structure, the necessary leadership to effectively manage the performance of subcontractors in keeping with the project objectives.

### **3.8.2 Communications and Access**

The Contractor shall establish and maintain a close management and technical interface with CSA technical and project authorities to assure a coordinated program effort and monitoring of the total program cost, schedule and performance.

The Contractor shall provide access to its plant and personnel, at mutually agreeable dates, by representatives of CSA or other organizations nominated by the CSA, for review of program status.

The Contractor shall provide temporary accommodation and other facilities for the use of the CSA representatives (and the nominated attendees) visiting the Contractor's premises for reviews, meetings, audits, liaison, etc.

The accommodation shall be adequate for the purposes of the visit and the facilities provided shall include telephone, faxing, photocopying and Internet access.

All documentation and data generated by the Contractor for the project shall be accessible to the TA for review.

### **3.8.3 Project Meetings**

The Contractor shall hold the meetings described in Section 3.6. Some or all of these meetings may be attended by representatives of the CSA, and/or other organizations nominated by the CSA. Canada reserves the right to invite additional knowledgeable people (Public Servants or others under NDA) to this meetings.

All meetings will be held between the Contractor and the TA at a mutually agreeable time. The Contractor shall provide formal notification of the proposed meeting date to the TA no less than 10 working days before the meeting (with the exception of the KoM where the Contractor shall provide formal notification no less than 5 working days before the meeting).

For meetings held at government venues, the Contractor shall inform the TA of the names of Contractor and Subcontractor attendees no less than 10 working days before each meeting.

Additional teleconferences and face-to-face review meetings may be held if necessary when mutually agreed to by the Contractor and the CSA project manager.

Meetings can be alternatively replaced by videoconference or teleconferences for cost and/or time savings and when appropriate to support the scope of the meeting.

### **3.8.3.1 Kick-off Meeting**

Within two weeks of the contract award (or at a date mutually agreeable to by TA and the Contractor) a Kick-Off Meeting should be scheduled by the Contractor. The Contractor should provide the meeting agenda at least five working days before the meeting. The presentation should include the following content:

- Review of contract deliverables;
- Work requirements;
- Foreground Intellectual Property (FIP) and Background Intellectual Property (BIP);
- Licensing issues if any;
- Project's funding and expected cash-flow;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate.

This meeting will be held at Contractor Facilities or via teleconference.

All key participants under the contract, including at least one representative from each subcontractor, shall attend this meeting.

### **3.8.3.2 Review Meetings (Mission Concept Review, Interim Review, Mission Requirement Review)**

During the contract, various meetings will be necessary to evaluate progress of the work. The Meetings will be held according to the schedule in Table 3.6-1. The Meetings are intended to provide an opportunity for the Contractor, the PA, the SA, and other invited attendees to review and discuss the following in detail, as necessary:

- The contents of the contract deliverables;
- The technical work of each task;
- Foreground Intellectual Property (FIP) and Background Intellectual Property (BIP);
- Discuss project management issues;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate.

The Contractor's project manager, the systems engineer and all key Contractor participants, including at least one representative from each Subcontractor, shall attend all Review meetings.

### **3.8.3.3 Final Review Meeting**

The Final Review Meeting will be held at the Canadian Space Agency at the end of the contract. The specific intent of this meeting will be to discuss in detail the results obtained and the proposed follow-on activities. The Final Review Meeting is intended to provide an opportunity for the Contractor, the PA, the SA and other invited attendees to review and discuss the project.

- Contract deliverables;
- Foreground Intellectual Property (FIP) and Background Intellectual Property (BIP);
- Licensing issues if any;
- Final Funding and cash-flow;
- Discuss project management issues;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate

The Contractor shall submit the Final Data Package 10 working days before Contract End Date; document versions shall be as per the CDRL.

The Contractor's project manager, the systems engineer and all key Contractor participants, including at least one representative from each Subcontractor, shall attend Final Review Meeting.

### **3.8.4 Agendas, Minutes and Action Item Log**

The Contractor shall provide a Meeting Agenda for all reviews and meetings including teleconferences and shall deliver these to the TA no less than 5 working days before the meeting and shall have it approved by the TA.

The Contractor shall produce the minutes for all reviews and meetings including teleconferences and shall deliver these to CSA no more than 5 working days after the meeting.

The Contractor shall maintain a detailed Action Item Log (AIL) throughout the project to track actions resulting from all reviews and meetings including teleconferences using the following red-yellow-green spotlight method:

- 'Green' implying that the action item will be completed on-time.
- 'Yellow' implying that there exist an issue which will prevent meeting the deadline, and
- 'Red' implying that the action is past due.

Also, a chart indicating how many action items are open and how many are closed since the beginning of the project shall be produced at the meetings. The AIL shall be delivered the next business day following the review or meeting (including teleconference).

### **3.8.5 Project Reporting**

### **3.8.6 Documents Deliverables**

The Contractor shall deliver all documentation listed in the CDRL tables (Appendix A) as a minimum. The format and content of the deliverables shall be in accordance with the requirements specified in the Data Item Descriptions (DIDs) (Appendix B), both the specific DID identified in the CDRL and the General Preparation Instructions, DID-0000.

Except for the documents that will remain CSA documents, the Contractor may propose documents in a contractor's format provided the purpose, scope and content equal or exceed the DID requirements. Subject to CSA approval, the content of the Contractor's document will replace the content of the document specified in the DID.

SI units shall be used/supplied by the Contractor. Conversion factors shall be supplied for all non-SI units used in the deliverable documents (including dates as YYYY-MM-DD).

The Contractor shall obtain approval from the CSA for all CDRL Documents so indicated in the CDRL table (see Section 3.8.6.1).

#### **3.8.6.1 Documents Delivered for Approval**

The term "Approval" as used in this document and in other documents referred to herein, means written approval by CSA, of documents submitted by the Contractor. Once approved, the document is authorized for further use by CSA. The TA does not take responsibility for the validity of the data, or statements, and the Contractor is fully responsible for the content and secondary effects derived there from. The document may not be changed without the TA's approval. No request or document for which approval is required shall be acted upon or implemented by the Contractor until such approval is provided. Such requests and documents will be reviewed promptly by the TA and the necessary written approval or disapproval will be provided after their receipt by CSA. In the event of a failure by the TA to approve or disapprove the document within 15 calendar days, the documents may be deemed approved. In the event that a request or document is disapproved, the TA will advise the Contractor in writing as to the reasons for such disapproval and will define the additions, deletions or corrections that the TA deems necessary to render the request or document acceptable. Disapproved requests or documents that are subsequently amended by the Contractor and resubmitted for approval will be either approved or disapproved by the CSA.

#### **3.8.6.2 Documents Delivered for Review**

The term "Review" as used in this document and in all other documents referred to herein, means, unless specifically stated otherwise, a CSA review of the documents submitted for that purpose by the Contractor. The acceptance by the TA of a document for review shall imply that the document has been reviewed, commented on, revised as necessary, and has been determined to meet the requirements. The TA does not take responsibility for the validity of the data, or statements, and the Contractor is fully responsible for the content and secondary effects derived there from. In the event that the TA does not concur with a document submitted for review, the TA will so notify the Contractor. Such notification will include a full explanation of the reasons for the lack of concurrence and will recommend the additions, deletions or corrections that the TA deems beneficial to the needs of the project.

The Contractor is obligated to consider implementation of the changes suggested by CSA insofar as the changes are in accordance with the relevant DID in Appendix D and this SOW. If written notification of concurrence is not provided by CSA within 15 calendar days of the receipt of the document, the document will be deemed to have been reviewed by the TA without comment.

### **3.8.7 Subcontract Management**

The Contractor shall be fully responsible for implementation and execution of all tasks, including those subcontracted to others. Whenever this is the case, the Contractor shall prepare and maintain subcontract Statements of Work, technical requirements documents, etc., necessary to effectively manage the subcontractors' work. At the request of the TA, copies of subcontractor documentation shall be delivered to the TA.

The Contractor shall ensure that all of the relevant requirements of this Statement of Work are flowed down to the subcontract Statements of Work.

### **3.8.8 Product Assurance**

There are no applicable product assurance requirements in this study.

## **3.9 INTELLECTUAL PROPERTY**

The Contractor shall prepare Background and Foreground Intellectual Property (BIP and FIP) Report, identifying the BIP and FIP that will be generated in this study.

#### **4 GOVERNMENT FURNISHED EQUIPMENT AND INFORMATION**

No GFE.

# APPENDICES

## APPENDIX A CONTRACT DATA REQUIREMENTS LIST (CDRL)

This Appendix defines the documentation to be delivered by the Contractor.

### **LEGEND:**

A = Approval (in the Approval Category)

CF = Contractor's format

X = Ad-hoc, as and when requested

**TABLE A-1: CDRL**

<b>Title</b>	<b>DID No.</b>	<b>Approval Category</b>
Meeting Agenda	0004	A
Minutes of Meetings	0005	A
Action Items Log (AIL)	0006	A
Delta Mission Conceptual Design Document	0200	A
Mission Planning and Development Report	0210	A
Mission and System Requirements List	0220	A
Preliminary Concept of Operations	0230	A
BIP and FIP Disclosure Report	0240	A
Executive Report	0250	A
Technical Notes	CF	X



## **APPENDIX B DATA ITEMS DESCRIPTIONS (DIDs)**

<b>DID-0000 - GENERAL PREPARATION INSTRUCTIONS</b> .....	<b>24</b>
<b>DID-0004 – MEETING AGENDA</b> .....	<b>27</b>
<b>DID-0005 – MINUTES OF MEETINGS</b> .....	<b>28</b>
<b>DID-0006 – ACTION ITEMS LOG</b> .....	<b>29</b>
<b>DID-0200 – DELTA MISSION CONCEPTUAL DESIGN DOCUMENT</b> .....	<b>30</b>
<b>DID-0210 – MISSION PLANNING AND DEVELOPMENT REPORT</b> .....	<b>32</b>
<b>DID-0220 – MISSION AND SYSTEM REQUIREMENTS LIST</b> .....	<b>34</b>
<b>DID-0230 – PRELIMINARY CONCEPT OF OPERATIONS DOCUMENT</b> .....	<b>35</b>
<b>DID-0240 – FIP AND BIP DISCLOSURE REPORT</b> .....	<b>36</b>
<b>DID-0250 – EXECUTIVE REPORT</b> .....	<b>37</b>

# DID-0000 - General Preparation Instructions

## PURPOSE:

This DID describes the standard format for the preparation of deliverable project documentation. All documentation must be written in English and must be delivered in electronic format. Documentation must be prepared in the Contractor's format, however it must meet the requirements of this DID.

---

## PREPARATION INSTRUCTIONS:

### 1. GENERAL INSTRUCTIONS

#### 1.1. Electronic Copies

Electronic documents must be prepared using the most appropriate tool (Microsoft Word, Excel, MS Project, etc.); released versions must be delivered in electronic format and may be in PDF. Schedules must be submitted in Microsoft Project format. Documents must be delivered via e-mail or direct transfer (FTP). For direct transfer, a notification of the document's readiness and location on a Contractor repository must be sent.

The electronic file name and the identification number written on the document itself must have the following format:

**WXYZ-CDRL-NUM-CIE\_ContractNumber\_sentYEAR-MONTH-DAY**

where:

<b>WXYZ:</b>	A 4-8 letter acronym of the project
<b>CDRL-NUM:</b>	The CDRL Identifier
<b>CIE:</b>	Name of the Company (no space, no hyphen)
<b>ContractNumber:</b>	For example: _9F028-07-4200-03
<b>_sentYEAR-MONTH-DAY:</b>	Date Tracking Number

Electronic documents or notifications of their availability on Contractor repositories must be sent to the e-mail address of the TA.

Emails are to contain the project/program acronym or equivalent identifier in the "Subject" line and include the CDRL identifier under which deliverable documents are being submitted. Hard copy and media deliverables are to be addressed to:

Attention:  
Canadian Space Agency  
6767, Route de l'Aéroport  
Longueuil, QC, J3Y 8Y9  
CANADA

The DVD-ROM label must present the following information:

- a) Company Name

- b) Document Title
- c) Document Number and Revision Status
- d) CDRL Number
- e) Contract Number

## 1.2. Electronic Documents Format

Electronic copies of text documents must be formatted for printing on 8.5" x 11" paper.

### 1.2.1. Page Numbering

General format of documents should include page numbers and be formatted according to the Contractor's normal standard. If the document is divided into volumes, each such volume must restart the page numbering sequence.

### 1.2.2. Document Numbers

All pages must contain the Document Number at the top of the page. Document Numbers must include revision status and volume identification as applicable.

## 2. DOCUMENT STRUCTURE AND CONTENT

### 2.1. Overall

Except as otherwise specified, all documents must have the overall structure as follows:

- a) Cover/Title Page;
- b) Table of Contents;
- c) Scope;
- d) Applicable and Reference Documents;
- e) Body of Document; and
- f) Appendices
- g) The following property notice of all internal pages: ***Use, duplication or disclosure of this document or any of the information contained herein is subject to the Property Notice at the front of this document.***

### 2.2. Cover/Title Page

The title page must contain the following information:

- Document Number and date: Volume x of y (if multivolume)
- Rev. indicator / date of Rev.
- Document Title
- Project Name
- Contract No.
- CDRL Item No. or Nos., if one document responds to more than one CDRL, subject to prior approval from the TA.
- Prepared for: Canadian Space Agency
- Prepared by: Contractor name, CAGE Code, address, and phone number
- Product tree identifier, if applicable
- © HER MAJESTY THE QUEEN IN RIGHT OF CANADA [YEAR]
- The following property notice: ***This document is a deliverable under contract no. \_\_\_\_\_. It contains information proprietary to the Crown, or to a third party to which the Crown may have legal obligation to protect such information from unauthorized disclosure, use or***

*duplication. Any disclosure, use or duplication of this document or of any of the information contained herein for other than the specific purpose for which it was disclosed is expressly prohibited outside the Government of Canada except as the Crown may otherwise agree to in writing.*

### **2.3. Table of Contents**

The table of contents must list the title and page number of each titled paragraph and subparagraph, at least down to the third level inclusive. The table of contents must then list the title and page number of each figure, table, and appendix, in that order.

### **2.4. Scope**

This section must be identified as section 1 and must, as a minimum, provide the following information:

- a) Identification (number, title) of the system, hardware, or software to which the document applies;
- b) A brief overview of the system to which the document applies; and
- c) A summary of the purpose and content of the document.

The requirements specified in the following DIDs are the minimum expected. The Contractor must include in all documents all additional information required in order to ensure that the document provided will achieve its purpose as stated in the DID.

### **2.5. Applicable and Reference Documents**

This section must list by Document Number and title, all applicable and reference documents. This section must also identify the source of all applicable and reference documents and the revision indicator.

### **2.6. Body of Document**

The body of the document must be prepared in accordance with the content and format requirements defined in the specific Data Item Description.

### **2.7. Appendices**

Appendices may be used to provide information published separately for convenience of document maintenance.

## **3. DOCUMENT REVISIONS**

Changes in revised documents must be identified by a sidebar.

## **4. SUBMISSION OF DATA**

Data must be submitted via Letter of Transmittal (or an electronic equivalent as mutually agreed by the TA and the Contractor), and acknowledged. The Letter of Transmittal will contain as a minimum, the Contract Serial Number, the CDRL Number and the Title. The Letter of Transmittal must be forwarded by the Contractor in two copies; one copy of acknowledgement to be signed and returned to the Contractor by the recipient.

## **DID-0004 – Meeting Agenda**

### **PURPOSE:**

To clarify the purpose, content and timings 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; and
- f) Expected duration.

#### **2) DOCUMENT BODY:**

- a) Introduction;
- 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 any action items as a result of the current meeting and
- i) Set or confirm dates of future meetings.

## DID-0005 – 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 and date,
  - b) Project title, project number, and contract number,
  - c) Space for signatures of the designated representatives of the Contractor and the CSA,
  - d) Name and address of the Contractor;
- 2) Purpose and objective of the meeting;
- 3) Location;
- 4) Agenda;
- 5) Summary of the discussions, assumptions, 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.”*

The list of action items must include the following information:

- 1) the action item number;
- 2) a description of the action required;
- 3) the date the action item was opened;
- 4) the person responsible for ensuring that the action is carried out;
- 5) the due date for the action;
- 6) the status of the action (open or closed); and
- 7) any comments or remarks relevant to the action.

Once an action item is closed, the action item list should also indicate the date the action was complete.

## **DID-0006 – 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 AIL must be in a tabular form, with the following headings in this order:

- 1) Item Number;
- 2) Red, yellow, green stoplight
- 3) Item Title;
- 4) Open Date;
- 5) Source of AI (e.g. MCR meeting, RID, etc.);
- 6) Originator;
- 7) Office of Prime Interest;
- 8) Person responsible (for taking action);
- 9) Target/Actual Date of Resolution;
- 10) Status (Open or Closed);
- 11) Remarks; and
- 12) Chart of graphical representation of open, closed, and total action items.

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-0200 – Delta Mission Conceptual Design Document

## PURPOSE:

To develop mission concepts to meet primary requirements (snow mass measurements) and report on the feasibility to meet the secondary mission objectives (sea ice, land ice and ocean vector winds).

---

## PREPARATION INSTRUCTIONS:

The document must include as a minimum:

- 1) An introduction including the scope, the purpose and a list of assumptions (if any);
- 2) A main mission description (only the changes from previous concept):
  - a. Payload description;
  - b. Spacecraft Layout;
  - c. Constellation of formation-flying geometry (if applicable);
  - d. Coverage Analysis (including orbit description)
  - e. Spacecraft Main Engineering Budgets, including: mass, power, data rates, on-board storage, ADCS, propulsion;
  - f. Ground Segment and Operations;
  - g. Data Products and Data Latency;
  - h. Calibration and Validation;
  - i. Space-to-Ground link;
  - j. Launch Options;
  - k. Compliance to Measurement Objectives;
  - l. Possible options/variations to the baseline concept;
  - m. Response and Recommendations related to requested trades/questions detailed in section 3.3.1;
- 3) A cost-capped precursor mission description:
  - a. Payload description;
  - b. Spacecraft Layout;
  - c. Constellation of formation-flying geometry (if applicable);
  - d. Coverage Analysis (including orbit description)
  - e. Spacecraft Main Engineering Budgets, including: mass, power, data rates, on-board storage, ADCS, propulsion;
  - f. Ground Segment and Operations;



- g. Data Products and Data Latency;
- h. Calibration and Validation;
- i. Space-to-Ground link;
- j. Launch Options;
- k. Compliance to Measurement Objectives;
- l. Possible options/variations to the baseline concept.

## DID-0210 – Mission Planning and Development Report

**PURPOSE:**

To define the programmatic activities required to initiate and develop the mission.

**PREPARATION INSTRUCTIONS:**

The plan must include the following:

- 1) An introduction including the scope, the purpose and a list of assumptions (if any);
- 2) A description of the mission including its objectives;
- 3) Technology Readiness and Risk Assessment (TRRA);
- 4) Technology development activities to be performed, detailing the urgency, criticality and the main risks and challenges of each activity;
- 5) Possible technology demonstrations;
- 6) Estimated mission life cycle cost. The estimate must use the template below and provide a bottom-up justification for the cost of phase A and B;

Category		Phase A	Phase B	Phase C	Phase D	Phase E	Phase F
<b>Labour</b>	Management						
	Technology Development						
	Design						
	Documentation						
	Reviews						
	Manufacturing						
	Assembly						
	Testing						
	Product Assurance						
	Science Team Support (if applicable)						
	<b>Total Labour</b>						
<b>Non-Labour</b>	Hardware / Software Procurement						
	Science Team Support (if applicable)						
	Tools, Equipment and Facilities						

	Travel and Living						
	Other Direct Charges						
	<b>Total Non-Labour</b>						
<b>Risk</b>	Risk Contingency						
<b>Taxes</b>	GST						
<b>Total By Phase</b>							
<b>Total All Phases</b>							

- 7) Estimated mission schedule including all major milestones;
- 8) Preliminary mission risk assessment;
- 9) High-level preliminary concept of operations;
- 10) Potential collaborations;
- 11) Proposed Canadian capabilities development strategy;
- 12) Recommendations for follow-on activities.

## **DID-0220 – Mission and System Requirements List**

### **PURPOSE:**

To capture the mission requirements. This document is in Excel format and is designed to facilitate the efficient exchange of information with the Science Team.

---

### **CONTENT:**

The document includes the following:

- 1) A list of all mission requirements to respond to known and/or anticipated user requirements including explanatory notes when required. This list shall be organized by the high level mission architecture (e.g. Mission, Spacecraft, Bus, Payload, Ground Segment, Operations, etc.);
- 2) A traceability matrix to identify the correlation between mission requirements and Mission Objectives Document;
- 3) Current Best Estimate of Performance (CBE) for the current Mission conceptual Design with respect to each mission requirement;
- 4) Statement of compliance for the current Mission Conceptual Design with respect to each mission requirement;
- 5) A list of any mission goals that would enhance the mission objectives if implemented including explanatory notes when required;
- 6) Any appendices required to provide detailed information pertinent to the mission requirements that is not suitable to be contained in the main document as explanatory notes.
- 7) A list of all System Level Requirements to respond to known and/or anticipated Mission Requirements. This list shall be organized by the mission architecture (e.g. Mission, Spacecraft, Bus, Payload, Ground Segment, Operations, Product Assurance, etc.) and be consistent with the Mission Conceptual Design.
- 8) A traceability matrix to identify the correlation between System Requirements and Mission Requirements,
- 9) Current Best Estimate of Performance (CBE) for the current Mission Conceptual Design with respect to each system requirement;
- 10) Statement of compliance for the current Mission Conceptual Design with respect to each system requirement;

# DID-0230 – Preliminary Concept of Operations Document

## PURPOSE:

To describe how the system will be operated in order to meet the mission objectives.

---

## CONTENT:

The Concept of Operations Document must contain the following information:

- 1) Introduction including the scope, the purpose and a list of assumptions (if any);
- 2) Description of the overall concept of operations that proves the feasibility of command and control, housekeeping and payload data acquisition, downlinking, turnaround time, processing, analysis and distribution and payload calibration;
- 3) System operations requirements and constraints
  - a) System description
  - b) End-users description and requirements
  - c) System Health and Safety Requirements
  - d) Programmatic and operational constraints
  - e) Relationship with other missions / programs
  - f) External dependencies or interfaces with other organisations
- 4) Space segment characteristics including spacecraft monitoring and control, and spacecraft modes
- 5) Ground segment characteristics including Command & Control and Data Reception for the LEOP, commissioning phase and routine operations phase
- 6) System operations concepts
  - a) Data Reception, transfer, processing
  - b) Data turn around time
  - c) Instrument Calibration
  - d) Orbit Determination and Maintenance
- 7) Operational Scenarios

## **DID-0240 – FIP and BIP Disclosure Report**

### **PURPOSE:**

To fully disclose all FIP and BIP resulting from the study.

---

### **PREPARATION INSTRUCTIONS:**

The report shall include the following:

- an introduction including the scope and the purpose;
- a list and description of all FIP resulting from the study; and
- a list and description of all BIP required by CSA for use of the FIP resulting from the study.

## **DID-0250 – Executive Report**

### **PURPOSE:**

To provide a summary of the work accomplished during the contract.

---

### **PREPARATION INSTRUCTIONS:**

The Executive Report will be placed in the public domain (e.g. CSA's library, publication and/or website).

The report should not exceed ten (10) pages.

The Contractor should submit an electronic copy of the Executive Report in the Final Data Package. The structure for the Executive Report is as follows:

- 1) Introduction;
- 2) Project Objectives;
- 3) Approach / Project Tasks;
- 4) Accomplishments;
- 5) Science/Technology:
  - a) Innovative Aspects;
  - b) Application Fields;
- 6) Business Potential, Benefit and Impact on the organization;
- 7) Ownership of Intellectual Property; and
- 8) 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 should include the following proprietary notice ("Owner of FIP" being either the CSA or the Contractor):

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## **APPENDIX C    ACRONYMS AND ABBREVIATIONS**

ARO	After Receive Order
AD	Applicable Document
ADCS	Attitude Determination and Control Subsystem
AI	Action Items
AIL	Action Items Log
AOI	Area Of Interest
BIP	Background Intellectual Property
CA	Contract Authority
CDRL	Contract Data Requirements List
CoReH20	Cold Regions High Resolution Hydrological Observatory
CSA	Canadian Space Agency
DID	Data Item Description
ECCC	Environment and Climate Change Canada
ESA	European Space Agency
FIP	Foreground Intellectual Property
GFE	Government Furnished Equipment
IP	Intellectual Property
KoM	Kick-off Meeting
MCR	Mission Concept Review
MRR	Mission Requirements Review
MWI	Microwave Imaging radiometer
OGD	Other Government Departments
PA	Product Assurance
RD	Reference Document
RT	Review Team
SAR	Synthetic Aperture Radar
SOW	Statement Of Work
SWE	Snow Water Equivalent
TA	Technical Authority
TBC	To Be Confirmed
TBD	To Be Determined
TN	Technical Note
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
TRM	Transmit Receive Module



TRRA Technology Readiness & Risk Assessment  
WBS Work Breakdown Structure  
WMO World Meteorological Organization

