RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:

Travaux publics et Services gouvernementaux Canada
Place Bonaventure,
800 rue de la Gauchetière Ouest
1er étage
Montréal
Québec
H5A 1L6
FAX pour soumissions: (514) 496-3822

SOLICITATION AMENDMENT
MODIFICATION DE L'INVITATION

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

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

Comments - Commentaires

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

Issuing Office - Bureau de distribution

Travaux publics et Services gouvernementaux Canada
Place Bonaventure,
800 rue de la Gauchetière Ouest
Voir aux présentes - See herein
Montréal
Québec
H5A 1L6

Title - Sujet Space Exploration Robotics	
Solicitation No. - N° de l'invitation 9F050-160946/A	**Amendment No. - N° modif.** 001
Client Reference No. - N° de référence du client 9F050-16-0946	**Date** 2017-05-12
GETS Reference No. - N° de référence de SEAG PW-$MTB-690-14345	
File No. - N° de dossier MTB-7-40013 (690)	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin **at - à 02:00 PM** **on - le 2017-06-30**	**Time Zone** **Fuseau horaire** Heure Avancée de l'Est HAE
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☑ **Other-Autre:** ☐	
Address Enquiries to: - Adresser toutes questions à: Paquin, Esther	**Buyer Id - Id de l'acheteur** mtb690
Telephone No. - N° de téléphone (514) 496-3889 ( )	**FAX No. - N° de FAX** (514) 496-3822

Destination - of Goods, Services, and Construction:
Destination - des biens, services et construction:

AGENCE SPATIALE CANADIENNE / CANADIAN SPACE AGENCY
EXPLORATION SPATIALE / SPACE EXPLORATION
6767 ROUTE DE L'AÉROPORT
SAINT-HUBERT
Québec
J3Y 8Y9

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée	**Delivery Offered - Livraison proposée**

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

Telephone No. - N° de téléphone
Facsimile No. - N° de télécopieur

Name and title of person authorized to sign on behalf of Vendor/Firm (type or print)
Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)

Signature **Date**

Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
9F050-160946/A	001	mtb690
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
9F016-16-0946	MTB-7-40013	

Project title

Deep Space Exploration Robotics (DSXR) Phase O

The Request for Proposal is hereby amended as follow:

1) **Add** the Attachment 1 to Part 3, the Attachment 1 to Part 4 and the Attachment 1 to Part 5.
2) **Delete** the Annex A-16-0946
   Add: Annex A (2)-16-0946

Agence spatiale canadienne | Canadian Space Agency

CSA-DSXR-SOW-0001

Canadian Space Agency

ANNEX "A"

DSXR – Deep Space Exploration Robotic System
Phase 0
Statement of Work (SOW)

Initial Release
April 13, 2017

This Page Intentionally Left Blank

APPROVALS

This document and all changes to it shall be approved by the undersigned. Proposed changes to the currently approved baselined version of this document shall be forwarded to the CSA Configuration Management Receipt Desk for evaluation and submission for approval. Approved changes shall be incorporated into this document.

Prepared by:

Glen Bilodeau — Date
Program Manager
Space Exploration, CSA

Reviewed by:

Daniel Lefebvre — Date
Technical Authority
Space Exploration, CSA

Approved by:

Daniel Rey — Date
Mission Manager
Space Exploration, CSA

This Page Intentionally Left Blank

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 SUMMARY 3
1.2 SCOPE 5
1.3 OBJECTIVE 5
1.4 DOCUMENT CONVENTIONS 5

2 DOCUMENTS 6

2.1 APPLICABLE DOCUMENTS (AD) 6
2.2 REFERENCE DOCUMENTS (RD) 6

3 WORK REQUIREMENTS 8

3.1 MISSION ANALYSIS, PLANNING AND DEVELOPMENT 8
3.1.1 Mission Objectives and User Needs Definition 10
3.1.2 Mission Conceptual Design 10
3.1.3 DSXR Mission Requirements 10
3.1.4 Mission Feasibility Study 10
3.1.5 Mission Development Plan 11
3.1.6 Technology Readiness and Risk Assessment (TRRA) 14
3.1.7 Technology Roadmap 15
3.1.8 Intellectual Property 15
3.1.9 Ground Segment Options Assessment 15
3.1.10 Lunar-Deployable Robotic System Assessment 15
3.1.11 Intra-Vehicular Robotic System Assessment 15
3.1.12 Collision Impact Detection and Damage Avoidance Assessment 16
3.1.13 Cislunar Architecture and Draft Standards Review 16
3.2 OPERATIONS 16
3.2.1 Concept of Operations and Operational Requirements 16
3.2.2 Preliminary Ground Segment Facility Requirements Specification 16
3.3 ENGINEERING 17
3.3.1 System Conceptual Design 17
3.3.2 Preliminary Interface Control Document 17
3.3.3 Preliminary Systems Engineering Management Plan 17
3.3.4 Preliminary Systems Requirements Document 17
3.3.5 Preliminary Environmental Requirements Document 17
3.3.6 Preliminary CAD Models 18
3.3.7 Preliminary Proofs of Concept and SLA Models 18
3.3.8 Preliminary Graphical Simulation Models 18
3.3.9 Mission Requirements Verification Matrix 18
3.3.10 Core Flight Software System Architecture Assessment 18
3.4 PROJECT MANAGEMENT 20
3.4.1 Team Organization 20
3.4.2 Contractor Work Breakdown Structure 20
3.4.3 Detailed Schedule and Critical Path 20
3.4.4 Communications and Access 21
3.4.5 Project Meetings 21
3.4.6 Agendas, Minutes and Action Item Log 24
3.4.7 Bi-Weekly Teleconference Meetings 24
3.4.8 Other Meetings 25
3.4.9 Project Reporting 25
3.4.10 Document Deliverables 25
3.4.11 Subcontract Management 27
3.4.12 Product Assurance 27
3.5 OPTIONAL SERVICES 27

4 CONTRACTOR DELIVERABLES 29

4.1 HARDWARE 29
4.2 SOFTWARE 29
4.3 DOCUMENTATION 29

5 GOVERNMENT FURNISHED EQUIPMENT 30

APPENDICES 32

A CONTRACT DATA REQUIREMENTS LIST (CDRL) 33

A.1 PROJECT MANAGEMENT 34
A.2 PRODUCT ASSURANCE 34
A.3 MISSION DOCUMENTATION 34
A.4 OPERATIONS 35
A.5 ENGINEERING 36

B DATA ITEMS DESCRIPTIONS (DIDS) 37

DID-002 – MISSION CONCEPT DOCUMENT (MCD) 38
DID-007 – MISSION DEVELOPMENT PLAN 40
DID-008 – MISSION REQUIREMENTS DOCUMENT 41
DID-0013 – TECHNOLOGY READINESS AND RISK ASSESSMENT WITH STAND ALONE REPORT 43
DID-100 – GENERAL PREPARATION INSTRUCTIONS 46
DID-102 – CWBS AND WORK PACKAGE DESCRIPTIONS 51
DID-105 – PROJECT SCHEDULE 52
DID-107 – PROGRESS REPORT 53
DID-110 – MEETING AGENDA 55
DID-111 – MINUTES OF MEETINGS 56
DID-112 – ACTION ITEMS LOG (AIL) 57
DID-114 – PHASE CLOSURE / FINAL REPORT 58
DID-204 – MISSION FEASIBILITY STUDY 59
DID-320 – PRODUCT ASSURANCE AND IMPLEMENTATION PLAN 61
DID-400 – SYSTEM REQUIREMENTS DOCUMENT 67
DID-450 – SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP) 70
DID-501 – INTERFACE CONTROL DOCUMENT (ICD) 73
DID-600 – CAD MODELS 76
DID-700 – SYSTEM CONCEPTUAL DESIGN DOCUMENT 77
DID-801 – GROUND SEGMENT FACILITY REQUIREMENTS SPECIFICATION 79
DID-825 –SYSTEM CONCEPT OF OPERATIONS 80

C CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY 82

C.1 PURPOSE 82
C.2 DEFINITIONS 82
C.3 INSTRUCTIONS FOR COMPLETING IP DISCLOSURE TABLES 83

D ROBOTIC FUNCTIONS 88

E ACRONYMS AND ABBREVIATIONS 90

LIST OF TABLES

TABLE PAGE
TABLE 2-1: APPLICABLE DOCUMENTS....6
TABLE 2-2: REFERENCE DOCUMENTS....7
TABLE 3-1 : TEMPLATE FOR COST BREAKDOWN (EXAMPLE)....12
TABLE 3-2: PROPOSED PROJECT MILESTONES....21
TABLE 3-3 : NOMINAL PLANNED MEETINGS....22

LIST OF FIGURES

FIGURE PAGE
FIGURE 1-1: CONCEPT OF DSXR SYSTEMS ON A DEEP-SPACE HABITAT....1
FIGURE 1-2: NOTIONAL MOON-MARS HUMAN EXPLORATION PHASES....2
FIGURE 1-3: NOTIONAL MOON-MARS HUMAN EXPLORATION PHASES....2
FIGURE 1-4: CONCEPT OF ROBOTIC SYSTEM WITH TOOL CADDY, CAPTURE TOOL, DEXTEROUS TOOL, AND EVA SOCKET INTERFACE....4
FIGURE 1-5: CONCEPT OF SMALL DEXTEROUS ROBOTIC SYSTEM....4
FIGURE 1-6: NOTIONAL GROUND SEGMENT WORKSTATION CONCEPT....4
FIGURE 3-1: REQUIREMENT FLOWDOWN FOR DSXR SYSTEM (NOTIONAL)....9
FIGURE 3-2: CFS ARCHITECTURAL LAYERS....19

1 INTRODUCTION

Canada, as a partner in the International Space Station (ISS), has undertaken important discussions with the partnership to determine the next step for human exploration. A common long term goal is the human exploration of Mars. One step towards this long term goal is demonstrating and proving technologies beyond the ISS. The partnership is discussing a space platform, deep-space habitat, in a lunar orbit that will extend human presence and further demonstrate and prove technologies and operations at a larger distance from Earth (RD-06, RD-12), see Figure 1-1, Figure 1-2and Figure 1-3.

Like Canadarm2 on the International Space Station, a Deep-Space Exploration Robotic system (DSXR) will assure the logistics, maintenance, inspection, and assembly of this outpost. For the current planning concept, the system consists of the following:

1. Large robotic system and tools that will provide functions including remote inspection, free-flying vehicle capture, payload and On-orbit Replaceable Unit (ORU) handling and station maintenance.
2. Dexterous robotic system and tools that will perform servicing of the robotic elements, and possibly used internally and/or deployed to the lunar surface.
3. Robotic Interface Fixtures, Platforms and Receptacles that will be needed by the habitat vehicles, ORU providers, and the robotic system.
4. Ground segment that will provide planning, monitoring, commanding and visualization functions.

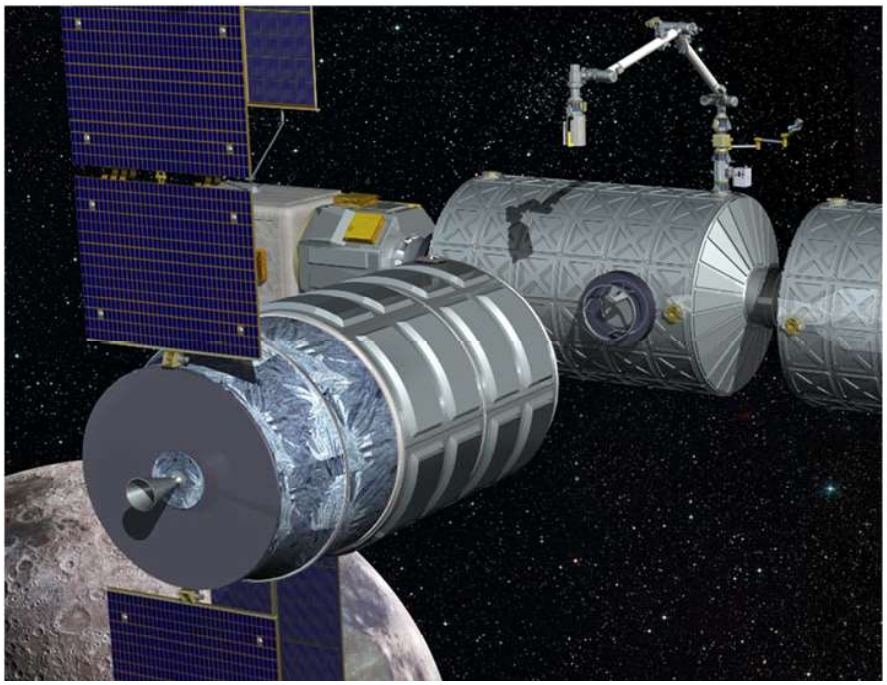

FIGURE 1-1: CONCEPT OF DSXR SYSTEMS ON A DEEP-SPACE HABITAT

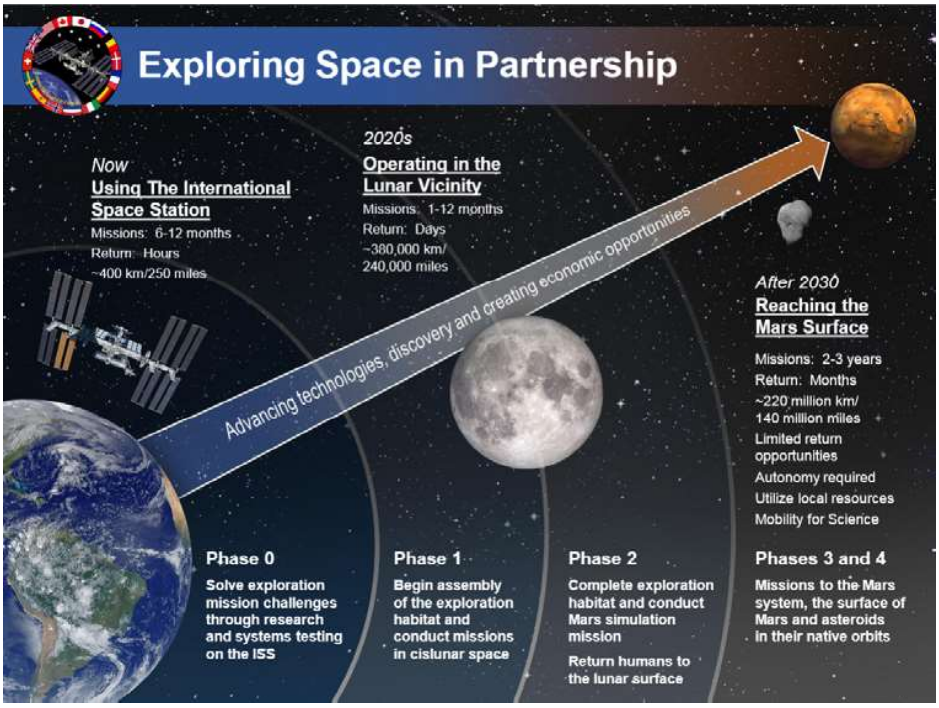

FIGURE 1-2: NOTIONAL MOON-MARS HUMAN EXPLORATION PHASES

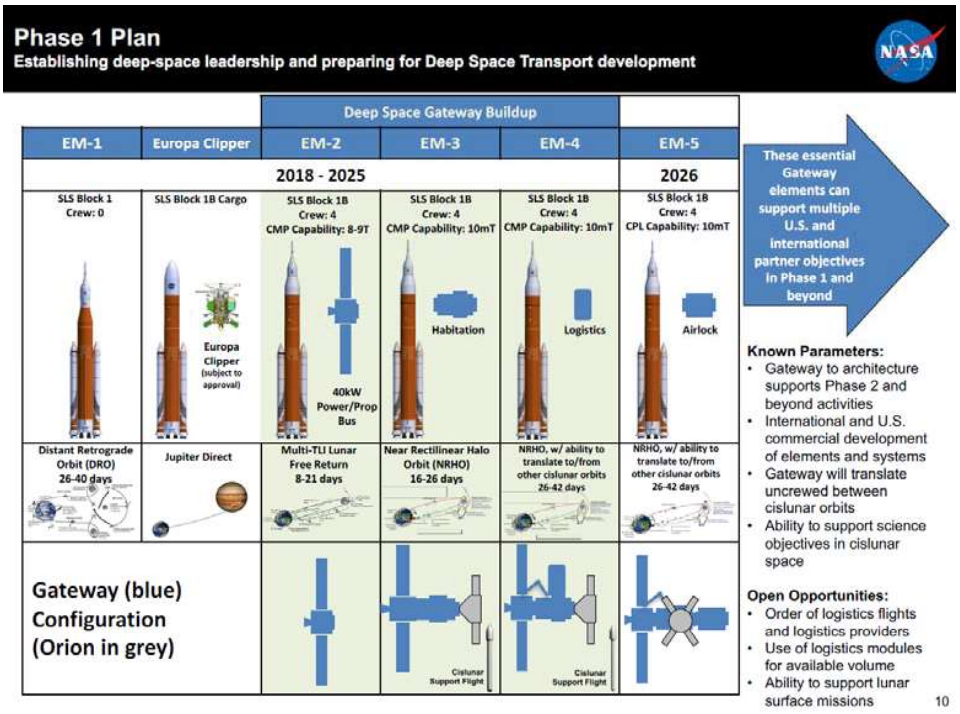

FIGURE 1-3: NOTIONAL MOON-MARS HUMAN EXPLORATION PHASES

1.1 SUMMARY

The Phase 0 will elaborate on four sub-systems of deep-space exploration robotic system:

Large Robotic System and Essential tools:

The large robotic system is a dual-ended manipulator with the ability to relocate to base locations on the habitat. This multi-purpose manipulator can be adapted to a variety of missions, and specialized functions such as free-flyer capture and other tasks. The large robotic system interfaces with a dexterous end-effector tool to access and perform external maintenance and inspection operations. Mission planning and execution take place through or supported by a ground segment. See Appendix D for the full list of robotic system mission level functions. The large robotic system also includes all required flight support equipment, as well as on-orbit centralized avionics and man-machine interfaces, leveraging any suitable assets provided by the Deep Space Gateway.

The essential tool set for the Large Robotic System includes the Tool Caddy, the Capture/Rigidize Tool, and the Dexterous Adaptor Tool, see Figure 1-4. Large Arm end-effectors also include a socket interface for a NASA supplied EVA portable foot restraint.

Dexterous Robotic System, IVR Kit and Surface Kit:

The dexterous robotic system allows self-maintenance of the large robotic system via operation from a separate station base location such as the extended science airlock platform. Maintenance of the Dexterous Robotic system is performed by crew inside the station via airlock transfer. This study will include the development and assessment of a concept to enable a dexterous robotic system which could be used for intravehicular servicing as well as external. This study will also assess the deltas associated with a lunar-surface compatible version of the dexterous robotic system for possible deployment onto a mobile rover platform.

Robotic Interface Fixtures, Platforms and Receptacles:

The interfaces include all robotic hardware attached to vehicles and ORUs to enable robotic operations and handling (e.g. low profile passive base, grapple fixture, and dexterous fixture), as well as ORU platforms and their receptacles (e.g. mate/demate wedge platform and receptacle). These elements will be under the greatest schedule pressure for a cislunar habitat program given the early definition and delivery required to support international partner schedules.

Ground Segment:

The ground segment portion of the DSXR allows for mission planning, rehearsal/validation, transfer of plan from the ground to the space segment, system monitoring, video monitoring, 3D visualization and manual commanding of the space segment.

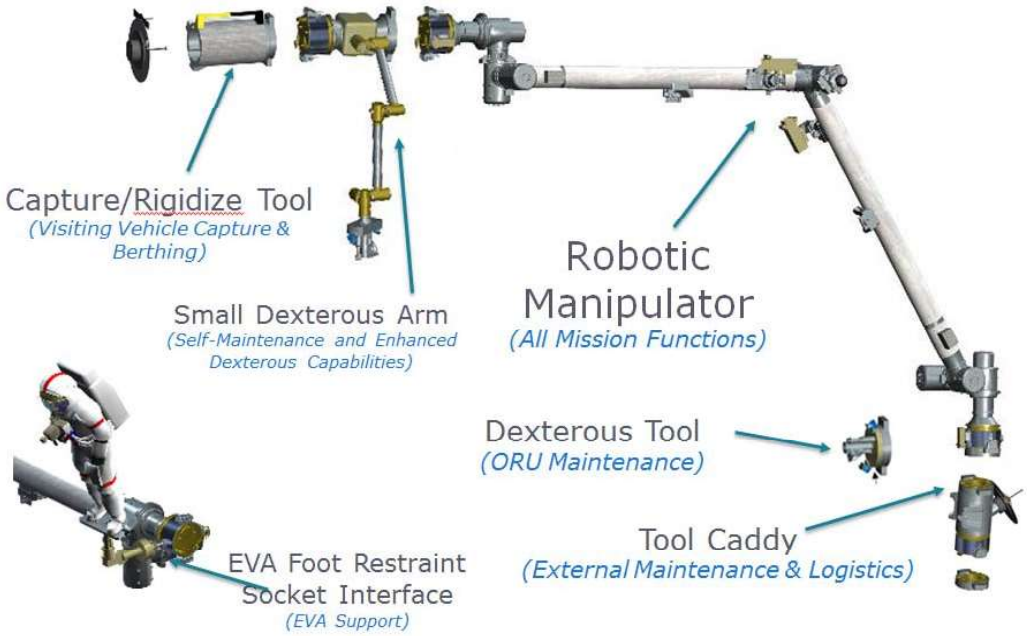

FIGURE 1-4: CONCEPT OF ROBOTIC SYSTEM WITH TOOL CADDY, CAPTURE TOOL, DEXTEROUS TOOL, AND EVA SOCKET INTERFACE

FIGURE 1-5: CONCEPT OF SMALL DEXTEROUS ROBOTIC SYSTEM

FIGURE 1-6: NOTIONAL GROUND SEGMENT WORKSTATION CONCEPT

1.2 SCOPE

This Statement of Work (SOW) defines activities for Phase 0, including system definitions and feasibility assessments, associated with the DSXR Beyond Low Earth Orbit (BLEO) habitat potential contributions.

These activities will also include a review of the robotic system concept to confirm the approach and mission's goals and high level requirements.

One key result of a Phase 0 is to provide information for CSA to clearly understand the options, costs, schedule, and risks associated with a DSXR mission. The sub-systems being studied in Phase 0 remain options subject to further down-selection, descope or staggered delivery. For that reason it is important to provide information for each element (Large Robotic System, Dexterous Robotic System, Robotic Interface Fixtures/Platforms/Receptacles, Ground Segment) separately. Details of the required information will be included in separate Contractual Data Requirements List (CDRL) and Data Item Descriptions (DIDs) (as described in Section 3 - Work Requirements).

It is expected that the international reference mission scenario and architecture will include options and the baseline is expected to evolve during the period of performance of this work. The Contractor will be called upon to support the evaluation of options, make recommendations and update the DSXR concept and architecture accordingly.

1.3 OBJECTIVE

The objectives of Phase 0 are to identify and consolidate users' needs, identify preliminary mission requirements, flow down mission level requirements to the systems level, validate concept definition and design, identify critical technologies, and prepare development plans for follow on phases of potential DSXR contributions to a BLEO habitat.

At the end of this Phase 0 Study, the CSA should have all the technical and programmatic information necessary to make an informed decision about the DSXR system contribution and for subsequent immediate programmatic steps.

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:

1. "Must" is used to indicate a mandatory requirement;
2. "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;
3. "May" indicates an option;
4. "Will" indicates a statement of intention or fact, as does the use of present indicative active verbs.

2 DOCUMENTS

2.1 APPLICABLE DOCUMENTS (AD)

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

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. AD-01, AD-02, AD-03 and AD-04 can be obtained from the following File Transfer Protocol (FTP) site:

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

TABLE 2-1: APPLICABLE DOCUMENTS

AD No.	Document Number	Document Title	Rev. No.	Date
AD-01	CSA-ST-GDL-0001	CSA Technology Readiness Levels and Assessment Guidelines	C	March 2017
AD-02	CSA-ST-FORM-0003	Critical Technology Element (CTE) Identification Criteria Worksheet	A	March, 2014
AD-03	CSA-ST-FORM-0001	Technology Readiness and Risk Assessment (TRRA) Worksheet (PDF)	F	March 2017
AD-04	CSA-SE-STD-0001	CSA Systems Engineering Technical Reviews Standard	A	Nov 7, 2008

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, but are not required to develop the proposal.

RD-02 can be obtained from the following File Transfer Protocol (FTP) site: ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/.

TABLE 2-2: REFERENCE DOCUMENTS

RD No.	Document Number	Document Title	Rev. No.	Date
RD-01	PMBOK Guide	A Guide to the Project Management Body of Knowledge	5th or latest edition	2013
RD-02	CSA-SE-PR-0001	CSA Systems Engineering Methods and Practices	Rev. B	Mar 10, 2010
RD-03	NASA GSFC-STD-7000	Goddard Technical Standard: General Environmental Verification Standard (GEVS) For GSFC Flight Programs and Projects http://everyspec.com/NASA/NASA-GSFC/GSFC-STD/GSFC_STD_7000_170/	A	April 22, 2013
RD-04	GSFC 320-MAR-1001	Standard Mission Assurance Requirements https://ossmacm.gsfc.nasa.gov/index.cfm	E	November 2013
RD-05	ANSI/AIAA G-043-2012	Guide to the Preparation of Operational Concept Documents. http://arc.aiaa.org/doi/abs/10.2514/4.869297		2012
RD-06	N/A	The Global Exploration Roadmap http://www.globalspaceexploration.org/wordpress/wp-content/uploads/2013/10/GER_2013.pdf		August 2013
RD-07	Apogy Website	https://projects.eclipse.org/proposals/apogy		
RD-08	Xcore Documentation	https://wiki.eclipse.org/Xcore		
RD-09	Guidelines on Costing (Treasury Board)	https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=30375		
RD-10	Core Flight System Documentation and Opensource Code	https://cfs.gsfc.nasa.gov/		
RD-11	NASA HEO Presentation to Advisory Council	Progress in Defining the Deep Space Gateway and Transport Plan www.nasa.gov/sites/default/files/atoms/files/nss_chart_v23.pdf	v.23	March 2017
RD-12	ESD 30000	Space Launch System (SLS) Mission Planner's Guide	Initial Baseline	April 2017
RD-13	SLS-SPEC-159	Cross-Program Design Specification for Natural Environments http://ntrs.nasa.gov/search.jsp?R=20160004378	Rev D or latest	November 2015

3 WORK REQUIREMENTS

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, applicable technical subject matter experts and disciplines, and the 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.

3.1 MISSION ANALYSIS, PLANNING AND DEVELOPMENT

The Contractor must perform the following tasks:

- Collect/define User Requirements/Science Requirements /Demonstration or Commercial Requirements
- Parsing of requirements to distinguish essential from desirable. Requirements to be captured in a Mission Requirements Document and flowed down to preliminary Systems Requirement Document
- Initial Analysis comprising Concept Formulation, Feasibility Assessment, Analysis, Derivation of Mission and System Requirements.

Figure 3-1 illustrates the expected requirement flow down for the DSXR System.

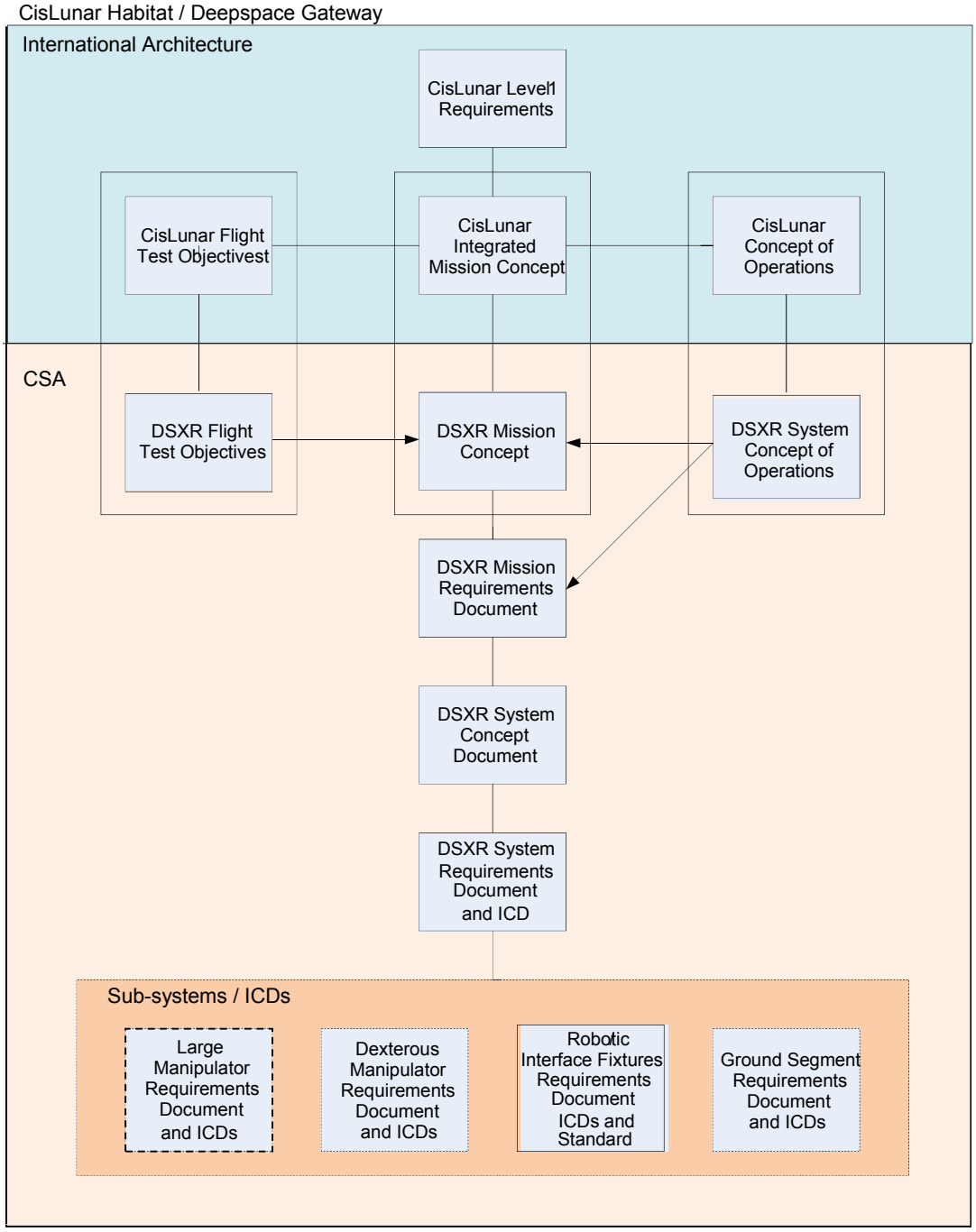

FIGURE 3-1: REQUIREMENT FLOWDOWN FOR DSXR SYSTEM (NOTIONAL)

3.1.1 Mission Objectives and User Needs Definition

The Contractor must review the Global Exploration Roadmap (RD-06), NASA plans for the Deep Space Gateway (RD-11), the functional needs outlined in Appendix D, as well as CSA provided reference material after contract award further defining the Deep Space Gateway architecture, concept, and concept of operations. The Contractor must produce inputs in the form of a Mission Objective and User Needs Definition Document (CDRL MD1) for the Canadian contribution.

This document must capture and summarize the pertinent mission goals, assumptions and objectives, identify the stakeholders and provide a clear articulation of observation requirements, data and applications needs, processing and distribution requirements, calibration, validation and characterization requirements, as expressed by the user community.

3.1.2 Mission Conceptual Design

The Contractor must develop a Mission Concept Document (MCD) (CDRL MD2) that supports the definition, development, and operation of the system based on RD-12. This document communicates to systems developers and users, in the user's language, the desired characteristics of the system to be developed.

3.1.3 DSXR Mission Requirements

Independent of a future availability of the Cislunar Habitat Mission Requirement Document (MRD) a stable mission requirement baseline is necessary to manage the interface with external partners and proceed with the development of system requirements.

The Contractor must develop a DSXR Mission Requirements Document (MRD) for the DSXR System (CDRL MD3) which will be used to capture the subset of mission requirements that will be applicable to the development of the DSXR. The MRD must include system functional and performance requirements, interface requirements, operational requirements, and mission environmental requirements. It will also serve to distinguish essential requirements from goals (desirable objectives), and identify gaps, assumptions, TBDs and TBCs.

3.1.4 Mission Feasibility Study

The Contractor must perform a study to demonstrate the viability of the mission (CDRL MD4).

3.1.5 Mission Development Plan

The contractor must breakdown the mission into sub-systems at a level sufficient to estimate required developments, cost, risk and performance. The system breakdown must be the basis of the TRRA and Development Plan for the mission.

The Mission Development Plan includes (Large Robotic System, Dexterous Robotics System, Robotic Interface Fixtures/Platforms/Receptacles, and Ground Segment separately):

- identification of the mission cost;
- identification of the mission schedule;
- identification of the technology development required to bring the technology readiness to the appropriate level at the appropriate time;
- identification of the development and manufacturing approach;
- identification of mission ground support and operations' needs; approach for calibration, data product, application development and simulation;
- provision of a mission risk assessment;
- identification of potential collaborations;
- provision of a Canadian capabilities development strategy; and
- provision of a commercialisation plan.

The information requested in sections 3.1.5.1 through 3.1.5.7 must be presented in the Mission Development Plan (CDRL MD5).

3.1.5.1 Mission Cost Estimate

The Contractor must provide an indicative DSXR System Cost Estimate separately for each of the following: Large Robotic System package, Dexterous Robotics System package and kit options, Robotic Interface Fixtures/Platforms/Receptacles, and Ground Segment, in accordance with Treasury Board (TB) guidelines (RD-09), as per Table 3-1 Template for Cost Breakdown, broken down per Work Breakdown Structure (WBS), for all phases leading to the development, implementation, operation and disposal. Along with the cost estimate, a detailed justification for those costs must be included. The justification must describe the type of analysis (analogous, bottom-up, etc.), as well as the assumptions made (CDRL PM6).

Cost estimates must provide sufficient granularity to allow costing estimating of the DSXR System across the life cycle of the mission.

TABLE 3-1 : TEMPLATE FOR COST BREAKDOWN (EXAMPLE)

Category (per WBS)		Phase A	Phase B	Phase C	Phase D	Phase E	Phase F
Labour	Management						
	Technology Development						
	Design						
	Documentation						
	Reviews						
	Manufacturing						
	Assembly						
	Testing						
	Product Assurance						
	Operations Team Support						
	Total Labour						
Non-Labour	Hardware / Software Procurement						
	Operations Team Support						
	Tools, Equipment and Facilities						
	Travel and Living						
	Other Direct Charges						
	Total Non-Labour						
Risk	Risk Contingency						
Taxes	GST						
Total By Phase							
Total All Phases							

3.1.5.2 Overall Mission Schedule

The Contractor must suggest a preliminary Mission Schedule relative to the overall life cycle of the mission including the impact of hardware integration and qualification milestones. The timeline must include key milestones from Phase A to Phase F completion, such as Preliminary Design Review, Critical Design Review and Launch. Refer to CSA Systems Engineering Technical Review Standard (AD-04) for a full description of all the possible reviews, which may vary depending on the nature of the mission architecture.

3.1.5.3 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 required.

3.1.5.4 Preliminary Mission Risk Assessment

The Contractor must provide a preliminary technical, schedule, cost and programmatic risk assessment for the entire mission lifecycle, starting with Phase A through to Phase F. For each risk identified, the Contractor must identify the phase of the mission to which the risk applies, the likelihood of occurrence, the impact should the risk occur and any possible mitigation actions that may be taken to decrease either the likelihood or the impact. Specific mitigation actions must be identified for medium and high risks. Contingency plans (i.e.: identifying alternative strategies) must also be developed for medium and high risks, or when it is uncertain that mitigation plans will be effective.

The Contractor must integrate all risks when producing risk-related information and document it in a Risk Assessment Matrix. The risk assessment process and matrix are generally provided in (RD-01).

3.1.5.5 Collaboration

The Contractor must identify potential partners/stakeholders (for example, Universities, sub-system providers, terrestrial commercial partners, etc.) state the benefits of their participation in such a mission and provide a preliminary assessment of roles and responsibilities. The basis and process of stakeholder analysis is described in the Project Management Book of Knowledge (PMBoK) (RD-01).

3.1.5.6 Canadian Capabilities Development

This report must provide an estimate of the anticipated percentage of Canadian content relative to the overall cost presented in Table 3-1, what options could be undertaken to maximize the Canadian content and their corresponding impacts and benefits. The Contractor must describe the Canadian supply chain involved in this current Phase 0 study, and expected to be involved in subsequent phases.

The report must also provide an overview of the Contractor’s strategy to develop and maintain Canadian capabilities. If the overall approach of the Contractor implies technology transfer and partnership with foreign entities to develop the Canadian capabilities, the Contractor must specify teaming arrangements, Intellectual Property (IP) ownership issues, licensing, royalties and opportunities that this partnership would open.

3.1.5.7 Commercialization Plan

The Contractor must provide information on the minimum business in the field required to maintain the necessary expertise in the long run.

The Contractor must provide a commercialization plan to explain the potential economic benefits of an investment in such a mission. This plan must include a description of potential products and spin-offs (space and non-space) that can be commercialized, a stakeholder analysis, and analysis of the competitors (national and international) for the potential products. The Contractor must include an estimate of the potential market for their products as well as specify companies/market segments/export markets that would purchase their products. The Contractor must describe and explain their overall/general business model for any potential new business.

The Contractor must conduct a request for information, in coordination with CSA, seeking capabilities within Canada that can be spun into the DSXR System. The goal is to seek any new developments in the terrestrial domains that are of high maturity that could be integrated into the DSXR system. The findings must be part of the commercialization plan.

The Contractor must conduct a request for information, in coordination with CSA, seeking capabilities within Canada on maximizing public engagement, inspiration and innovation through the DSXR system, and how the DSXR system can be used to engage the public. There is high potential for DSXR to inspire Canadians through innovative use of modern and future technologies, in space and on Earth, that could potentially be integrated with the DSXR system.

3.1.6 Technology Readiness and Risk Assessment (TRRA)

The Contractor must conduct a Technology Readiness and Risk Assessment (TRRA) in accordance with the requirements of the CSA TRRA guidelines (AD-01).

The main steps of the TRRA are:

- Logically breakdown the instrument into technology elements (CDRL MD6);
- Classify technology elements as critical or non-critical using the criteria defined in the Critical Technology Elements (CTE) worksheet (AD-02) and provide sufficient rationale for that classification (CDRL MD7);
- Produce a Technology Readiness and Risks Assessment for each Critical Technology Element using the PDF form provided in AD-03 (CDRL MD8).
- Prepare a report according to CDRL-MD9.

As the maturity of the technology grows and requirements are better defined, the TRRA may need to be updated to reflect this progress.

The Contractor must update the Technology Readiness and Risk Assessment to reflect the change in maturity of the system as a result of the work performed in Phase 0. For purposes of technology development, the Contractor should also provide driving requirements, cost estimate, and schedule to reach the next Technology Readiness Level (TRL) for Critical Technology Elements (CTE).

3.1.7 Technology Roadmap

The Contractor must provide a Technology Development Plan, also known as Technology Roadmap (TRM) including the recommended timeline and sequence of required technology developments to reach TRL 6 and eventually TRL 8 (CDRL MD10). The TRM will also provide a notional budget providing estimated costing for the proposed technology development steps.

The TRM must show how the technology development plan and associated TRL progression aligns with the system's mission phases/milestones versus the NASA mission phases/milestones.

The Technology Roadmap may be provided as a chapter of the Mission Development Plan (CDRL MD5).

3.1.8 Intellectual Property

The Contractor must complete the Contractor Disclosure of Intellectual Property CSA Form (CDRL MD11), identifying the Background and Foreground Intellectual Property (BIP and FIP) that will be generated in this Phase 0 contract, the owners of the BIP and how it will be managed and coordinated among the various collaborators and entities involved.

3.1.9 Ground Segment Options Assessment

The Contractor must perform a tradeoff assessment for the Ground Segment (CDRL MD12). The Contractor must list the possible options and concepts for its development and operations. The assessment must include the following (but not limited to): (i) describe, explain each option, including both contractor and government roles (ii) cost/benefit analysis, (iii) evaluation criteria, (iv) advantages and disadvantages, (v) Canadian industrial capabilities, (vi) explain any constraints and assumptions, (vii) explain the essential criteria to selection an option, (viii) provide rationale for discounted and viable options. In the end, provide a recommended option for Ground Segment development and operations.

3.1.10 Lunar-Deployable Robotic System Assessment

The Contractor must perform an assessment of a dexterous robotic system that could be used on the habitat and that could either be directly deployable to the lunar surface, or scarred to enable modifications or enhancements by the station-based personnel for deployment on the lunar surface (CDRL MD13). The assessment must include the following (but not limited to): (i) describe the technical deltas, (ii) cost/benefit analysis, (iii) explain any constraints and assumptions, (iv) advantages and disadvantages. The Contractor must produce a preliminary set of mission requirements for lunar-based robotic system.

3.1.11 Intra-Vehicular Robotic System Assessment

The Contractor must develop a concept and perform an assessment of an intra-vehicular robotic system for the deep-space habitat (CDRL-MD14). The Contractor must collect the user needs, develop an initial set of mission requirements, assess feasibility of implementation options that the

Contractor will develop in coordination with the CSA. The assessment must include the following (but not limited to): (i) describe each technical option, (ii) cost/benefit analysis, (iii) explain any constraints and assumptions, (iv) advantages and disadvantages, (v) nominal technology readiness and risk assessment (TRRA), (vi) explain the essential criteria to select an option, (vii) provide rationale for discounted and viable options.

3.1.12 Collision Impact Detection and Damage Avoidance Assessment

Collaborative robots for terrestrial applications are more and more common, primarily in manufacturing. It is envisaged that this would expand to space applications. These collaborative robots have active safety features and control systems that continuously detect and avoid hazardous or damaging impact situations. As part of this Phase 0 study, the Contractor must perform an assessment of such systems that have potential to continuously assure EVA, station and robot safety (CDRL MD15). The assessment must include the following (but not limited to): (i) describe each technical option, (ii) cost/benefit analysis, (iii) explain any constraints and assumptions, (iv) advantages and disadvantages, (v) technology readiness and risk assessment (TRRA), (vi) explain the essential criteria to select an option, (vii) provide rationale discounted and viable options. The Contractor must produce a preliminary set of mission and system requirements for the viable option(s).

3.1.13 Cislunar Architecture and Draft Standards Review

It is expected that the Cislunar Architecture will evolve and that draft international standards will be proposed to facilitate interoperability, reduce costs, and inform early definition and design work. The Contractor must support CSA in the analysis, review, evaluation and development of recommendations regarding the other partner element concepts and the proposed standards. The standards include External Robotic Interfaces, Power, Avionics, Software, and Thermal.

3.2 OPERATIONS

3.2.1 Concept of Operations and Operational Requirements

The Contractor must develop a Concept of Operations (CDRL OP1) in order to meet the mission objectives. This document must provide a comprehensive summary of all operability aspects of the mission. The associated or derived Mission and System level operational requirements must be captured in the Mission Requirements and Preliminary System Requirements documents respectively (CDRLs MD3 and EN9).

3.2.2 Preliminary Ground Segment Facility Requirements Specification

The Contractor must develop a Preliminary Ground Segment Facility Requirements Specification (CDRL OP2) that responds to the Mission Requirements of the space segment. This specification follows the assessment resulting from Section 3.1.9.

3.3 ENGINEERING

3.3.1 System Conceptual Design

The Contractor must develop a System Conceptual Design Document (CDRL EN1) that meets the DSXR Mission Requirements.

The system conceptual design document must include the considered alternatives and trades performed to meet the DSXR requirements.

3.3.2 Preliminary Interface Control Document

The Contractor must prepare a Preliminary Interface Control Document (ICD) (CDRL EN2) in which:

1. All external interfaces are identified and characterized.
2. All internal interfaces are identified and characterized between all sub-systems, including those between the DSXR Large Robotics, Dexterous System, Robotic Interface Fixtures/Platforms/Receptacles and Ground Segment.
3. All software interfaces are identified and characterized.
    i. The software interface must include an interface to Apogy (RD-07). It is intended that the DSXR contribution to the CisLunar concept will be integrated with Apogy simulation environment. In order to integrate into Apogy, the first step is to define a software interface using the Xcore (RD-08) language. The Contractor must provide a preliminary version of the Software Interface implemented by the API. The language must be the Xcore language format (CDRL EN3). The goal is to integrate into Apogy during subsequent phases of the project.
    ii. The software interface should include an interface to the NASA core Flight System software framework (RD-10).

3.3.3 Preliminary Systems Engineering Management Plan

The Contractor must provide or produce a preliminary Systems Engineering Management Plan (CDRL EN8). The Contractor must use CSA's System Engineering methods and practices or equivalent (RD-02).

3.3.4 Preliminary Systems Requirements Document

The Contractor must produce a preliminary Systems Requirements Document (CDRL-EN9) for both software and hardware.

3.3.5 Preliminary Environmental Requirements Document

The Contractor must produce a preliminary Environmental Requirements Document (CDRL-EN10). It must consider all environments the DSXR system and sub-systems will be subject to, that is, from ground, launch and to accomplishing the functional requirements in deep-space including external, internal and lunar surface. It must not reproduce what has already been captured in NASA documents (e.g. RD-12) but refer to applicable sections of existing relevant documents as much as possible and provide derived requirements as applicable to DSXR.

3.3.6 Preliminary CAD Models

The Contractor must develop a Computer Assisted Design (CAD) model (CDRL EN4) for the DSXR hardware configuration for use as input to future analyses or trade-off studies. In order to facilitate international collaboration, high level CAD models will be shared with international partners. In order to protect intellectual property, the contractor is requested to provide simplified models in addition to those models developed to meet the intent of this contract.

3.3.7 Preliminary Proofs of Concept and SLA Models

The Contractor must identify key risk areas that can be mitigated through proofs of concept such as functional Stereolithography (SLA) models (CDRL EN5). The Contractor must demonstrate risk mitigation or areas of development by use of these proofs of concept. These can be used as inputs to future demonstrations or trade-off studies. An approximately 40:1 reduced scale model of the DSXR with functional joints must be delivered along with at least two habitat base modules and a logistics vehicle model with nominal base and grapple fixture locations.

3.3.8 Preliminary Graphical Simulation Models

The Contractor must develop kinematic and geometric simulation models of the Proving Ground Habitat Systems and DSXR concept (CDRL EN6). These models can be used to graphically demonstrating mission scenarios and for communications purposes. The models must be based on common industry standards.

3.3.9 Mission Requirements Verification Matrix

The Contractor must develop the Mission Requirements Verification Matrix (CDRL EN7) to identify the various requirements developed to meet the Phase 0 scope.

3.3.10 Core Flight Software System Architecture Assessment

The envisioned software architecture for CisLunar will be based on NASA's Core Flight System (cFS) framework (RD-10). The cFS is a NASA Agency Asset for Spacecraft Flight Software Reuse. It has been productized over several years by Goddard Space Flight Center and has been supported by continuous NASA level funding since 2012. The cFS is an open source software supported by the NASA community. It has been fully tested, documented and is at TRL 9. The architecture is based on published service layer (cFS) and open source Operating System Abstraction Layer (OSAL) for common services such as: publish and subscribe message bus, time services, events, tables, file, task execution. It also runs on multiple platforms. Figure 3-2 presents an overview of the CFS architecture.

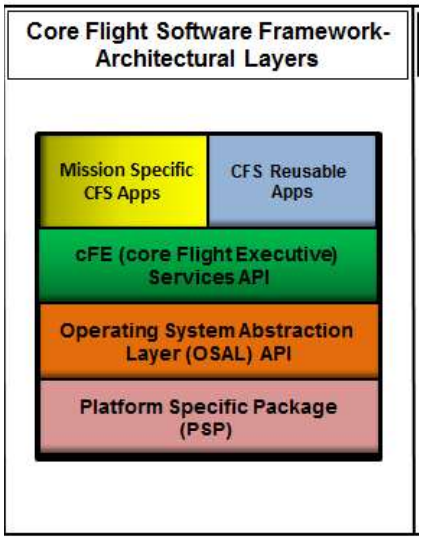

FIGURE 3-2: CFS ARCHITECTURAL LAYERS

It is envisioned that the cFS will be running on NASA assets and therefore, there will be a Mission Specific App (yellow box in Figure 3-2) connecting to the Deep Space Exploration Robotics System. The Contractor is required to evaluate the option of building their architecture also on CFS and must perform a feasibility assessment. A preliminary software design option based on cFS is required along with recommendations and total end-to-end system impacts. (CDRL-EN11). An alternative architecture may also be assumed.

A software breadboard may be developed for trial purposes.

3.4 PROJECT MANAGEMENT

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

Refer to Appendix A, for the full Contract Data Requirement List (CDRL).

3.4.1 Team Organization

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

The Contractor must 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 CSA Mission Manager (P/MM) and/or Technical Authority (TA). In the absence of the single point of contact, the Contractor must designate an alternate to maintain continuity of communication between the Contractor and Project/Mission Manager and/or TA.

The Contractor must also identify other key personnel who are considered essential to the performance of the contract. The Contractor must assign personnel with appropriate qualifications and experience to all posts within the project organization, including engineers and supporting staff with the necessary expertise to define/interpret the operational requirements for the mission and data products (for the purpose of the contract work).

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

3.4.2 Contractor Work Breakdown Structure

The Contractor must prepare and maintain a detailed Contractor Work Breakdown Structure (CWBS) (CDRL PM4). The CWBS must include all project management, product assurance, mission and operations planning and engineering work identified in this SOW, including subcontractors' work.

3.4.3 Detailed Schedule and Critical Path

The Contractor must prepare and maintain a detailed schedule (CDRL PM5) based on the CWBS for all the work to be performed under this Phase 0 contract.

The schedule must show dependencies between the activities to identify the critical path. The schedule must be updated at each major milestones. The schedule must include all the milestones listed in Table 3-2: Proposed Project Milestones.

TABLE 3-2: PROPOSED PROJECT MILESTONES

ID	Milestone
1	Kick-off Meeting (KoM)
2	Mission Concept Review (MCR)
3	Mission Requirements Review (MRR) and Technical Readiness and Risk Assessment
4	Mission Development Plan Review and Preliminary System Requirements Review
5	Phase 0 Final Review

3.4.4 Communications and Access

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

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

All documentation and data generated by the Contractor for the project must be accessible to the CSA Mission Manager and TA for review.

3.4.5 Project Meetings

The Contractor must hold the meetings described in Table 3-3 Planned Meetings. Some or all of these meetings may be attended by representatives of the CSA, and/or other organizations nominated by the CSA.

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

For meetings held at government venues, the Contractor must inform the CSA Mission Manager and/or 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 must be held if necessary when mutually agreed to by the Contractor and the CSA Mission 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.

All technical reviews will be chaired by the CSA Mission Manager.

TABLE 3-3 : NOMINAL PLANNED MEETINGS

ID	Milestone	Months after Contract Award	Venue
M1	Kick-off Meeting (KoM)	≤ 1 month	CSA
M2	Mission Concept Review (MCR)	≤ 3 months	Videocon
M3	Mission Requirements Review (MRR) and Technology Readiness and Risk Assessment (TRRA)	6 months	Contractor
M4	Mission Development Plan Review (MDPR) and Preliminary System Requirements Review (PSRR)	9 months	CSA
M5	Phase 0 Final Review (FR)	12 months	CSA
	Monthly Meetings	As required	Telecon
	Provision to support four (4) international meetings	TBD	TBD, could be USA, Europe or Japan

3.4.5.1 M1 – Kick-off Meeting

This meeting will serve as an opportunity for CSA and Public Services and Procurement Canada (PSPC) to review the Contractor's plans, the requirements of the work (SOW), schedules, deliverables, risks, and address issues (CDRL PM8). It will also serve to baseline the Product Breakdown Structure (PBS) (CDRL MD6) for the mission and sub-systems which will be subsequently used in the TRRA and Mission Development Plans.

3.4.5.2 M2 – Mission Concept Review (MCR)

The purpose of the MCR is to demonstrate the feasibility of the mission and the project readiness to proceed with the development of mission requirements.

The Contractor must make a presentation (CDRL PM9) such as to demonstrate that the MCR entry and exit criteria are met, including the common entry and exit criteria as per AD-04.

The deliverables for this review will

- Comprehensively define mission objectives and user needs, as they relate to DSXR (CDRL MD1), thus establishing mission success criteria (equivalent to NASA minimum, full, and stretch mission requirements);
- Ensure the Mission Conceptual Design meets mission objectives and needs (CDRL MD2);
- Ensure the Concept of Operations clearly supports the achievement of the mission objectives and needs (CDRL OP1).

3.4.5.3 M3 – Mission Requirements Review (MRR)

The purpose of the MRR is to demonstrate the validity of the mission requirements and the project readiness to proceed with the development of system requirements.

The Contractor must make a presentation (CDRL PM10) such as to demonstrate that the MRR entry and exit criteria are met, including the common entry and exit criteria as per AD-04.

The deliverables for this review will serve to ensure that:

- The mission objectives and needs have been logically and fully flowed down to the mission requirements;
- The pertinent subset of mission requirements have been defined;
- The preliminary system conceptual design meets mission requirements and is feasible;
- The Concept of Operations clearly supports the achievement of mission requirements
- Identify the list of critical technology elements and technology dependencies (i.e. new or emerging technologies on which the project depends).

3.4.5.4 M3 – Technology Readiness and Risk Assessment (TRRA)

The focus of the TRRA process is to provide inputs to the Technology Development Plan by identify critical technologies and assess their maturity level. The intent of this milestone is to review the PDF worksheets (CDRL MD8) for each Critical Technology Element.

Please refer to section 3.1.6 for more information.

3.4.5.5 M4 – Mission Development Plan Review (MDPR)

The deliverables of the MDPR will serve as input for CSA's downselect decision. The Contractor must make a Mission Development Plan Review presentation (CDRL PM11).

3.4.5.6 M4 – Preliminary System Requirements Review (PSRR)

The purpose of the DSXR PSRR is to prepare for the DSXR Mission SRR for each subsystem of the DSXR. The Contractor must make a Preliminary System Requirements Review presentation (CDRL PM12).

3.4.5.7 M5 – Final Review Meeting (FR)

The Final Review will serve to review all final deliverables, and close all open actions. The Contractor must make a Final Review Presentation (CDRL PM13) to accomplish this objective.

3.4.6 Agendas, Minutes and Action Item Log

The Contractor must provide a Meeting Agenda (CDRL PM1) for all reviews and meetings including teleconferences and must deliver these to the CSA Mission Manager and/or TA no less than 5 working days before the meeting and must have it approved by the CSA Mission Manager and/or TA.

The Contractor must produce the minutes for all reviews and meetings including teleconferences and must deliver these to CSA (CDRL PM2). In the case of teleconferences, they must be delivered the next business day.

The Contractor must 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 stoplight 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 must be produced for the monthly progress report and at the meetings. The AIL (CDRL PM3) must be delivered with the Monthly Progress Report PM7.

3.4.7 Bi-Weekly Teleconference Meetings

The Contractor must hold bi-weekly teleconference meeting with the PM, and the duration should be limited to one hour. The bi-weekly teleconference is mainly to address technical issues and to discuss progress.

3.4.8 Other Meetings

Coordination meetings between Canadian Space Agency and international space agencies are ongoing regarding the development of overarching mission objectives and requirements with regards to a Beyond LEO Deep Space Habitat. These meetings offer "up to the minute" information that is beneficial to the work performed in this Contract. As such, the Contractor must have allowance to support these meetings, subject to CSA approval. Furthermore, the Contractor must include allowance to adjust any of the deliverables based on information from these meetings, as applicable and at the appropriate Contract milestones. Four international, week-long meetings must be assumed, supported onsite by a maximum of two members of the Contractor team. These meetings typically also require the review of material and may require presentation material from the contractor. These would be on a task authorization basis.

3.4.9 Project Reporting

3.4.9.1 Monthly Progress Reports

The Contractor must submit monthly Progress Reports (CDRL PM7).

The Monthly Progress Reports must be delivered no later than five working days after the end of the month. As all deliverables, it must be submitted via CSA's Configuration Management Library for the DSXR mission, and a copy must also be sent by email to (PSPC) Contracting Officer.

3.4.9.2 Phase 0 Closure Report

The Contractor must submit a Phase 0 Closure Report (CDRL PM14). The report must summarize the outcome of the Phase 0 work.

3.4.10 Document Deliverables

The Contractor must deliver all documentation listed in the CDRL tables (Appendix A) as a minimum. Some documents may be combined or divided by mutual agreement. The format and content of the deliverables must 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 DID-100 – General Preparation Instructions.

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.

All documents must be delivered via CSA's Configuration Management Library for the DSXR mission.

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

The delivery schedule for all documentation must be as defined in the CDRL table.

The Contractor must obtain approval from the CSA for all CDRL Documents so indicated in the CDRL table.

3.4.10.1 Documents Delivered for Approval

The term "Approval" as used in this document and in other documents referred to herein, means written approval by CSA Mission Manager, of documents submitted by the Contractor. Once approved, the document is authorized for further use by CSA. The CSA 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 CSA Mission Manager approval. No request or document for which approval is required must be acted upon or implemented by the Contractor until such approval is provided. Such requests and documents will be reviewed promptly by the CSA Mission Manager and the necessary written approval or disapproval will be provided after their receipt by CSA. In the event of a failure by the CSA Mission Manager to approve or disapprove the document within fifteen (15) working days, the document may be deemed approved.

In the event that a request or document is disapproved, the CSA Mission Manager will advise the Contractor in writing as to the reasons for such disapproval and will define the additions, deletions or corrections that the CSA Mission Manager 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. Approval or disapproval of resubmitted requests or documents will be based solely on those points that were not previously deemed to be acceptable.

3.4.10.2 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 CSA Mission Manager of a document for review must imply that the document has been reviewed, commented on, revised as necessary, and has been determined to meet the requirements.

The CSA 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 CSA Mission Manager does not concur with a document submitted for review, the CSA Mission Manager 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 and/or corrections that the CSA Mission Manager deems are 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 B and this SOW. If written notification of concurrence is not provided by the CSA Mission Manager within fifteen (15) working days of the receipt of the document, the document must be deemed to have been reviewed and accepted by the CSA Mission Manager without comment.

3.4.11 Subcontract Management

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

At the request of the CSA Mission Manager and/or TA, copies of subcontractor documentation must be delivered to the CSA Mission Manager and/or TA.

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

3.4.12 Product Assurance

The Contractor must produce a preliminary DSXR System Product Assurance Requirements document (CDRL PA1). The Contractor must review the GSFC Standard Mission Assurance Requirements (MAR) (RD-04) and must produce an assessment of these requirements and to identify any recommendations that should be captured in the DSXR System Product Assurance Requirements as a result of the assessment (CDRL PA1). Any other references used in the development of the System Product Assurance Requirement document must be cited in the document.

The Contractor must produce a Preliminary System Product Assurance Requirements document (CDRL PA2). This document must encompass the design, development, procurement, manufacturing, integration, test and delivery of the space segment and ground segment hardware, software. It must cover the following Product Assurance activities: Product Assurance Program, Qualification Program, Reliability, Parts/Materials/Processes Program, Quality Assurance Program, Software Product Assurance, Verification, Safety, Configuration management and Non-conformance management.

Ongoing discussions at the international level may lead to informed product assurance requirements specific to the DSXR mission. The Contractor must consider these discussions as input to the Phase 0 work.

In presenting the Development Plans for follow up phases (CDRL MD5), the Contractor must explain the mission Reliability/Availability Policy (CDRL PA1) that will be used to meet the reliability and availability of the mission goals.

The Contractor must produce a preliminary Product Assurance and Implementation Plan (CDRL PA3).

3.5 OPTIONAL SERVICES

It is expected that the Deep Space Gateway architecture and associated standards will undergo modifications during this period, that the DSXR concept will need to be updated, and that the International Partners will have special requests or raise new questions regarding the DSXR concept and architecture.

The Contractor must:

Project Management

1. Plan, schedule, assign and organize resources and ensure completion of all work carried out under the contract.
2. Maintain project management interface with the CSA project team.
3. Monitor and report on technical, cost and schedule progress, on a monthly basis according to CDRL-PM7.
4. Provide the management, technical leadership, applicable technical subject matter experts and disciplines, and the support necessary to ensure effective and efficient performance of all project efforts and activities.
5. Produce a closure report at the end of the option period (per CDRL-PM14)

Engineering

1. Support CSA in the review, evaluation and development of recommendations regarding modifications to the Deep Space Gateway partner element concepts and the proposed standards. The standards include External Robotic Interfaces, Power, Avionics, Software, and Thermal.
2. Provide technical leadership on the conceptual design and architecture of the DSXR including preparation and presentation of special topics, as requested by CSA.
3. Provide support as requested by CSA to develop/evaluate new/novel concepts for DSXR and its subsystems in order to remain compatible with modifications to the Deep Space Gateway concept.
4. As requested by CSA, generate CSA ICD material for novel operations and/or review external ICD material related to Robotics and Robotic interfaces. Support CSA in the identification and evolution of interface definition. This includes the preparation of draft technical drawings or models.
5. As requested by CSA, perform relevant analysis, model updates, operational flows, and deliver associated documentation as required to address technical aspects and changes related to the DSXR concept, requirements or operations.
6. Maintain and update Phase 0 documentation, as applicable, based on international developments.

International Meeting Support

1. Prepare/review/update presentations in support of international discussions and meetings with respect to technical aspects of the DSXR.
2. As requested by CSA, participate in concept and mission review meetings at international partner locations. Four international, week-long meetings must be assumed, supported onsite by a maximum of two members of the Contractor team. These would be on a task authorization basis.

4 CONTRACTOR DELIVERABLES

4.1 HARDWARE

No hardware is expected to be deliverable under this contract. However, all SLA models developed under this contract, in support of proof of concept activities must be identified and delivered (CDRL-EN6).

4.2 SOFTWARE

The Contractor must deliver source code of the software developed as part of the Work.

4.3 DOCUMENTATION

The Contractor must deliver all documentation requested in Appendix A.

The Contractor may propose to combine documents called by more than one CDRL into one document, but this is subject to prior approval from the CSA. Where this approval is granted, the document cover page must list all the CDRL numbers that are covered by this document (see DID-100 – General Preparation Instructions).

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

Documents must be delivered in the original software application format. One electronic copy of each deliverable document must be transferred to the CSA to the address and in the format specified inDID-100 – General Preparation Instructions. No paper copy is to be delivered.

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

5 GOVERNMENT FURNISHED EQUIPMENT

No government furnished equipment is expected to be deliverable under this internal study. If applicable, any government furnished information must be returned to the Crown at the conclusion of the Contract.

This Page Intentionally Left Blank

APPENDICES

A CONTRACT DATA REQUIREMENTS LIST (CDRL)

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

LEGEND:

C) DID No.

- CF = Contractor's format

2) Document Versions:

- D: Draft (under Version Control, expected to be updated – up to 50% complete and correct)
- P:Preliminary (under Version Control, expected to be updated – 70% complete and correct).
- IR: Initial Release (under Configuration Control, may well be revised during normal project life – 95-100% complete & correct).
- U: Update (expected revision, but not final; under Configuration Control, previous versions remain unchanged under Configuration Control).
- F: Final (under Configuration Control, normally not expected to be revised, but could be if necessary – 100% complete and correct).

TABLE A-1: CONTRACT DATA REQUIREMENTS LIST

CDRL No.	Title	SOW Sect. No.	DID No.	Initial Release	Update	Final	Acceptance Category
A.1 PROJECT MANAGEMENT							
PM1	Meeting Agenda	3.4.6	110	Each milestone			Review
PM2	Minutes of Meetings	3.4.6	111	Each milestone			Review
PM3	Action Items Log (AIL)	3.4.6	112	Each milestone	As required		Review
PM4	CWBS and Work Package Descriptions	3.4.2	102	Proposal	M1 KoM		Approval
PM5	Phase 0 Project Schedule	3.4.3	105	M1 KoM	Monthly		Review
PM6	Mission Life-Cycle Cost Estimates	3.1.5.1	Table 3-1	M3 MRR	M4 MDPR	M5 FR	Approval
PM7	Progress Report	3.4.9.1	107		Monthly		Review
PM8	Kick-Off Meeting Presentation	3.4.5.1	CF	M1 KoM			Review
PM9	Mission Concept Review Presentation	3.4.5.2	CF	M2 MCR			Review
PM10	Mission Requirements Review Presentation	3.4.5.3	CF	M3 MRR			Review
PM11	Mission Development Plan Presentation	3.4.5.5	CF	M4 MDPR			Review
PM12	Preliminary SRR Presentation	3.4.5.6	CF	M4 PSRR			Review
PM13	Final Review Presentation	3.4.5.7	CF	M5 FR			Review
PM14	Phase 0 Closure Report	3.4.9.2	114	M5 FR			Review
A.2 PRODUCT ASSURANCE							
PA1	Reliability/Availability Policy	3.4.12	CF	M4 MDPR	As required	M5 FR	Approval
PA2	Preliminary Product Assurance Requirements		CF	M4 PSRR		M5 FR	Review
PA3	Preliminary Product Assurance and Implementation Plan	3.4.12	320	M4 MDPR	As required	M5 FR	Review
A.3 MISSION DOCUMENTATION							
MD1.	Mission Objectives and User Needs Definition	3.1.1	CF	M2 MCR	As required	M5 FR	Approve
MD2.	Mission Concept Document (MCD)	3.1.2	002	M2 MCR	As required	M5 FR	Approve

CDRL No.	Title	SOW Sect. No.	DID No.	Initial Release	Update	Final	Acceptance Category
MD3.	DSXR Mission Requirements Document (MRD)	3.1.3	008	M3 MRR		M5 FR	Approval
MD4.	Mission Feasibility Study	3.1.4	204	M3 MRR	As required	M5 FR	Review
MD5.	Mission Development Plan (MDP)	3.1.5	007	M2 MCR	M3 MRR & As Required	M4 MDPR	Approval
MD6.	Product Breakdown Structure (PBS) for the mission and sub-systems (to be used in TRRA and Mission Development Plan)	3.1.6	CF	M2 MCR		M4 MDPR	Approval
MD7.	Criticality Technology Element (CTE) Report	3.1.6	AD-02	M3 MRR		M4 MDPR	Approval
MD8.	TRRA for Critical Elements (PDF Worksheets)	3.1.6	AD-03	M3 TRRA		M4 MDPR	Approval
MD9.	TRRA Stand Alone Report	3.1.6	0013	M3 TRRA	As required	M4 MDPR	Approval
MD10.	Technology Roadmap (TRM)	3.1.7	CF	M4 MDPR		M5 FR	Approval
MD11.	Contractor Disclosure of IP	3.1.8	App C	Proposal		M5 FR	Approval
MD12.	Ground Segment Assessment	3.1.9	CF	M2 MCR	As required	M5 FR	Review
MD13.	Lunar-Deployable Robotic System Assessment	3.1.10	CF	M2 MCR	As required	M5 FR	Review
MD14.	Intra-Vehicular Robotic System Assessment	3.1.11	CF	M2 MCR	As required	M5 FR	Review
MD15.	Collision Impact Detection and Avoidance Assessment	3.1.12	CF	M2 MCR	As required	M5 FR	Review
MD16.	Cislunar Architecture and Draft Standards Review	3.1.13	CF	As required	As required	As required	Review
A.4 OPERATIONS							
OP1.	Concept of Operations (ConOps)	3.2.1	825	M2 MCR	M3 MRR	M5 FR	Approval
OP2.	Preliminary Ground Segment Facility Requirements Specification	3.2.2	801	M4 MDPR		M5 FR	

CDRL No.	Title	SOW Sect. No.	DID No.	Initial Release	Update	Final	Acceptance Category
A.5 ENGINEERING							
EN1.	System Conceptual Design Document	3.3.1	700	M3 MRR	As required	M5 FR	Review
EN2.	Preliminary Interface Control Document (ICD)	3.3.2	501	M4 PSRR		M5 FR	Review
EN3.	Software Interface Definition in Xcore Format	3.3.2	CF	M3 MRR	As required	M5 FR	Approval
EN4.	CAD models	3.3.6	600	M3 MRR	As required	M5 FR	Review
EN5.	Proofs of Concept (SLA Models)	3.3.7	CF	M3 MRR		M5 FR	Review
EN6.	Graphical/Kinematic Simulation Models	3.3.8	CF	M4 PSRR		M5 FR	Review
EN7.	Requirements Verification Matrix	3.3.9	CF	M4 PSRR	As required	M5 FR	Approval
EN8.	Preliminary Systems Engineering Management Plan	3.3.3	450	M4 PSRR		M5 FR	Review
EN9.	Preliminary System Requirements Document (SRD)	3.3.4	400	M4 PSRR		M5 FR	Review
EN10.	Preliminary Environmental Requirements	3.3.5	CF	M4 PSRR		M5 FR	Review
EN11.	cFS Mission Specific App Feasibility Assessment	3.3.10	CF	M3 MRR		M4 MDPR	Review

B DATA ITEMS DESCRIPTIONS (DIDS)

DID-002 – MISSION CONCEPT DOCUMENT (MCD)....38
DID-007 – MISSION DEVELOPMENT PLAN....40
DID-008 – MISSION REQUIREMENTS DOCUMENT....41
DID-0013 – TECHNOLOGY READINESS AND RISK ASSESSMENT WITH STAND ALONE REPORT 43
DID-100 – GENERAL PREPARATION INSTRUCTIONS....46
DID-102 – CWBS AND WORK PACKAGE DESCRIPTIONS....51
DID-105 – PROJECT SCHEDULE....52
DID-107 – PROGRESS REPORT....53
DID-110 – MEETING AGENDA....55
DID-111 – MINUTES OF MEETINGS....56
DID-112 – ACTION ITEMS LOG (AIL)....57
DID-114 – PHASE CLOSURE / FINAL REPORT....58
DID-204 – MISSION FEASIBILITY STUDY....59
DID-320 – PRODUCT ASSURANCE AND IMPLEMENTATION PLAN....61
DID-400 – SYSTEM REQUIREMENTS DOCUMENT....67
DID-450 – SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP)....70
DID-501 – INTERFACE CONTROL DOCUMENT (ICD)....73
DID-600 – CAD MODELS....76
DID-700 – SYSTEM CONCEPTUAL DESIGN DOCUMENT....77
DID-801 – GROUND SEGMENT FACILITY REQUIREMENTS SPECIFICATION....79
DID-825 –SYSTEM CONCEPT OF OPERATIONS....80

DID-002 – Mission Concept Document (MCD)

DID Issue: IR **Date: 2014-02-17**

PURPOSE:

To support the definition, development, and operation of the system. This document communicates to systems developers and users, in the user's language, the desired characteristics of the system to be developed.

PREPARATION INSTRUCTIONS:

The MCD is an important complementary document to the System Requirements Document (SRD), the Interface Requirements Document (IRD), and the Environmental Requirements and Test Specification (ERTS). Written in a narrative form and non-specification-type prose, it describes the way in which the system is envisioned to fit and function within its operational environment.

The contents of the MCD must be tailored as outlined below.

1. Introduction
    1.1. Identification
    1.2. Scope
    1.3. System overview
    1.4. Document overview
2. Referenced documents
3. System description
    3.1. System goals and objectives
    3.2. System scope
    3.3. Minimum supporting documentation
    3.4. System states and modes
    3.5. System architecture
    3.6. System interfaces
    3.7. System capabilities
4. Operational needs
    4.1. Mission needs
    4.2. Users' needs
5. Operations
    5.1. Operational overview

5.1.1.Mission
5.1.2.Operational policies
5.1.3.Operational constraints
5.1.4.Existing operational environment
5.2. Operations team
5.2.1.Personnel profile
5.2.2.Organizational structure
5.2.3.Personnel interactions
5.2.4.Personnel activities
5.3. Operational processes
6. Operational environment
7. Support environment
8. System operational scenarios

DID-007 – Mission Development Plan

DID Issue: Tailored for DSXR **Date: 2017-03-08**

PURPOSE:

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

PREPARATION INSTRUCTIONS:

Referring to Table A-1:

- The Initial Release must include drafts of items 3, 10, 12, and 13, and preliminary inputs of the remainder of the plan.
- The Update must include final versions of items 3, 10, 12, and 13, and drafts of the remainder of the plan.
- The Final release must be the final version of the plan.

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 goals and objectives;
3) Identification of stakeholders and their needs and expectations;
4) A description of the estimated mission life cycle cost;
5) A description of the estimated mission schedule including all major milestones;
6) A description of the technology development required;
7) A description of the proposed development, manufacturing, and verification approach;
8) A description of the preliminary mission risk assessment;
9) A description of the preliminary Concept of Operation;
10) A description of potential collaborations;
11) A description of the intellectual property to be generated throughout the whole project (not just Phase 0);
12) A description of the proposed Canadian capabilities development strategy;
13) A description of the proposed commercialisation plan; and
14) Recommendations for follow-on activities.

DID-008 – Mission Requirements Document

DID Issue: Tailored for use in DSXR Phase 0 **Date: 2017-04-11**

PURPOSE:

To capture the mission requirements required to proceed with the development of system requirements. The MRD will include functional and performance requirements, interface requirements, mission environmental requirements, and operational requirements. It will also serve to distinguish essential requirements from goals (desirable objectives), and identify gaps, assumptions, TBDs, TBCs and unknowns that must be addressed.

PREPARATION INSTRUCTIONS:

The document must include the following:

1) An introduction including the scope and purpose
2) A short description of the mission including background objectives and a list of assumptions (if any);
3) A list of applicable and reference documents (if any);
4) User requirements, which represent a clear articulation of the data and applications needs as expressed by the user community; these requirements shall be summarized in a table at the end of this section or in an Appendix;
5) Mission requirements that respond to user requirements and break down as follows:
    a) functional requirements,
    b) performance requirements,
    c) operational requirements,
    d) resource allocation requirements,
    e) verification requirements, other applicable requirements types.
6) Interface Requirements, including but not limited to:
    a) Electrical Interface Requirements;
    b) Thermal Interface Requirements;
    c) Mechanical Interface Requirements;
7) Mission environmental requirements will likely be derived from GSFC Standard GEVS (RD-03) and will cover topics such as mechanical, thermal, vacuum, contamination, outgassing, EMC/EMI, acoustics, shock, radiation, for the following environments:
    a) Ground operations and handling
    b) Integration to launch vehicle environment (for flight segment only)
    c) Launch environment (for flight segment only)

    d) On-orbit environment (for flight segment only)

8) In-flight requirements:
    a) Operational modes
    b) Upload and download of data/telemetry requirements
    c) Telemetry availability
    d) Commanding capabilities
    e) Staffing requirements (ground and flight segments)
9) Recovery of samples (for flight segment only, the DSXR may retrieve lunar or asteroid samples brought to the deep space habitat)
    a) Timing and location of recovery
    b) Contamination protection requirements (reciprocal)

The mission requirements must be summarized in one or more tables at the end of this section or in an Appendix.

DID-0013 – Technology Readiness and Risk Assessment with Stand Alone Report

DID Issue: IR **Date: 2015-04-28**

PURPOSE:

The Technology Readiness and Risk Assessment (TRRA) Report is used to describe 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, the criticality of the constituent technologies, and the expected degree of difficulty in achieving 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.

The TRRA Report is used to assess project status and technical risks, and to guide definition of risk reduction work in following phases.

Agreement on the appropriate PBS level and identification of the CTEs is required prior to the TRRA leading to the elaboration of the TRRA Report. For each CTE the TRRA Report captures the key requirements, heritage, Technology Readiness Level (TRL) achieved, Technology Need Value (TNV), the Research and Development Degree of Difficulty (R&D3) to complete the development, and references to supporting evidence for all assessments.

PREPARATION INSTRUCTIONS:

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

1. INTRODUCTION

This section should include

1.1. Project Description;

1.2. Purpose of Document;

1.3. Scope.

2. DOCUMENTS

This section must include

2.1. Applicable Documents (which must include the following):

a) TRRA Guidelines (CSA-ST-GDL-0001 at latest approved revision).

2.2. Reference Documents (which must include the following):

a) TRL Handbook for Space Applications (TEC-SHS/5574; ESTEC);

b) (all evidence documents referred to in body of report).

3. MISSION OBJECTIVES

This section must provide an overview of the mission, describing the key mission requirements and any assumptions.

4. MISSION ENVIRONMENT

This section must describe in detail the mission environment and any assumptions.

This section should include a summary comparison table(s) between heritage and current mission environments with references to source documents.

5. PRODUCT BREAKDOWN STRUCTURE

This section must provide a table or diagram with hierarchy of PBS and element numbers.

This section must provide schematics illustrating the elements of the PBS and their parts.

6. KEY PERFORMANCE PARAMETERS (KPPS) FOR EACH CTE

This section must describe the Key Performance Parameter(s) identified for each PBS element (where applicable). The KPP description must identify what parameter value/range is currently achievable and what is required.

7. CRITICAL TECHNOLOGY ELEMENTS (CTES)

7.1. Description of the CTE;

7.2. Rationale for selecting the CTEs.

The intent of this section can be met by completing and cross-referencing the Critical Technologies Elements Identification Criteria Worksheet (CSA-ST-FORM-0003).

8. TECHNOLOGY MATURITY AND VIABILITY ASSESSMENTS

This section must include a sub-section for each CTE covering:

8.1. Description;

8.2. Main requirements (including KPP(s) associated with this CTE);

8.3. Heritage and compliance;

8.4. TRL achieved;

8.5. R&D3;

8.6. TNV.

The intent of this section can be met by completing and cross-referencing the applicable Technology Readiness and Risk Assessment Worksheet (CSA-ST-FORM-0001) for each CTE and including the Technology Risk Matrix generated from the Technology Readiness and Risk Assessment Data Rollup Tool (CSA-ST-RPT-0002).

9. TRRA SUMMARY AND RECOMMENDATIONS

This section must include a Summary table of results with columns covering:

- PBS # ; Technology Name; TRL (calculated); TNV (user input);
- R&D3 (user input); TNV • Δ-TRL (calculated); /R&D3/ (calculated).

This section must present a summary of remaining Technology R&D Options, Risks, Cost, and Feasibility for each CTE of the PBS.

This section must summarize the recommended technology development plan and should refer to a separate Technology Development Plan report if appropriate.

10. CONCLUSIONS

This section should include a statement regarding current overall state of TRRA assessment and identify any open work.

11. APPENDIX A – TECHNOLOGY READINESS AND RISK ASSESSMENT WORKSHEETS

This section must include, or refer to an attachment which includes, all of the completed worksheets: the Critical Technologies Elements Identification Criteria Worksheet (CSA-ST-FORM-0003 – AD-03), the Technology Readiness and Risk Assessment Worksheet (CSA-ST-FORM-0001 (AD-03) for each CTE and rollup using the Technology Readiness and Risk Assessment Data Rollup Tool (CSA-ST-RPT-0002). These worksheets can be obtained from the FTP site:

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

DID-100 – General Preparation Instructions

DID Issue: Tailored for use in DSXR Phase 0 **Date: 2017-04-11**

PURPOSE:

This DID specifies:

a) format requirements for the preparation and formatting of deliverable project documentation;

b) document and data delivery methods, notifications and identification requirements;

c) document and data structure requirements.

d) Metadata requirements for all document and data submissions

When documentation is prepared in the Contractor's format, it must still meet the requirements of this DID.

PREPARATION INSTRUCTIONS:

1. GENERAL INSTRUCTIONS

1.1. Preparation

All documentation shall be written in English and must be delivered in electronic format. Documents must be prepared using the most appropriate software (Microsoft Word, Excel, etc.). Schedules must be submitted in Microsoft Project format. Documents whose native format is not a common office program must be delivered in PDF in addition to the native format.

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

WXYZ-CDRL-NUM-CIE_ContractNumber_sentYYYY-MM-DD_Title

where:

WXYZ: A 4-8 letter acronym of the project

CDRL-NUM: The CDRL Identifier

CIE: Name of the Company (no space, no hyphen)

ContractNumber: For example: _9F028-07-4200-03

_sentYEAR-MONTH-DAY: Date Tracking Number

_Title: Document Title (Can be an acronym)

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.

1.3. Delivery, Notifications and Identification Requirements

Data must be submitted with a Letter of Transmittal (or an electronic equivalent as mutually agreed by the CSA and the Contractor), and acknowledged. 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. The Letter of Transmittal will contain as a minimum, the Contract Serial Number, the CDRL Number and the Title.

1.3.1.E-mailed Documents

E-mailed documents must be sent to:

asc.bibliothequegc-cmlibrary.csa@canada.ca

Covering e-mails must contain the project/program acronym or equivalent identifier in the "Subject" line and include the CDRL identifier under which deliverable documents are being submitted.

1.3.2.Direct Transferred Documents

For direct transfer, a notification of the document's availability and location on a Contractor repository must be sent to:

asc.bibliothequegc-cmlibrary.csa@canada.ca

If deliverables contain ITAR content, notifications of their availability on Contractor repositories shall be sent to:

CSA-CM-ITAR@asc-csa.gc.ca

The notification must include the project/program acronym or equivalent identifier and the CDRL identifier under which the deliverable documents are being submitted.

1.3.3.Documents Delivers on DVD or CD-ROM Disk

Hard copy and media deliverables are to be addressed to:

CM Library, 6A-100

Attention: CSA DSXR Phase 0 Project

Canadian Space Agency

6767, Route de l'Aéroport

Longueuil, QC, J3Y 8Y9

CANADA

The DVD or CD-ROM label must show the following information :

a) Company Name

b) Document Title

c) Document Number and Revision Status

d) CSA SOW Number

e) CDRL Number and Title

f) Contract Number

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) Introduction;

d) Applicable and Reference Documents;

e) Body of Document; and

f) Appendices

2.2. Cover/Title Page

The title page must contain the following information:

a) Document Number and date: Volume x of y (if multivolume)

b) Rev. indicator / date of Rev.

c) Document Title

d) Project Name

e) Contract No.

f) CDRL Item No. or Nos., if one document responds to more than one CDRL, subject to prior approval from the PA.

g) Prepared for: Canadian Space Agency

h) Prepared by: Contractor name, CAGE Code, address, and phone number

i) Product tree identifier, if applicable

j) © HER MAJESTY THE QUEEN IN RIGHT OF CANADA [YEAR].

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 appendix, figure and table, in that order.

2.4. Introduction

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

a) Project description and background;

b) Identification (number, title) and a brief overview of the system, hardware, or software to which the document applies;

c) Purpose of the document;

d) Scope of the document (what it includes and what it does not include);

e) Document conventions; and

f) Roles and responsibilities of the participants and stakeholders.

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. Acronyms must be in the last appendix.

3. METADATA ON DELIVERABLES

In order for CSA to be able to properly manage deliverables and the system configuration as well as to process contractor's deliverables in an efficient manner, the contractor must, for each deliverable, provide metadata as described in the following table.

Provided by Supplier	Metadata Description	Comments
Yes	CSA Project Identifier	Project Acronym
Yes	Contract Identifier	PSPC identifier
Yes	Contract Revision Identifier	PSPC identifier
Optional	Contract Revision Date	
Yes	SOW Identifier	CSA Doc ID
Yes	SOW Revision Identifier	CSA Doc Revision ID
Yes	Document Type	Dwg, Doc, RFD, RFW, ECR, ECN, IP CR, IP CN/CD, QN, etc.
Yes	CDRL Identifier	Per CSA SOW (e.g. EN-006)
Yes	CDRL Sub-category Identifier	If multiple, separate subject documents per CDRL item (e.g. EN-006.03) (can be contractor defined)
Optional	Project WBS identifier	
Optional	SOW paragraph identifier.	
Optional	DID/ DRD Identifier	
Yes	Deliverable submission format	Electronic, Hard copy, On media (CD-ROM, etc.)
Yes	Deliverable Transmittal Identifier	e.g. CADM09-0123. Can also be a notification of delivery identifier
Yes	Deliverable Transmittal Date	
Yes	Originator's Organization Identifier	CAGE code, company name, short name, etc.
Optional	Document Author	

Provided by Supplier	Metadata Description	Comments
Yes	Deliverable Type	Dwg, Doc, RFD, RFW, ECR, ECN, NCR, Problem Report, IP CR, IP CN/CD, QN, etc.
Yes	Document Type	Specification, Design, Plan, Tech Note, Report, etc.
Yes	Originator's Document Identifier	
When applicable	Originator's Document Volume Identifier	
When applicable	Originator's Document Part Identifier	
When applicable	Originator's Document Issue Identifier	When both Issue and Revision are used concurrently to identify released documents
Yes	Originator's Document Revision Identifier	
Yes	Originator's Document Title	
Yes	Document Release Date	
Yes	Document Effective Date	Applicable to document changes, deviations, waivers,
Yes	Document Expiry Date	If applicable
When applicable	Originator's Authorizing ECN Identifier	Class 2 ECN approving document release and submission to customer
Yes	Document Maturity	Draft, Preliminary, Initial Release, Updated Revision, etc.
When applicable	Class	If deliverable is a change, deviation, waiver, etc. to a released item. (Class I, Class II)
Yes	Security Classification of Deliverable	Per Government of Canada definitions for Classified and Protected data (C,S,TS,PA,PB,PC)
Yes	Sensitivity of Document contents	Company Proprietary, Trade Secret, etc.
Yes	ITAR Content Indicator	Yes or No
Yes	Export Controlled Content Indicator	Yes or No
Yes	Affected Document Identifier	If deliverable is a change, deviation, waiver, etc. to a released document/drawing/model. Enables change-to-document, waiver-to-document relationships, etc.
Yes	Affected Document Revision Identifier	As above
Yes	Affected Document Title	As above
Yes	Product Breakdown Structure / Item Hierarchy Identifier	Critical for Item-to-Document Relationship
Yes	Associated Project/System Milestone Review	PDR, CDR, etc. When Reviews are at sub-system level, identify accordingly. E.g. Bus PDR
When applicable	Associated System Baseline	If different from Project Milestone
Yes	Filename of Deliverable	Filename and file type (for all representations submitted - .doc, .pdf, etc.). Original, revisable format to be delivered before contract completion.
Yes	Format of Deliverable / Application used to produce	MS WORD 2007, Project Scheduler 9, etc.
When applicable	Filename of Parent Deliverable Bundle	If part of a document Bill of Material
When applicable	Identification of Delivery Media	If physically delivered
When applicable	Originator's Repository Address of deliverable	To identify source location of document

DID-102 – CWBS and Work Package Descriptions

DID Issue: IR **Date: 2013-12-18**

PURPOSE:

The Contractor Work Breakdown Structure (CWBS) is used during planning for estimating resources and scheduling the work. During the implementation phase, it is used for reporting and controlling costs and schedule.

PREPARATION INSTRUCTIONS:

The Contractor must provide a Work Breakdown Structure (WBS) describing all the project elements that organize and define the total scope of the project, including subcontracted work, and must be deliverable-oriented.

The Contractor must prepare and maintain a WBS Dictionary made up of Work Package Descriptions (WPDs) for every element to the lowest level of the WBS. Each WPD must include, as a minimum:

a) A unique identifier traceable to the WBS;

b) A title;

c) The name of the individual responsible for completion of the work;

d) The scope of the work package;

e) The start date and duration;

f) Required inputs and dependencies;

g) A description of every activity covered by the WPD including the level of effort and earned value measurement method for each activity, and all non-labour costs;

h) Assumptions;

i) Output and work package acceptance criteria;

j) Issue date;

k) Version number; and

l) List of deliverable with delivery milestone.

DID-105 – Project Schedule

DID Issue: IR **Date: 2014-01-06**

PURPOSE:

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

PREPARATION INSTRUCTIONS:

The project schedule must be based on the CWBS, in the form of a Gantt chart. The schedule must be provided in MS project format, and in PDF. 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 S&MA activities, must be grouped separately from the deliverables, and must be shown at the top of the chart.

DID-107 – Progress Report

DID Issue: Tailored for use in DSXR Phase 0

PURPOSE:

The Progress Report presents the results of the work done to date in the contract, and in particular since the previous report. The Progress Report is used by the Government to assess the Contractor's progress in performance of the work.

PREPARATION INSTRUCTIONS:

The Monthly Progress Report must include status data and information summarizing project management, technical and schedule progress and accomplishment for each element of the Contractor's Work Breakdown Structure (CWBS). The report must address the major activities of the reporting period and must emphasize major achievements and events of special significance. Difficulties and/or problems that have affected the work progress, proposed corrective actions, project impact expected and concerns for the future, must also be reported.

Each progress report must answer the following three questions:

1) Is the project on schedule?
2) Is the project within budget?
3) Is the project free of any areas of concern in which the assistance or guidance of the CSA may be required?

Each negative response must be supported with an explanation.

The Progress Report must include the following information, as a minimum:

1) Summary outlook, including technical performance, work performed, schedule and cost status (at CWBS level 2), organization and key personnel changes and areas of concerns;
2) Financial status including actual and forecasted expenditures, by month, as compared to the original monthly planned expenditure profile;
3) Updated milestones payment plan;
4) A detailed integrated project schedule status including:
    a) Dependencies between activities,
    b) Percent of completion for all activities,
    c) List of completed milestones,
    d) Critical path,
    e) 1st level subcontractor's activities having impact on WP delivery date;
    f) All other activities having an impact on WP delivery date.

5) Schedule variances from the plan, including deviations from schedule and proposed corrective actions for significant variances;
6) Major meetings schedule update;
7) Status of the work in progress, specifically the work performed in the previous calendar period; sufficient sketches, diagrams, photographs, etc. must be included, if necessary, to describe the progress accomplished;
8) The work projected for the next period, and estimated date of completion of next milestone;
9) Outline of technical and programmatic issues, with solutions recommended;
10) Contractual issues, including changes to activities and costs;
11) Subcontracts events, status and issues;
12) Equipment ordered, received, made and assembled;
13) Description of trips or conferences connected with the Contract during the period of the report;
14) Risk status report including previous issues resolved, status of on-going risks (changes, likelihoods and impacts), and identification of new risks, their likelihood and impact, and proposed mitigation action;
15) PA Reporting: A narrative section describing: significant accomplishments during the reporting period, audits performed, significant problems, recommended solutions, and corrective action status, significant changes in the PA organization and program related organizations.
16) Status of all action items from previous review(s) and meeting(s).

DID-110 – Meeting Agenda

DID Issue: IR **Date: 2013-12-19**

PURPOSE:

The Meeting Agenda specifies 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; 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 newly created/closed action items, decisions, agreements and minutes; and

i) Set or confirm dates of future meetings.

DID-111 – Minutes of Meetings

DID Issue: IR **Date: 2013-12-19**

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 in the Contractor's format and must, as a minimum, include the following information:

1) Title page containing the following:
    a) Title, type of meeting and date
    b) Project title, project number, and contract number
2) Purpose and objective of the meeting;
3) Location;
4) Agenda;
5) Summary of the discussions, decisions and agreements reached;
6) List of 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-112 – Action Items Log (AIL)

DID Issue: IR **Date: 2013-12-19**

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) Person responsible (for taking action);
8) Target/Actual Date of Resolution;
9) Progress update;
10) Rationale for closure;
11) Status (Open or Closed); and
12) Remarks.

The date in column 8) will be the target date as long as the item is open, and the actual date once the item is closed.

DID-114 – Phase Closure / Final Report

DID Issue: Tailored for use in DSXR Phase 0 **Date: 2017-03-08**

PURPOSE:

The purpose of the Phase Closure/ Final Report is to record formally the history of the Phase (or Project if this is the Final Report), its achievements, financial, material and human resources expenditure, problems encountered and solutions implemented.

PREPARATION INSTRUCTIONS:

The Phase Closure / Final Report will encompass all the work done in the project during the Phase just ended or for the entire project. It should be a comprehensive summary of the phase or project work with the emphasis on the problems encountered, solutions implemented, successes encountered and lessons learned. It must include sufficient drawings, graphs, tables, figures, sketches and photographs as appropriate. The Phase Closure Report must be a standalone document and must contain at least the following information:

1) Executive Summary.
2) Comparison of mission and system requirements against user requirements and objectives.
3) Comparison of run-out costs with estimates by major Work Package (if applicable).
4) Comparison of actual versus planned schedules and milestones.
5) Comparison of risks anticipated versus actual experience.
6) Problems encountered and solutions implemented.
7) Final CDRL.
8) Lessons learned.

DID-204 – Mission Feasibility Study

DID Issue: IR **Date: 2014-02-18**

PURPOSE:

The feasibility report is used to assess the strengths and weaknesses of the proposed mission and its objectives. It must determine the practicality of the mission objectives, evaluate the prospects of success and provide recommendations based on the findings of the report.

PREPARATION INSTRUCTIONS:

The document must include the following:

1) an introduction including the scope, the purpose and a list of assumptions (if any);
2) a list of applicable and reference documents (if any);
3) a short description of the mission including the mission objectives, performance criteria , the overall requirements of the spacecraft (BUS, sub-systems), the payload(s), the ground segment and user terminals.
4) define the success criteria for the mission and analyze the current status of the project for comparison
5) Assess present and future needs
6) Define alternatives to meet those needs
7) Evaluate viable alternatives (note: consider the most applicable approach for the mission)
    a) Experimental approach: demonstrate the viability of achieving the performance criteria for each mission objective through experimental data and results.
        i) The experimental data and results must be compared to the applicable theories. Any divergence between theory and experiment must be explained and suggestions are to be made for possible improvements to reduce the deviation between experimental results and theory.
    b) Analytical approach: demonstrate the viability of achieving the performance criteria for each mission objective through previously obtained experimental data and flight demonstration results.
        i) The contractor must demonstrate the applicability of the analytical data used to evaluate the feasibility of the performance criteria of the mission objectives. The contractor must provide a description of the methods used to obtain the analytical data and present the applicability of the analytical data to the current mission.
        ii) The contractor must propose improvements/changes to obtain the analytical results to conform to the current mission performance criteria and applicable theories.
8) Identify and develop the preferred solution
9) Programmatic Aspects:

a) Provide an estimation of the cost of developing the most viable technologies that are essential to the completion of the project.

b) Provide a realistic timeline of the development of the viable technologies

c) Deduce from cost and scheduling estimations; the most cost and time efficient technology to develop and apply in the project.

d) State the benefits of the technological developments and the project itself toward Canada in social and economic terms.

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.

DID-320 – Product Assurance and Implementation Plan

DID Issue: IR **Date: 2014-01-17**

PURPOSE:

The Product Assurance Implementation Plan (PAIP) describes the organization, objectives, and PA activities planned for the project. The PAIP provides the Government with insight into the Contractor's PA organization, tasks, and activities and allows the Government to assess compliance with the governing PA requirements specified in the PAR Document and in this SOW.

PREPARATION INSTRUCTIONS:

The PAIP may be prepared in the Contractor's format and shall, as a minimum, provide the following information, to the extent it is applicable in the Phase(s) covered by this SOW:

1. INTRODUCTION

1.1. Purpose and Scope

1.2. General Approach to Product Assurance

This section provides an overview of the objectives to be achieved by the plan.

1.3. Document Conventions

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1. Applicable Documents

This section lists applicable documents that will be followed in the implementation of the PAIP.

2.1.1.CSA Documents

2.1.2.In-house PA procedures

2.1.3.General standards and practices (Military, NASA, Industry, Software, etc.)

2.2. Reference Documents

This section lists documents that provide additional information or guidelines, but that are not compulsory.

3. PRODUCT ASSURANCE PROGRAM

3.1. General Requirements and Approach to Product Assurance

3.2. QA System, ISO 9001 or Equivalent

3.3. Responsibility

3.4. PA Organization

This section identifies the organizations in the company responsible for applying the provisions of the PAIP: organizational structure, relationships to other organizations within the project and company, including personnel identification and required skill levels.

3.5. Audits

This section describes the audits to be performed throughout the life of the project including an audit schedule to be approved by the CSA S&MA representative. This applies to the Contractor and the subcontractors.

3.6. Mandatory Inspections

3.7. Right of Access/Observation

This section covers government rights to access the premises and the program data including: a list of all reviews Government representatives may attend, a list of all audits the Government may conduct, and any special agreements or conditions of access, including Subcontractor Audits;

3.8. Project Reviews

3.9. PA Reporting

This section describes the plans for monitoring the different phases of the program development, for problem reporting and for ensuring that corrective actions are taken.

3.9.1.CSA Notification

This section specifies the frequency, format, and content of the PA reports submitted to program management to report program progress as well as problems, risks, and proposed solutions.

3.9.2.Requests for Deviations and Waivers

3.10. Product Assurance at Subcontractors Facilities

4. QUALIFICATION PROGRAM

This section presents parts, materials and processes control plans that describe the approach, methods, procedures and organization that will be implemented to assure compliance to the parts/materials/processes program requirements. This shall include a commercial parts control plan in accordance with the requirements of the S&MA Requirements.

4.1. General

4.2. Classification for Qualification Status

4.3. Qualification Philosophy

4.4. Qualification Status Reviews

4.5. Qualification Process Requirements

4.6. Qualification Status List

4.7. Qualification of Parts

4.7.1.Parts Qualification – General

4.7.2.Application-specific Integrated Circuits (ASICs)

4.7.3.GIDEP / ESA Alerts

4.8. Qualification of Material and Processes

4.9. Software Qualification

4.10. Qualification Testing

4.11. Acceptance Testing

4.12. Statement of Compliance

4.13. Unit Qualification

4.13.1. COTS Components / Units

4.13.2. Modified COTS Components / Units

4.13.3. Newly Developed Units

4.14. Flight Certification

5. RELIABILITY

This section describes the objectives and tasks to be performed to ensure reliability and maintainability requirements are adequately implemented.

5.1. General

5.2. Reliability Modeling

5.3. Severity Classification

5.4. Reliability Modeling

5.5. Derating Analysis

5.6. Failure Mode, Effects, and Criticality Analysis (FMECA)

5.7. Critical Items

5.8. Worst Case Analysis

5.9. Parts Stress Analysis

5.10. Performance Trend Analysis

5.11. Radiation Analysis

5.12. Multipaction

5.13. Critical Items

5.14. Hardware Risk Assessment Levels

5.14.1. Risk Assessment of COTS Hardware

5.14.2. Part List

5.14.3. Risk Assessment for Parts

5.14.4. Contamination Control

5.14.5. Temperature Limits and Cycling

5.14.6. Radiation

6. EEE PARTS PROGRAM

6.1. General

6.2. EEE Parts Selection

6.3. Non-standard Parts
6.4. Parts Control Board
6.5. NSPARS
6.6. Parts Specifications and Procurement
6.7. Custom Parts
6.8. Plastic Encapsulated Microcircuits
6.9. Parts Used on Cots Equipment for Flight Items
6.10. Value Added Testing
6.11. Part Analysis
6.12. Additional Part Requirements

7. MECHANICAL PARTS, MATERIALS AND PROCESSES PROGRAM

7.1. Objectives
7.2. Materials and Process Selection
7.3. Non-Standard Materials and Processes
7.4. Materials and Processes Procurement Specifications
7.5. Qualification of Mechanical Parts, Materials And Processes
7.6. Declared Mechanical Parts, Materials And Processes Lists
7.7. Materials And Processes Control Boards
7.8. Organic Materials
7.9. Inorganic Materials
7.10. Process Criteria
7.11. Corrosion Control-Compatibility of Process Materials
7.12. Chlorinated Fluorocarbons
7.13. Age Sensitive Materials
7.14. Purchaser's Inspection

8. QUALITY ASSURANCE PROGRAM

8.1. Objectives
8.2. Organization and Management
8.3. Design and Development
8.4. Procurement
8.5. Manufacturing

8.5.1.Review of Quality Related Manufacturing Documentation
8.5.2.Training and Certification

8.5.3.Process and Cleanliness Controls

8.5.4.Workmanship Standards

8.5.5.Stamp Control

8.5.6.Equipment Certification

8.6. Verification, Inspection and Testing

8.6.1.Test Specifications, Procedures and Data Sheets

8.6.2.Test Software

8.6.3.Test Witnessing

8.6.4.Quality Documents and Records

8.7. Identification and Traceability

8.8. Non-conforming Item Control

8.8.1.Non-conforming Item Action and Control

8.8.2.Non-conforming Items – Definitions and Classifications

8.8.3.Non-conformance Documentation and Review Board Notification

8.8.4.Non-conformance Review Boards

8.9. Test Failure Reporting

8.10. Handling, Storage and Shipping

8.11. Configuration and Data Management

This section details the objectives and tasks to be performed to ensure that the configuration management activities are carried out according to the standards and procedures established in the Contractor's CADM Plan.

9. SOFTWARE PRODUCT ASSURANCE (SPA)

9.1. Objectives

9.2. Organization and Responsibility

9.3. Software Development Planning

9.4. Software PA Program

9.5. Software Categories and Applicability

9.6. Software Quality Evaluation Activities

9.7. SPA Phase-Independent Activities

9.8. SPA Phase-Dependent Activities

10. SAFETY PROGRAM

10.1. Objectives

10.2. Safety Requirements

10.3. Safety Responsibilities

10.4. Safety Activities

10.4.1. Design

10.4.2. Manufacturing

10.4.3. AIT

10.4.4. Launch

APPENDIX A PA COMPLIANCE MATRIX

This Appendix presents a matrix testifying to the compliance with the applicable PA Requirements. The compliance matrix shall include as a minimum the following:

a) Indicate the PAR specification paragraph and requirement;

b) Indicate the PAIP corresponding paragraph to address the requirement in the CSA PAR;

c) Indicate Compliance I or Non-compliance (NC) and reasons for NC; and

d) List of the contractor PA and process documents that will be used to address a requirement.

APPENDIX B ACRONYMS

DID-400 – System Requirements Document

DID Issue: A **Date: 2017-04-11**

PURPOSE:

To define the functional, performance, environmental and other requirements for a given system, segment, subsystem, unit, module or assembly and to provide the basis on which the Specifications Documents will be developed.

NOTE: Requirements Documents are sometimes called "Requirements Specification". This DID applies to them as well.

PREPARATION INSTRUCTIONS:

1) Requirements documents shall conform to norms of English usage for Systems Engineering:

   "shall" indicates a mandatory requirement

   "should" indicates a preferred but not mandatory alternative,

   "will" indicates statement of intention or fact

   "may" indicates an option.

2) Requirements documents shall define the requirements on the subject item (segment, subsystem, etc.) as a whole and shall not contain specific requirements on sub-items. All requirements shall be verifiable on the item as integrated.

3) All requirements shall be documented in the MBSE model and requirements documents expressed from the model *(Optional)*.

4) Requirements documents shall cite applicable standards and parent requirements, and shall make clear the priority sequence of the applicable documents.

5) There shall be one set of requirements for each node in the System Hierarchical Tree. Note that interface requirements (which are between two or more nodes) are in separate documents.

6) Requirements shall conform to the following standards for quality:

   a) They shall be unambiguously clear to the intended readership;

   b) There shall be one requirement per paragraph;

   c) Each requirement shall have a unique identifier (e.g. an ID number or paragraph number);

   d) They shall not define design solutions;

   e) They shall define their source and/or rationale

   f) They shall be verifiable, preferably by test;

   g) They shall specify the conditions under which they apply; and

   h) Performance requirements shall be quantified.

7) The Requirements Document shall comprise a number of sections, each defining a specific set of requirements. The document shall address all of the following categories of requirements, as applicable to the project:
    a) Functional and performance requirements (see item 8) below);
    b) External interface requirements (unless done in a separate document);
    c) Resource allocation requirements,
    d) Design requirements;
    e) Construction requirements (see item 9) below);
    f) Environmental requirements (see item 10) below),
    g) Qualification and/or verification requirements;
    h) Safety requirements
    i) System environmental requirements associated with:
        i) Storage, packaging and handling environment
        ii) External stowage requirements, if any;
        iii) Ground operations environment
        iv) Integration to launch vehicle environment (for flight payload only)
        v) Launch environment (for flight payload only)
        vi) On-orbit environment (for flight payload only)
    j) Operational requirements, (unless done in a dedicated document),;
    k) Ground Support Equipment requirements, if any (unless done in a separate document); and
    l) Other applicable requirements types.
8) Functional and performance requirements shall include:
    a) Functional and performance requirements imposed on the system by the needs (flow down from MRD);
    b) Operating modes requirements;
    c) Power requirements including:
        i) Power consumption,
        ii) Power transients,
        iii) Voltage requirements;
    d) Telemetry and Telecommand requirements;
    e) Software requirements;
    f) Other applicable requirements.
9) Construction requirements shall include, as applicable to the project:
    a) Requirements associated with materials, parts and processes;

b) Physical requirements including
    i) mass properties,
    ii) envelopes,
    iii) physical attributes (# of samples, etc.);
c) Containment requirements.

10) Environmental requirements shall address the following, as applicable to the project:
a) Environmental test factors;
b) Protoflight and Qualification testing, philosophy and factors;
c) Environmental Design and Test Requirements:
    i) Structural/Mechanical Design Requirements,
    ii) Thermal Design requirements,
    iii) Grounding requirements
    iv) Electrostatic and EMC Design requirements,
    v) Atmospheric Environment,
    vi) Radiation Environment,
    vii) Meteoroid and orbital debris environment, and
    viii) Cleanliness and contamination environment;
d) Subsystem and Component requirements Item c) applied to subsystem and units.

DID-450 – Systems Engineering Management Plan (SEMP)

DID Issue: IR **Date: 2014-01-24**

PURPOSE:

To define and describe the approach to and details of System Engineering activities to be performed by the Contractor and its lower-tier contractors.

PREPARATION INSTRUCTIONS:

The SEMP shall cover all engineering activities to be performed within the applicable contractual time and responsibility boundaries. The System Engineering Management Plan (SEMP) shall describe how a fully integrated engineering effort will be managed and conducted through design, analysis, development, integration, and testing of the system. It shall highlight key engineering methods and tools to be applied, and describe interfaces to external activities. It shall also reference and make use of the lower-tier Engineering Management Plans, and provide a coherent and consistent planning document for the entire Contractor Engineering program.

The SEMP shall include the following data, tailored to the specific needs of each project. See the CSA Systems Engineering Management Plan (SEMP) Template, CSA-SE-PL-0001, Rev. A for more details. Where one of the items listed below is the subject of a separate document, the SEMP shall merely include a pointer to that document.

1. INTRODUCTION

1.1. Purpose

1.2. Scope

1.3. Relationship to other standards and plans

2. DOCUMENTS

2.1. Applicable Documents

2.2. Reference Documents

3. PROJECT OVERVIEW

3.1. Mission Description

3.2. Project Objectives and Constraints

3.3. System Description

3.4. Project Phases and Reviews

4. APPROACHES AND TECHNIQUES

4.1. Systems Engineering Process

4.2. SE Management and Control

4.2.1.SE Management

4.2.2.Technical Organisation

4.2.3.Responsibility Allocation

4.2.4.Systems Engineering Working Group (SEWG)

4.2.5.Technical Reviews and Audits

4.2.6.Design and Development Plan

4.2.7.Technology Readiness Levels

4.2.8.Interface Management

4.2.9.Technical Performance Measures (TPM) Management

4.2.10. Environmental Engineering

4.2.11. Human Factors Engineering

4.2.12. Software Development

4.2.13. Schedule and Cost

4.2.14. Risk Management

4.2.15. Procurement

4.2.16. Documentation

4.2.17. Configuration Management

4.3. Requirements Engineering

4.3.1.Requirements Generation

4.3.2.Requirements Maintenance

4.4. Requirements Analysis, Functional Analysis/Allocation and Synthesis/Design

4.5. Manufacturing, Software Development and AIT

4.5.1.Manufacturing

4.5.2.Software Development

4.5.3.Assembly, Integration and Test

4.5.4.Handling, Storage and Shipping

4.6. Verification

4.6.1.Verification Strategy and Verification Plan

4.6.2.Space Environmental Qualification Program

4.6.3.Verification Process

4.6.4.Verification Categories

4.6.5.Verification Implementation

4.7. Validation

4.7.1.Validation Strategy and Validation Plan

4.7.2.Validation Process

4.7.3.Validation Implementation

4.8. System Analysis

4.9. SE Interfaces

4.9.1.CSA Mission Sponsor

4.9.2.External Stakeholders

4.9.3.CSA Project Management Interface

4.9.4.CSA Engineering Specialists

4.9.5.Safety and Mission Assurance Interface

4.9.6.CSA Configuration Management

4.9.7.Operations and Logistics Interface

4.9.8.Contractor Relations

APPENDIX A LIST OF ACRONYMS

DID-501 – Interface Control Document (ICD)

DID Issue: IR **Date: 2014-01-16**

PURPOSE:

To define and control the interface between several cooperating or attached Hardware Configuration Items (HWCI) or Configuration Software Configuration Items (CSCI).

PREPARATION INSTRUCTIONS:

The ICD may describe the interfaces between a system or subsystem and all external systems or subsystems with which it interfaces (External ICD), or it may define all interfaces amongst subsystems within a system (Internal ICD).

Examples of External ICDs are:

- Spacecraft-to-Launch Vehicle ICD
- Spacecraft-to-Ground Segment ICD

Examples of Internal ICDs are:

- Spacecraft Internal ICD (e.g. between Bus and Payloads)
- Ground Segment Internal ICD

Systems may be manned or unmanned; they may be space or ground systems such as Ground Segment facilities. The specific requirements below must be tailored accordingly.

The ICD may be structured by types of interfaces (as defined above), or by subsystem and then by types of interfaces under each subsystem.

The ICD must contain the following information, as a minimum, tailored as required by the type of ICD as described above, and the particular system and interfaces being defined:

1. Purpose and Scope
2. Applicable and Reference Documents
3. Identification (name, number) and brief overview of the system and role within the system, of the interfaces to which the ICD applies
4. Interface diagrams showing by name and identifier all interfaces among the HWCIs and CSCIs to which this ICD applies
5. Identification (name, identifier) and purpose of each of the interfaces
6. Physical / Mechanical Interfaces
   - 6.1. Coordinate System
   - 6.2. Dimensions and tolerances
   - 6.3. Units of measurement

6.4. Envelope, Volume and Mass Properties

6.5. Attachment methods

6.6. Alignment features

7. Structural/Mechanical Interfaces

7.1. Applied Loads and Disturbances (including random vibrations, frequency spectrum)

7.2. Acoustics

7.3. Depressurization/Repressurization

7.4. Ground Handling Environment

8. Thermal/Fluids Interfaces

8.1. General Requirements (touch temperature, condensation prevention, etc.)

8.2. Thermal Environment

8.3. Payload/Subsystems Cooling

8.4. Vacuum Exhaust Interfaces

9. Electrical Power Interfaces

9.1. Electrical Power Requirements, Sources and Allocation

9.2. Power Supply characteristics and limits

9.3. Overload protection and limits

9.4. Power control

9.5. Electrical connectors (types, pinouts, locations, mating and demating)

9.6. Cable schematics

10. Electromagnetic Compatibility (EMC)

10.1. EMC Classifications

10.2. Host system produced interference environment

10.3. Payload produced interference environment

10.4. Bonding and grounding

10.5. Power and signal circuits isolation

11. Command and Data Handling (C&DH)

11.1. Communications Technology (RS-422, Ethernet, Analog, Discrete, video, laptop, etc.)

11.2. Signal Characteristics

11.3. Response / Telemetry Format

11.4. Request/Command Format

11.5. Processing Requirements

11.6. Connector/Pin Interface

11.7. Data Acquisition, Storage and Management

11.8. Synchronization

11.9. Application Programming Interfaces

12. Environmental Interfaces

    Any environmental factors not addressed elsewhere in the ICD (e.g. radiation, atmosphere, illumination, etc.)

13. Materials and Processes Interfaces
14. Human Factors Interfaces
15. Propulsion Interfaces
16. Pyrotechnic Interfaces
17. Fire Prevention
18. Ground Operations and scientific data processing

    18.1. Facilities

    18.2. Payload Handling

    18.3. Ground Support Equipment (GSE)

    18.4. Communications Requirements

    18.5. Power Requirements

    18.6. Special Equipment

    18.7. Storage

DID-600 – CAD Models

DID Issue: IR **Date: 2014-01-16**

PURPOSE:

To provide a 2D or 3D virtual model of a product to support the performance of various analyses (mechanical, electrical, thermal, optical) and virtual testing.

PREPARATION INSTRUCTIONS:

All CAD models developed must be delivered.

Models must be delivered in the following formats:

a) Mechanical design: STEP AP203 (.stp) and in JT2GO (.jt) and PDF (with 3-D viewing);

b) Electrical design: .dsn, .sch, Pspice and Gerber formats;

c) Thermal Design: TMG universal file format, or I-Deas Archive file format;

d) Software design: UML 2.0 or XML;

e) Model-based Systems Engineering Model (if required): Artisan Studio.

f) Optical design models: Zemax

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 analysis that don't use a specialty tool, CSA will accept Matlab, Excel and MathCad format data. Where a highly specialized tool is used (e.g. bearing analysis, EMC analysis) delivery format must be negotiated with the CSA. 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.

Assumptions that are used must be stated, along with resulting limits on model accuracy.

DID-700 – System Conceptual Design Document

DID Issue: A **Date: 2017-04-11**

PURPOSE:

In its preliminary form, to describe the preliminary system conceptual design proposed to meet the mission requirements.

In its final form, to describe the conceptual design of the system, to assist in finalizing the design of the system and allocating the requirements to subsystems, to demonstrate its feasibility and to support programmatic estimates.

PREPARATION INSTRUCTIONS:

NOTE: This DID comprises two sets of requirements: the first for the preliminary form of the document and the second for its final form.

Preliminary form

The preliminary document must include the following:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A description of the overall system and software conceptual design;
3) A description of any payload detailed analysis, breadboard design and performance (field) testing, if applicable; and
4) A description of any trade-off studies performed.

Final form

The final document must include the following:

1) Introduction: recalling the major objectives and guidelines for the project;
2) Architecture, design and interfaces: giving a high level description of the architecture and design of the system and its subsystems, software, including internal and external interfaces;
3) Trade-offs: criteria definition, analysis, criteria results, decisions;
4) Design decisions: rationales for design choices;
5) Budgets: a summary of the engineering budgets and TPMs, and margins, their allocation to subsystems;
6) Drawings and schematics: architectural diagrams for the main aspects of the system (structure, electronics, power, communications, software, etc.) describing and referencing important design drawings such as functional interconnect diagrams, activity flow diagrams, ICDs;
7) Analyses: summarizing the analyses performed, main results and problems encountered; this is a summary of each full analysis report presented separately;

8) Tests: summarizing the tests to be performed to verify the performance and environmental requirements;
9) Operations concepts: summarizing the operations of the system in both nominal and contingency conditions;
10) Maintenance approach: describing the maintenance approach especially for maintainable items such as the spares for manned systems, flight software and ground systems;
11) Verification Matrix: To demonstrate design compliance to system requirements by providing clear link between design and requirements. Indication of design compliance, non-compliance and partial compliance.

DID-801 – Ground Segment Facility Requirements Specification

DID Issue: IR **Date: 2014-02-12**

PURPOSE:

To determine the upgrade(s) required to existing Government Ground Segment (GS) facilities to meet the operations requirements of a new system.

PREPARATION INSTRUCTIONS:

The GS Facility Requirements Specification shall contain the following information, as a minimum:

1. INTRODUCTION

- 1.1. Purpose
- 1.2. Scope
- 1.3. Intended Audience
- 1.4. Assumptions
- 1.5. Document Overview

2. DOCUMENTS

- 2.1. Applicable Documents
- 2.2. Reference Documents

3. FACILITY REQUIREMENTS

- 3.1. GS Facility Requirements
- 3.2. Operations Support Infrastructure
- 3.3. Office Accommodations
- 3.4. Network Infrastructure Requirements

4. FACILITY UPGRADES

- 4.1. Existing Government Facilities

  List of existing subsystems such as Planning Subsystem, Spacecraft Control Subsystem, etc.
- 4.2. New Government Facilities

  List of new subsystems that are required.

APPENDIX A EXISTING GOVERNMENT FACILITIES EQUIPMENT REPORTS

DID-825 –System Concept of Operations

DID Issue: IR **Date: 2014-02-06**

PURPOSE:

To define the overall end-to-end System Concept of Operations.

PREPARATION INSTRUCTIONS:

This document must be prepared in accordance with standard ANSI/AIAA G-043-1992 – Guide for the Preparation of Operational Concept Documents (RD-05).

The System Concept of Operations 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 organizations;
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) Planning processes,
    b) Operations execution processes,
    c) Evaluation processes,
    d) Data Reception,
    e) Data Transfer,
    f) Data processing,
    g) Data turnaround time,
    h) Instrument calibration,

i) Support processes,

j) Operations team,

k) Orbit determination and maintenance;

7) Operational Scenarios.

C CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY

C.1 PURPOSE

The BIP/FIP Disclosure Report serves to identify FIP produced under the Contract with the CSA, as well as any BIP elements that were used to develop the FIP.

This is not to be confused with the identification of the FIP and BIP that will be generated throughout the entire project, which is documented in DID-007 – Mission Development Plan.

C.2 DEFINITIONS

Intellectual Property (IP)	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.
Background Intellectual Property (BIP)	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.
Foreground Intellectual Property (FIP)	IP that is first conceived, developed, produced or reduced to practice as part of the Work under the Contract.

C.3 INSTRUCTIONS FOR COMPLETING IP DISCLOSURE TABLES

Identification

- The Contractor must respond to the 7 questions in Table C-1 when Foreground Intellectual Property (FIP) is created under the Contract with the CSA.

BIP

- If the Contractor intends to use Background Intellectual Property (BIP) to develop the FIP, the Contractor must complete Table C-2 (Disclosure of BIP brought to the project by the Contractor) and forward it to the CSA Project Manager before the beginning of the Contract if any.
- At the end of the Contract, the Contractor must review and update the BIP disclosure (Table C-2) when applicable.
- 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 C-3 (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 C-4 (Canada's Owned FIP Additional Information).

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.

TABLE C-1: CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY

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 C-2 – 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 5 5 – Canada's Owned Additional Information
- ☐ No

For the Contractor:

Signature	Date

For CSA Project Manager:

Signature	Date

TABLE C-2: BIP DISCLOSURE

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 C-3: FIP DISCLOSURE

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 C-2 (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 C-4 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 C-4 only for this IP.*

TABLE C-4 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?**
ID# should be same as corresponding FIP element in Table C-3.	*Title of FIP should be same as corresponding FIP element in Table C-3.*	*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.*

D ROBOTIC FUNCTIONS

Robotic Functions	Rationale & Value Added to Mission
1) Habitat inspection;	The ability to position the tip of a robotic arm with cameras and/or sensors on the end can enable the in-flight inspection of the Habitat vehicle and its subsystems to observe both nominal and off-nominal operations.
2) Crewed vehicle inspection	The ability to position the tip of a robotic arm with cameras and/or sensors on the end can enable the in-flight inspection of critical regions on the crewed vehicle such as thermal protection surfaces.
Visiting Vehicle (or new Outpost module) operations support	
3) Berthing/Docking interface inspection	A robotic manipulator can perform a visual inspection of the berthing/docking interface to verify integrity of the interface seals and mechanisms and other critical features.
4) Free-Flyer Capture	A robotic manipulator on the Habitat can provide free-flyer capture capability so as to support the resupply of the facility and offer the mission an alternate/backup capability to direct docking. Visiting vehicles can be autonomously captured and berthed for unloading of pressurized (via crew) or unpressurized (via robotics) cargo.
5) Vehicle/Module berthing (up to soft-capture, then release prior to hard dock)	In addition to providing functional redundancy to logistics resupply architecture, the use of berthing rather than docking enables larger volume equipment to be transferred from the vehicle to the Habitat
6) Cargo unloading/loading	Robotics will enable the remote or autonomous transfer of unpressurized cargo from visiting vehicles to Gateway to support station resupply activities even during unmanned periods in the mission.
7) Vehicle/Module relocation between ports	A robotic arm allows for a flexible configuration of the Cis-lunar Habitat by providing the ability to relocate modules and vehicles to manage and optimize the occupied nodes.
8) Visiting vehicle inspection	The ability to position the tip of a robotic arm with cameras and/or sensors on the end can enable the in-flight inspection of critical regions on visiting vehicles (those designed for non-destructive re-entry to Earth) such as thermal protection surfaces.
9) Visiting vehicle unberthing and release	A robotic manipulator on the Habitat can provide the mission an alternate/backup capability to direct undocking of visiting vehicles.

Robotic Functions	Rationale & Value Added to Mission
Extra-Vehicular Activity (EVA) support	
10) EVA viewing and monitoring	The ability to position the tip of a robotic arm with cameras and/or sensors on the end can provide mission managers (on the Earth), public relations, and the EVA crew themselves a birds-eye-view of the activities for improved situational awareness.
11) Direct EVA support for planned and unscheduled Outpost maintenance	As has been demonstrated with over 30 years of space shuttle and international space station operations, manifesting a robotic arm can provide the crewed phases of the mission with an efficient, reconfigurable, and stable EVA platform.
Extra-Vehicular Robotic (EVR) Maintenance and Logistics Operations	
12) Relocation of modules	The use of robotics to conduct the replacement of external ORUs offers the ability to reduce the demand for EVA during crewed phases and enable continued maintenance of the facility during un-crewed phases.
13) Relocation of sensor (e.g. rendezvous sensor) packages	Using a manipulator to relocate rendezvous sensor packages between the various Cis-lunar habitat docking ports enables efficient reuse of mass where, rather than integrating a rendezvous sensor on each visiting vehicle, a single sensor system can be manifested on the habitat and used to support rendezvous of all visiting vehicles to each of the docking ports.
14) Launching of science payloads	The ability to perform controlled ejection of components in any direction provides the mission the ability an option for Habitat waste management as well as to offer the capability to deploy microsatellites (delivered to Cis-lunar via visiting vehicles) to deep space.
15) Jettisoning spent components	The ability to perform controlled jettisoning of components in any direction provides the mission an option for Habitat waste management. I.e. rather than storing waste within the volume-limited habitable environment of the Cis-lunar vehicle, a vehicle airlock can be used to transfer waste containers to the external environment for the manipulator to retrieve and dispose of.
Support to lunar missions	
16) Transfer dirty samples to Outpost airlock	The mission is seeking to have a geological sample from the moon returned to the Cis-lunar Transit Habitat by a robotic spacecraft. The sample is located within a canister or container that can be removed using the robotic manipulator. In this scenario, the robotic manipulator grapples the sample container and removes it from the robotic lunar lander. The robotic manipulator then moves the sample container to an airlock which allows the Cis-lunar Transit Habitat crew to then access the sample container from within the pressurized habitat environment.

E ACRONYMS AND ABBREVIATIONS

AD	Applicable Document
AI	Action Items
AIL	Action Items Log
BIP	Background Intellectual Property
CA	Contract Authority
CASCA	Canadian Astronomical Society
CDRL	Contract Data Requirements List
CM	Configuration Management
ConOps	Concept of Operations
CSA	Canadian Space Agency
CWBS	Contract Work Breakdown Structure
DID	Data Item Description
DSXR	Deep Space Exploration Robotics
FIP	Foreground Intellectual Property
GFE	Government Furnished Equipment
GS	Ground Segment
GSE	Ground Support Equipment
ICD	Interface Control Documents
IP	Intellectual Property
ISS	International Space Station
IVR	Intra-Vehicular Robotics
KoM	Kick-off Meeting
LEOP	Launch and Early Operations
LRP	Long Range Plan
LV	Launch Vehicle
MAR	Mission Assurance Requirements
MCR	Mission Concept Review
MDP	Mission Development Plan
MM	Mission Manager
MRD	Mission Requirements Document
MRR	Mission Requirements Review
NASA	National Aeronautics and Space Administration
OGD	Other Government Departments
OpRR	Operation Requirement Review
PA	Product Assurance

PFR	Performance and Functional Requirements
PM	Project Manager
RD	Reference Document
RID	Review Items Discrepancy
SLA	Stereolithography
SOW	Statement Of Work
TA	Technical Authority
TB	Treasury Board
TBC	To Be Confirmed
TBD	To Be Determined
TRRA	Technology Readiness and Risk Assessment
TRL	Technology Readiness Level
TRM	Technology Roadmap
WBS	Work Breakdown Structure
WPD	Work Package Description
XML	Extensible Markup Language

Attachment 1 to Part 3

Technical and Managerial Bid Preparation Instructions

9F050-160946/A

General Information

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 in the following order:

1. Title/Project Identification Page (see 3A.1);
2. Table of Contents (see 3A.2);
3. Relevance Criteria (see 3A.3);
4. Technical Criteria (see 3A.4);
5. Managerial Criteria (see 3A.5);
6. 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 the bid submitted by a Bidder.

3A.1 Title/Project Identification Page

The first page of the bid submitted should state the following information:

a) The Request For Proposal file number (DSXR 9F00xx-xxxxxx)
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).

3A.2 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.3 Relevance Criteria

The Bid should describe the proposed project as outlined in the following subsections.

3A.3.1 Relevance and Merit of the Concept (Evaluation Criterion 1)

This subsection should describe the concept in detail, and provide substantiated evidence describing the relevance and merit of the proposed concept with respect to the scope of work presented in the SOW. The description should include an understanding of the stated performance and functional requirements with explanations as to how the proposed solution would achieve the stated requirements. In doing so, this section should describe the degree of relevance the proposed concept has with the Bidder's technology. The relevance of the proposed concept will consider the components selected including their suitability, design, maturity levels, and space heritage or path to spaceflight.

3A.4 Technical Criteria

3A.4.1 Feasibility of Achieving Goals and Technical Objectives (Evaluation Criterion 2)

In this subsection, the Bidder should provide a description and overall feasibility assessment of the proposed approach and the degree to which it is capable of delivering the goals and technical objectives.

The proposed effort should be well presented and substantiated through well-conceived and feasible concepts and methods to obtain the desired technical results. The bid should explain and substantiate that the overall scenario is valid and demonstrate that the proposed concept is based on a reasonable technology development plan or on well proven technology. Details on technology readiness are provided in The CSA Technology Readiness Levels and Assessment Guidelines and the Technology Readiness Levels Handbook for Space Applications.

3A.4.2 Understanding the Requirements and Technical Principles (Evaluation Criterion 3)

In this section, the Bidder should provide an overview of the technical methodology and its correlation with the main activities of the work-plan. The methodology outlined in this section should describe how the work would be conducted using analytical methods, procedures, techniques, industry standards, best practices, and the state-of-the-art for pertinent disciplines.

The Bidder should also elaborate on and substantiate the proposed methodology while referring to the main activities of the work-plan described in the body of the bid and

appearing in the Work Breakdown Structure (WBS). The effectiveness of the methodology and its correlation to the work-plan should be explained and substantiated in this section.

This section should identify and substantiate in detail the underlying requirements and the technical principles and knowledge necessary to realize the proposed concept. It should thoroughly demonstrate an understanding of these requirements and principles. The bid should include a presentation of proposed concept and operations requirements that will be addressed by the proposed activities and objectives, and their relationship to the overall objectives. A thorough review of the existing literature to the central theme of the proposed concept should be provided.

3A.4.3 Scope of the Study (Evaluation Criterion 4)

The section should address the scope and aspects of the proposed study in relation to what is specified in the statement of work. It should provide a detailed description and substantiation of the approach for the Phase 0 development including a conceptual design of potential systems and subsystems, and a description of the operation concept.

3A.5 Management Criteria

3A.5.1 Team Capability (Evaluation Criterion 5)

3A.5.1.1 Team Expertise

This subsection should identify the Project Manager and Technical Lead, and outline their respective qualifications. It should identify the key members of the project's technical, scientific and management teams and state the specific qualifications for the work required. Detailed résumés are to be included in an appendix in Section I of the Bid. Provisions for back-up personnel for key positions are to be stated.

3A.5.1.2 Team Organization and Arrangements

This subsection should outline the roles and responsibilities of the proposed team members, and discuss and highlight the unique expertise that they offer with respect to the capability of the team. This subsection should also provide detailed roles and responsibilities of the key human resources. An organization chart should illustrate the structure of the proposed project team.

3A.5.1.3 Previous Project Experience

The Bidder should identify any previous experience with projects of a similar scope as the one proposed, including any projects undertaken with the CSA or other institutions. The Bidder should list previous projects and assignments undertaken, within the last five years, which are relevant to the proposed scope of work. The Bidder should identify any

team members in the current Bid that participated in those other projects and describe the nature of their contributions.

Note: The Bidder may describe as many previous projects as it feels are necessary to demonstrate the experience and qualifications of the company and of the proposed team, as long as the Bid length is not exceeded.

3A.5.2 Project Management Plan (Evaluation Criterion 6)

This subsection describes the Management Plan that will be retained to deliver the project, and to do so in the most effective manner.

The Management Plan should contain, as a minimum, the following information: Work Breakdown Structure, WP definition, personnel allocation, managerial risk assessment, milestones, deliverables, schedule, and project control system.

The Management Plan's presentation should be based on management tools most applicable to the proposed project, such as scope planning (WBS), schedule development charts (e.g. Gantt chart, etc.). Equivalent company-developed, project-tailored tools/charts are also acceptable, provided that the information is complete.

3A.5.2.1 Work Package Definition

This Management Plan subsection should define and specify the work to be executed according to the requirements of this SOW. The project should be broken down into Work Packages (WPs). Each WP should focus on specific activities that will form the total project and, as a minimum, should define and describe the specific work to be carried out and indicate: the person responsible, the WP's associated levels-of-effort and required resources, the schedule (start and finish dates), the risks, and the associated deliverables or outputs.

WPs stem from the WBS. The WBS should be taken to a low enough level and the associated WP should be defined in sufficient depth for the Bidder to demonstrate a clear understanding of the process to be followed to carry out the project. As a guideline, Table 1 of this attachment presents a sample Work Package Definition Sheet and Figure 1 provides a sample Work Breakdown Structure.

Table 1: Example of Work Package Definition Sheet

Project: Novel 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 Bid, indicate value 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		
Objectives: 1. Deliver a functional test setup for the T/R unit			
Inputs: 1. Test plan and procedure 2. Unit drawings 3. Unit Interface Control Documents			
Tasks: 1. Review input documentation 2. Define requirements 3. Produce initial concept 4. Design test setup 5. Fabricate test setup 6. Commission and debug			
Outputs and Deliverables: 1. Fully functional T/R unit test setup 2. Test setup log manual 3. Test setup user manual			

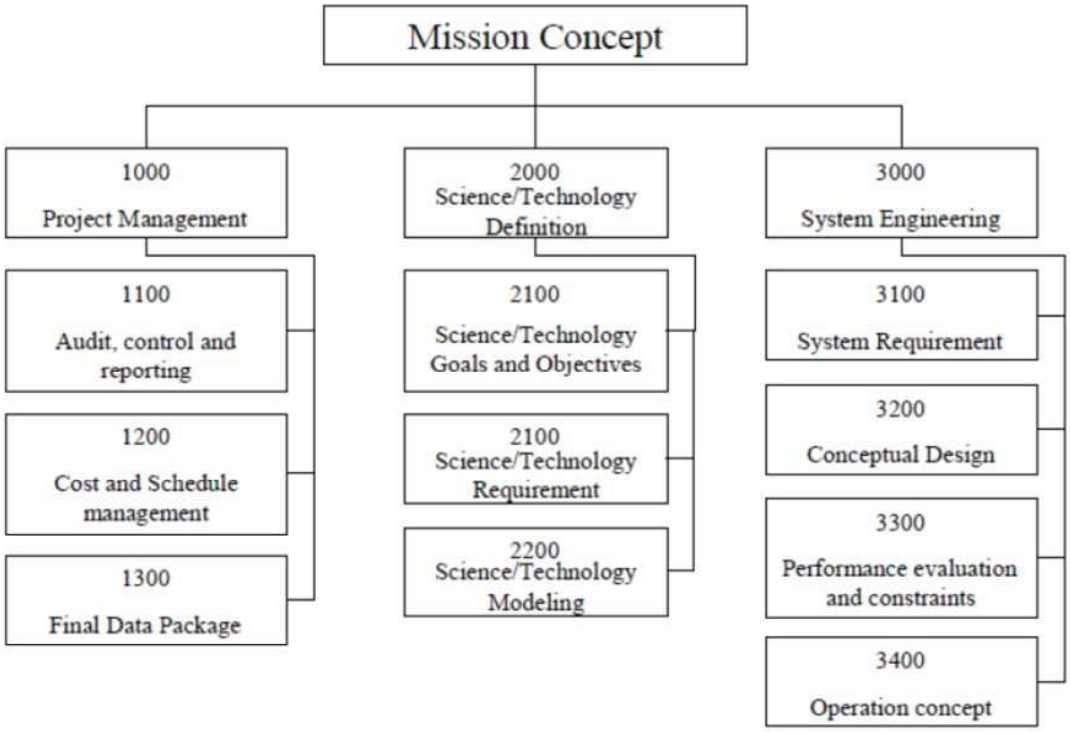

Figure 1: Example of a Work Breakdown Structure

3A.5.2.2 Resource Allocation -

This Management Plan subsection should include a resource assignment matrix showing the level-of-effort for each individual team member that has been apportioned to each WP. The matrix should identify each individual by name, and provide the estimated time (number of hours or days) required to complete each task. As a guideline, Table 2 of this attachment presents a sample of a Resource Allocation Matrix (RAM). The RAM should be presented in the Managerial Bid.

Table 2: Example of Resource Allocation Matrix

WBS number	Work Pack 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
	Total		475		725		625	1825

P: Participant
A: Accountable

3A.5.2.3 Managerial Risk Assessment

This Management Plan subsection should provide an assessment of the managerial risks involved in performing the work for the concept study, and identify critical issues that may jeopardize successful completion of the project within cost and schedule constraints.

3A.5.2.4 Milestones and Deliverables

Milestones and deliverables should be detailed in accordance with what is specified in the Statement of Work

3A.5.2.5 Schedule

This Management Plan subsection should relate tasks, milestones and deliverables to a project timetable. For planning purposes, the project expected start date is August 1st, 2017.

3A.5.2.6 Project Control System

This Management Plan subsection should outline the methods and systems to be used to control tasks, schedules, and costs for the project. Any project management tool or a spreadsheet software package may be used as long as it contains, as a minimum, the information required in the Monthly Progress Report (DID-107). Additionally, the Project Control System should provide the capability to report the amount of work per WBS item for each individual on a monthly basis.

3A.6 Bid Appendices

The following items should be addressed in individual appendices as part of the Bid.

3A.6.1 Appendices Required with the Bid

1. List of acronyms used in the Bid;
2. Bidder's Criteria Substantiation (see Attachment 1 to Part 4, Section 4A.2);
3. Résumés: The Bid should include résumés (and/or NSERC form 100) of all key resources proposed and these should be appended to Section I;
4. List of Contacts: The list of contacts should be appended to Section I, in a format suitable for distribution and should include all of the Bidder's points-of-contact involved in the Bid development and/or contract negotiations. The following example format should be used:

Table 3: Sample List of Contacts

Role	Name	Telephone	Fax	E-mail
Project Manager				
Project Engineers/ Principal Investigator				
Contracting Authority				
Claims officer				
Communications (for press release)				
Etc.				

3A.6.2 Applicable Bid Appendices

The following Bid appendices are to be provided, *if applicable*, with Section I:

1. Corporate literature: Only literature that is relevant and will be useful to support the Bid;
2. Relevant technical and/or scientific papers published by team members;
3. Any other Bid appendices deemed appropriate by the Bidder.

Bidders are reminded that the Bid should not exceed 50 pages excluding appendices

Attachment 1 to Part 4

Evaluation Criteria for the Technical and Managerial Bid

9F050-160946/A

4A.1 Mandatory Criteria

This criteria is deemed mandatory by CSA as the minimum necessary competence and capability for undertaking the work. The Mandatory requirement is evaluated on a pass or fail basis and will be evaluated very strictly as to compliancy. Therefore, no rating is associated with the criteria. Proposals not meeting the mandatory criteria will be deemed non-responsive.

M1: The Bidder and/or its subcontractors, if any, must have demonstrated experience that is relevant to the Work. In order to do so, the Bidder and/or its subcontractors, if any, must have experience in the user/mission requirements definition, system requirements definition, design, manufacture, test and successful operation of a minimum of one (1) system of similar or greater complexity over the last thirty (30) years. Similar complexity is understood as a physical system (complex hardware and software) that is rated for operations in space, or in environments or applications requiring very high reliability and that is subject to stringent safety/assurance requirements (e.g. complex military systems, aeronautical systems, or applications in the nuclear industry).

The Bidder must provide the following two items.

1. Project Description: The Bidder must describe one or more projects the Bidder has led and/or managed to demonstrate how each category of experience was acquired:
   - User/Mission requirements definition
   - System requirements definition
   - Design development
   - Manufacture and Assembly
   - Testing
   - Successful operations

2. Project Complexity: The Bidder must describe the project complexity for the project/projects described. Project complexity is defined by the Government of Canada through the Project Complexity and Risk Assessment (PCRA) Tool. Information on the tool can be found here:

https://www.canada.ca/en/treasury-board-secretariat/services/information-technology-project-management/project-management/project-complexity-risk-assessment-tool.html

For purposes of this evaluation criterion, the bidder must demonstrate complexity of the described project or projects by providing an assessment of the project(s) in key areas. Fifteen questions of the 64 questions were extracted from the PCRA tool that were deemed applicable for purposes of this criteria. Table 1 tabulates the questions. DSXR rating, as assessed by CSA, is provided as information only..

The Bidder's project(s) must meet or exceed the minimum rating for each question specified in Table 1 for each Knowledge Area. For each Knowledge Area, the Bidder must provide supporting rationale.

More than one project may be used to satisfy this experience requirement.

The project must not be a project in which software development was the primary and only deliverable.

Table 1. Project Description Complexity Assessment.

The Bidder should consult the PCRA Tool information webpage for clarifications associated with each question.

Knowledge Area	Question	Ratings	DSXR (for info and example)	DSXR Rationale (for info and example)	Minimum that the Bidder's project should meet	Bidder's project (add columns for other projects)	Rationale
Cost	1. What is the total project cost	1 = $1-5 million 2 = $5-10 million 3 = $10-25 million 4 = $25-100 million 5 = over $100 million	5	Current rough order magnitude estimates indicate DSXR is in a category of "Major Crown Project	4		
	2. What percentage of the total project cost estimate is for procurement?	1 = No procurement is required. 2 = under 25 per cent 3 = 26-50 per cent 4 = 51-75 per cent 5 = over 75 per cent	5	From Canada's perspective, procurement is >75%	2 (Bidder's perspective would include subcontracts)		
Investment portfolio management	3. Relative to the average project in your organization, which of the following adjectives describes the total project cost estimate?	1 = Small 3 = Medium 5 = Large	5	DSXR is considered a large project compared to other projects at the CSA.	3		
Human resources	4. How many people (part-time or full-time on the project,	1 = under 10 2 = 10-25 3 = 26-100	4	It is expected DSXR will require a large number of people at	3		

	including Government of Canada employees and individual contractors) are required to complete this project at its peak activity?	4 = 101-250 5 = over 250		its peak activity, including contractors given the large number of subsystems.			
Time	5. From project definition to project close-out, what is the expected duration of the project?	1 = under 12 months 2 = 12-24 months 3 = 24-36 months 4 = 36-48 months 5 = over 48 months	5	Current rough order magnitude schedule information show this project would require more than 5 years to complete.	4		
Time	11. Is the project susceptible to time delays? Time delays can have a number of causes, such as the following: a.Changes in technology; b.Requirements of participating organizations; c.Seasonal considerations; d.The need for policy approvals; and e.External influences.	1 = No, the project is not susceptible. 3 = Yes, the project is moderately susceptible; time delays will have minor effects on the schedule. 5 = Yes, the project is highly susceptible; time delays will have major effects on the schedule.	5	DSXR project is highly susceptible to time delays, on technical and programmatic aspects. Technical: highly dependent on parts procurement, testing, integration, interface definition with external stakeholders. Programmatic: highly dependent on approvals, agreements, international partnership, and external influences.	3		
Time	14. Are there any socio-economic considerations that	1 = No 5 = Yes	5	At this time, regional benefits is a consideration that	1		

	must be taken into account?			will need to be taken into account.			
Time	18. Do health and safety requirements add significant complexity to the requirements for this project?	1 = No 5 = Yes	5	DSXR will be associated with a human spaceflight and will be subject to safety requirements that will introduce significant complexity.	5		
Scope	50. How many of the following statements are true? a.The project solution requires a high degree (greater than normal) of availability. b.The project solution requires customization beyond normal configuration. c.The project solution requires a high degree of performance quality. d.The project solution requires a high degree of reliability.	1 = None of the statements are true. 2 = One of the statements is true. 3 = Two of the statements are true. 4 = Three of the statements are true. 5 = All of the statements are true.	5	All statements apply for DSXR. In support of a deep-space habitat (with and without humans present), DSXR will be required to be available, reliable, and its design (hardware/software) will be customized to meet the specific requirements of the mission.	4		
Scope	51. In defining project requirements, how many of the following statements are true? a.The requirements can be defined with very few people. b.The requirements can be defined in a short period of time. c.There are a small number of individual	1 = Four of the statements are true. 2 = Three of the statements are true. 3 = Two of the statements are true. 4 = One of the statements is true.	5	None of the statements are true for DSXR. For example: DSXR has many subsystems, is subject to various environments,will have many data and telemetry needs, and many interfaces. All of which require detailed definition	4		

	requirements to define. d.The requirements do not require a high degree of detail.	5 = None of the statements are true.		and involvement of many technical disciplines and subject matter experts.			
Investment portfolio management	58. Are any other projects dependent on outputs or outcomes of this project?	1 = No 5 = Yes	5	Yes. DSXR is a potential contribution to a larger international initiative.	5		
Investment portfolio management	59. Are outcomes of this project dependent on the outputs and/or outcomes of any other projects?	1 = No 5 = Yes	5	Yes. DSXR is a potential contribution to a larger international initiative and as such is dependent on that initiative to define interfaces for example.	5		
Scope	60. What degree of integration with externalities, such as other projects, systems, infrastructure, or organizations, is required?	1 = There are few complex integration requirements; activities to specify integration are included in the project management plan. 3 = There is adequate understanding and planning for integration. 5 = There are highly complex or numerous integration requirements and	5	DSXR, both technically and programmatically, has numerous and complex integration requirements. In the current Phase of DSXR, the current solicitation will advance the planning of required activities. Integration with externalities includes with International partners, ground and in-space infrastructure.	3		

		insufficient planning of required activities.					
Scope	61. What degree of integration is required within the project?	1 = There are few complex integration requirements; activities to specify integration are included in the project management plan. 3 = There is adequate understanding and planning for integration. 5 = There are highly complex or numerous integration requirements and insufficient planning of required activities.	5	DSXR, has many internal elements which require integration. These include ground infrastructure, between DSXR tools and robotic interfaces, and between technical and programmatic subject matter experts.	3		
Scope	62. Relative to the average (typical) project in your organization, which of the following adjectives describes the number of tasks, elements, or deliverables in the	1 = Small 3 = Medium 5 = Large	5	DSXR will have large number of tasks and deliverables in the work breakdown structure primarily owing to the breadth of the system and subsystems as well as the disciplines that will be involved.	3		

	work breakdown structure?						

4A.2 Point Rated Criteria

The Bidder must achieve the minimum score requirement 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.4: Evaluation Criteria and Benchmark Statements.

The criteria are grouped under the following divisions:

1) Relevance;
2) Technical; and
3) Management

Section 4A.4 "Evaluation Criteria and Benchmark Statements" of the current attachment contains a series of evaluation criteria, each supported by a set of 5 benchmark statements (0, A, B, C, D). Each of these statements has a corresponding value:

0 = 0% of the maximum point rating

A = 25% of the maximum point rating

B = 50% of the maximum point rating

C = 75% of the maximum point rating

D = 100% of the maximum point rating

As an example, the maximum point rating for the "Understanding the Requirements and Technical Principles" criterion is 20 points. If a Bid receives a "C" for this criterion in the evaluation process, the score attributed will be:

75% of 20 points = 15 points (score)

Table 4A.1 identifies:

1. The maximum point rating assigned to each criterion;
2. The maximum point rating possible for each division (Relevance, Technical, and Management);
3. The maximum point rating possible for the overall score;
4. The minimum point rating required for the overall score.

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

	Ratings
Relevance Criteria	
1. Relevance and Merit of the Concept	20
Minimum Score Requirement	***10***
Technical Criteria	
2. Feasibility of Achieving Goals and Technical Objectives	20
Minimum Score Requirement	***10***
3. Understanding the Requirements and Technical Principles	20
Minimum Score Requirement	***10***
4. Scope of the Study	20
Minimum Score Requirement	***10***
Management Criteria	
5. Team Capability	10
Minimum Score Requirement	***5***
6. Project Management Plan	10
Minimum Score Requirement	***5***
Minimum Overall Score Requirement	***60***
Maximum Score	***100***

4A.3 Bidder's Criteria Substantiation

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

The substantiation should be concise yet sufficiently complete to give the evaluators a good overall appreciation of the bid's merit relative to each criterion. Cross-references to appropriate sections of the bid should be provided and the essence of the referenced information should be summarized in the substantiation.

For convenience, a template for the Substantiation Table is provided in Table 4A.2 below. Enter each relevance/technical and management criterion section number, and the substantiation. Approximately half a page should be sufficient to make the Bidder's case for the rating assigned in the substantiation column.

Table 4A.2: Bidder's Criteria Substantiation.

Company: **Project Title:.**	
Criteria **Substantiation**	
Ex.: 1 *(criterion number)*	*Criterion substantiation and Bidder's bid cross-reference.* *Approximately 300 words should be sufficient to make the case.*

4A.4 Evaluation Criteria and Benchmark Statements

RELEVANCE CRITERIA

Criterion 1 - Relevance and Merit of the Concept

This criterion evaluates the relevance and merit of the proposed concept relative to the scope of work presented in the SOW. Furthermore, this criterion assesses the degree to which the bid shows the proposed technology can achieve technical compliance.

0)
- The relevance and merit of the proposed concept are not addressed

A)
- The relevance and merit of the proposed concept are only partially addressed and not substantiated; OR
- Addresses the technology but does not show an understanding of the driving needs, nor does it demonstrate how the proposed technology will contribute to meeting the stated requirements.

B)
- The relevance and merit of the proposed concept are addressed and partially substantiated; AND
- The proposed technology demonstrates a capacity to meet requirements

C)
- The relevance and merit of the proposed concept are addressed and substantiated; AND
- The proposed technology demonstrates a capacity to meet all of the requirements, AND
- The proposed technology items are either based on a concept proven in space or a very high reliability/safety/assurance environment with a credible path to space.

D)
- The relevance and merit of the proposed concept are addressed in detail and well substantiated; AND
- The proposed technology demonstrates the capacity to meet all of the requirements; AND
- The proposed technology items are components and concepts proven either in space or a very high reliability/safety/assurance environment with a credible path to space.

Technical Criteria

Criterion 2 – Feasibility of Achieving Goals and Technical Objectives

This criterion assesses the description and overall feasibility of the proposed approach and the degree to which it is capable of delivering the goals and technical objectives. This includes the compatibility of the technology selected and incorporation into the proposed design to address the technical requirements and enhancements. This criterion evaluates the technical risks associated with the eventual integration and implementation of the concept, and assesses whether the proposed effort is well documented and substantiated.

0)

- The feasibility of achieving the goals and technical objectives is not demonstrated

A)

- The bid does not present an adequate case with system(s) that can deliver the technical objectives; OR
- The proposed concept can obtain the desired technical results, but gaps exist.; OR
- Main elements of a preliminary technology development road map are lacking to meet the basic technical requirements.

B)

- The bid presents an adequate case with system(s) that can deliver the technical objectives; AND
- The proposed concept can obtain the desired technical results, but some important details or information are omitted; AND
- Some elements of a preliminary technology development road map are lacking, in order to meet the basic technical requirements.

C)

- The bid presents a well-referenced case with system(s) that can deliver the technical objectives; AND
- The proposed concept displays feasible and valid concepts and methods that can achieve the desired technical results with details; AND
- Main elements of a preliminary technology development road map are presented to meet the basic technical requirements and enhancements of the study.

D)

- The bid presents a well-referenced and convincing case with system(s) that can undoubtedly deliver the technical objectives. AND
- The proposed concept relies on well proven technology with one or more components having space flight heritage and is substantiated with ample details; AND

- A preliminary technology development roadmap is presented to meet the basic technical requirements and enhancements of the study.

Criterion 3 - Understanding the Requirements and Technical Principles

This criterion assesses the degree to which the Bid identifies and substantiates in detail the underlying requirements and technical principles and also to what extent it demonstrates a thorough understanding of these requirements and principles as presented in Annex A – Statement of Work

0)

- The bid does not address the requirements, OR
- The bid does not identify the technical principles driving the proposed concept.

A)

- The bid includes an incomplete overview of the main requirements; OR
- The bid demonstrates incomplete knowledge of the technical principles relevant to the goal of the study; OR
- The bid does not identify how the objectives will help in further defining these requirements; OR
- The bid does not include an adequate review of the existing literature or that of previous relevant technology.

B)

- The bid includes only an overview of the main requirements; AND
- The bid exhibits a general understanding of the requirements and principles; AND
- The bid includes a cursory review of and references to existing literature or that of previous work relevant to the central theme of the proposed concept.

C)

- The bid identifies and demonstrates an understanding of the main requirements; AND
- The bid demonstrates knowledge of the technical principles relevant to the goal of the study; AND
- The bid includes a presentation of the proposed concept and operations requirements that will be addressed by the proposed activities and objectives; AND
- The bid includes references to and a discussion of other work or previous activities relevant to the central theme of the proposed concept.

D)

- The bid includes an exhaustive identification and understanding of the requirements; AND
- The bid demonstrates a comprehensive knowledge of the technical principles relevant to the goal of the study; AND
- The bid includes a presentation of proposed concept and operations requirements that will be addressed by the proposed activities and objectives, and their relationship to overall objectives; AND

- The bid refers to and discusses thoroughly existing literature relevant to the central theme of the proposed concept.

Criterion 4 - Scope of the Phase 0 Study

The criterion assesses the description and overall scope of the proposed Phase 0 Study.

0)
- The bid does not address the scope and the aspects of what is requested in the SOW; OR
- The bid does not provide a description of the approach for the Phase 0 development.

A)
- The bid addresses the scope and the aspects of what is requested in the SOW, but gaps exist; OR
- The bid does not provide a description of the approach for the Phase 0 development.

B)
- The bid addresses the scope and the aspects of what is requested in the SOW with minor or no gaps; AND
- The bid provides a description of the approach for the Phase 0 development, but either gaps exit or they are not relevant.

C)
- The bid addresses the full scope and aspects of what is requested in the SOW; AND
  The bid provides a description and substantiation of a relevant approach for the Phase 0 development.

D)
- The bid addresses the full scope and aspects of what is requested in the SOW; AND
- The bid provides a detailed description and substantiation of a relevant approach for the Phase 0 development; AND
- The bid achieves the preliminary design of the proposed system and describes the operation concept.

MANAGEMENT CRITERIA

Criterion 5 - Team Capability

This criterion assesses the capability (education, knowledge, experience, expertise, and completeness of skill-sets in science, engineering, and management) of the personnel designated to carry out the Work.

0)

- The proposed team does not have the required expertise; OR
- The bid does not address this criterion

A)

- The proposed team has no experience in conducting work similar in complexity and scope to what is requested in the SOW; OR
- The proposed team lacks expertise and may not be capable of fulfilling the statement of work (SOW); OR
- The roles and responsibilities of the team members are not defined.

B)

- The key personnel identified in the proposed team have been involved in at least one project similar in complexity and scope to what is requested in the SOW; AND
- The proposed team is lacking some expertise but demonstrates that it is capable of fulfilling the statement of work (SOW); AND
- The team may have deficiencies in the overall skills of its members; AND
- Some team members have experience in the design and development of high reliability/safety/assurance hardware and software in a similar environment as described in the relevant SOW.

C)

- The key personnel identified in the proposed team have been involved in at least two projects similar in complexity and scope to what is requested in the SOW; AND
- The expertise of the proposed team demonstrates that it is highly capable of fulfilling the statement of work (SOW); AND
- The completeness of the team is very well demonstrated through the complementary skills of its members and by the roles / tasks that they are assigned during the concept study; AND
- The roles and responsibilities for most of the team members, including sub-contractors, are defined; AND
- Most of the required key personnel are identified and there are qualified back-up personnel identified for most of them; AND
- The key personnel have experience in the design and development of or high reliability/safety/assurance hardware and software in a similar environment as described in the relevant SOW.; AND
- At least one key personnel has extensive experience with space-rated hardware or operations.

D)

- The key personnel identified in the proposed team have been involved in more than two projects of similar complexity and scope to what is requested in the SOW; AND
- The supporting skill sets of team members is fully identified and assigned; AND
- The expertise of the proposed team demonstrates that it is highly capable of fulfilling the statement of work (SOW) with the potential of delivering an authoritative concept; AND
- The roles and responsibilities of all the team members, including all sub-contractors, are defined; AND
- The completeness of the team is very well demonstrated through the complementary skills of its members and by the roles / tasks that they are assigned during the concept study; AND
- All required key personnel are identified and there are qualified back-up personnel identified for all of them; AND
- The key personnel have significant experience in the design and development of space flight hardware and software in a similar environment as described in the relevant SOW.

Criterion 6 - Project Management Plan

This criterion assesses the completeness of the management plan (including WBS, WPs, personnel allocation, detailed schedule and milestones, and managerial risk assessment) and evaluates the effectiveness of the described methodology in successfully achieving the stated objectives of the work to carry out this study.

0)

- The work-plan does not follow a methodological approach and is unlikely to achieve the appropriate objectives; OR
- The bid does not address this criterion

A)

- The bid presents a poor work-plan; OR
- The proposed methodology is not effective in achieving the objectives of the work; OR
- There is a lack of correlation between the work-plan and the management method; OR
- Risks are not identified

B)

- The bid presents a basic work-plan; AND
- The proposed methodology is effective in achieving the objectives of the work; OR
- There is a lack of correlation between the work-plan and the management method; OR
- Risks are identified but mitigation strategies are insufficient.

C)

- The work-plan as described in the bid is based on a methodological approach; AND
- The effectiveness of the proposed methodology to achieve the objectives of the work is credible; AND
- The correlation between the work-plan and the management method exists; AND

- Risks are identified and mitigation strategies are discussed.

D)

- The work-plan as described in the bid follows a clearly defined methodology; AND
- The effectiveness of the proposed methodology to achieve the objectives of the work is highly credible; AND
- The correlation between the work-plan and the management method is clear; AND
- Risk analysis and mitigation strategies are provided;

ATTACHMENT 1 TO PART 5

FEDERAL CONTRACTORS PROGRAM FOR EMPLOYMENT EQUITY – CERTIFICATION
(For requirements estimated at** $1,000,000 and above**, Applicable Taxes included)

9F050-160946/A

I, the Bidder, by submitting the present information to the Contracting Authority, certify that the information provided is true as of the date indicated below. The certifications provided to Canada are subject to verification at all times. I understand that Canada will declare a bid non-responsive, or will declare a contractor in default, if a certification is found to be untrue, whether during the bid evaluation period or during the contract period. Canada will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply with any request or requirement imposed by Canada may render the bid non-responsive or constitute a default under the Contract.

For further information on the Federal Contractors Program for Employment Equity visit Employment and Social Development Canada (ESDC) – Labour's website.

Date:_____(YYYY/MM/DD) (If left blank, the date will be deemed to be the bid solicitation closing date.)

Complete both A and B.

A. Check only one of the following:

( ) A1. The Bidder certifies having no work force in Canada.

( ) A2. The Bidder certifies being a public sector employer.

( ) A3. The Bidder certifies being a federally regulated employer being subject to the *Employment Equity Act*.

( ) A4. The Bidder certifies having a combined work force in Canada of less than 100 permanent full-time and/or permanent part-time employees.

A5. The Bidder has a combined workforce in Canada of 100 or more employees; and

( ) A5.1. The Bidder certifies already having a valid and current Agreement to Implement Employment Equity (AIEE) in place with ESDC-Labour.

OR

( ) A5.2. The Bidder certifies having submitted the Agreement to Implement Employment Equity (LAB1168) to ESDC-Labour. As this is a condition to contract award, proceed to completing the form Agreement to Implement Employment Equity (LAB1168), duly signing it, and transmit it to ESDC-Labour.

B. Check only one of the following:

( ) B1. The Bidder is not a Joint Venture.

OR

( ) B2. The Bidder is a Joint venture and each member of the Joint Venture must provide the Contracting Authority with a completed annex Federal Contractors Program for Employment Equity - Certification. (Refer to the