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Core 0B2 / Noyau 0B2

Attn: Indra Hamilton

Gatineau

Québec

K1A 0S5

**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**  
Electronics, Simulators and Defence Systems Div.  
/Division des systèmes électroniques et des systèmes de  
simulation et de défense  
11 Laurier St. / 11, rue Laurier  
8C2, Place du Portage  
Gatineau  
Québec  
K1A 0S5

|   |  |
|---|--|
| <b>Title - Sujet</b>  |  |
| Remotely Operated Vehicle (ROV) Sys                         |  |
| <b>Solicitation No. - N° de l'invitation</b>                | <b>Amendment No. - N° modif.</b>       |
| W8476-185848/A  | 002                                    |
| <b>Client Reference No. - N° de référence du client</b>     | <b>Date</b>                            |
| W8476-185848  | 2018-06-29                             |
| <b>GETS Reference No. - N° de référence de SEAG</b>         |  |
| PW-SSQF-030-26869   |  |
| <b>File No. - N° de dossier</b>                             | <b>CCC No./N° CCC - FMS No./N° VME</b> |
| 030qf.W8476-185848  |  |
| <b>Solicitation Closes - L'invitation prend fin</b>         |  |
| <b>at - à</b>   | <b>Time Zone</b>                       |
| <b>02:00 PM</b>   | <b>Fuseau horaire</b>                  |
| <b>on - le</b>  | <b>2018-08-10</b>                      |
| <b>EST</b>  |  |
| <b>F.O.B. - F.A.B.</b>                                      |  |
| <b>Plant-Usine:</b>   | <b>Destination:</b>                    |
| <input type="checkbox"/>                                    | <input type="checkbox"/>               |
| <b>Other-Autre:</b>   | <input type="checkbox"/>               |
| <b>Address Enquiries to: - Adresser toutes questions à:</b> |  |
| Hamilton, Indra   | <b>Buyer Id - Id de l'acheteur</b>     |
|   | 030qf                                  |
| <b>Telephone No. - N° de téléphone</b>                      | <b>FAX No. - N° de FAX</b>             |
| (819) 420-1738 ( )  | (819) 956-5650                         |
| <b>Destination - of Goods, Services, and Construction:</b>  |  |
| <b>Destination - des biens, services et construction:</b>   |  |

**Instructions: See Herein**

**Instructions: Voir aux présentes**

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

|   |  |                                      |
|---|--|--------------------------------------|
| Solicitation No. - N° de l'invitation<br>W8476-185848/A | Amd. No. - N° de la modif.<br>002              | Buyer ID - Id de l'acheteur<br>030QF |
| Client Ref. No. - N° de réf. du client<br>W8476-185848  | File No. - N° du dossier<br>030QF.W8476-185848 | CCC No./N° CCC - FMS No./N° VME      |

Solicitation W8476-185848/A, **Amendment 002** has been raised to include Annex C English

A new closing date of **August 10<sup>th</sup>, 2018** at 14:00 EDT applies.

Solicitation No. - N° de l'invitation  
W8476-185848  
Client Ref. No. - N de rf. du client  
W8476-185848

Amd. No. - N de la modif.  
File No. - N du dossier  
030qfW8476-185848

Buyer ID - Id de l'acheteur  
030qf  
CCC No./N CCC - FMS No./N VMIE

## ANNEX C

### TECHNICAL PROPOSAL REQUIREMENT AND BID EVALUATION

#### Remote Operated Vehicle (ROV)

This documents consists of this page plus thirty-two (32) additional pages

TECHNICAL PROPOSAL REQUIREMENTS  
AND BID EVALUATION  
FOR THE  
HIGH RISK SEARCH REMOTELY OPERATED VEHICLE SYSTEM



NOTICE

This documentation has been reviewed by the technical authority and does not contain controlled goods. Disclosure notices and handling instructions originally received with the document shall continue to apply.

AVIS

Cette documentation a été révisée par l'autorité technique et ne contient pas de marchandises contrôlées. Les avis de divulgation et les instructions de maintenance reçues originellement doivent continuer de s'appliquer.

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## 1.0 General

### 1.1 Introduction

1.1.1 This document is split in two parts and defines the criteria that will be used to determine the winning bid for the procurement of the High Risk Search Remotely Operated Vehicle System (HRS-ROV).

1.1.1.1 The first part, Technical Proposal Requirements, defines the information and samples required from the Bidders for their proposal to be evaluated.

1.1.1.2 The second part, Bid Evaluation, defines the evaluation process Canada will undertake, and describes the Evaluation Trial tests and items that will be evaluated.

## 2.0 Technical Proposal Requirements

### 2.1 Responding to Evaluation Criteria

2.1.1 Bidders must provide the information required for each listed requirement in accordance with the method identified in the "Compliance Documentation Required" column in the tables at 3.4 & 3.5.

2.1.1.1 The following compliance methods define the information required:

2.1.1.1.1 **Test Report (TR)** - Where "TR" is identified, the Bidder must provide a completed and detailed Test Report, including test procedures, data and results, for tests conducted on the equipment offered, to confirm it fully complies with the requirement.

2.1.1.1.2 **Compliance Statement (CS)** - Where "CS" is identified, the Bidder must describe in detail how the equipment offered fully complies with the requirement. Supporting documentation is requested but not essential.

2.1.1.1.3 **Draft (DR)** - Where "DR" is identified, the Bidder must provide a draft of the requested document to describe in detail how the equipment offered fully complies with the requirement.

2.1.2 For each listed requirement, the Bidder must provide a response in the "Bidder's Response/References" column in the tables at 3.4 & 3.5 to clearly explain how the requirement is met, either by including the specific reference to indicate where in their proposal the information is found or including the complete response directly in that column.

### 2.2 Evaluation Trial Bidder Samples and FSRs

2.2.1 Successful Bidders advancing to Phase 2 Evaluation Trial must deliver (and pickup after the trial) two (2) complete samples of each of the proposed Small ROV System and Large ROV System (one of the samples is a backup in case of unexpected failure), all at no cost to Canada.

2.2.1.1 As part of the Small ROV System and Large ROV System samples, the Bidders must include technical manual(s) (in English), but these need not be exactly as specified in the SOW.

2.2.2 The Bidders must deliver the samples no later than 45 calendar days after being informed of their successful results of Phase 1 – Evaluation of Key Mandatory Requirements, to the following address:

**Attn: Maurina Kimmen**

Prairie Agricultural Machinery Institute (PAMI)  
Highway #5 West, 2215 8th Avenue  
Humboldt, Saskatchewan, S0K 2A0, CANADA  
Tel: 306-682-5033(x256) Fax: 306-682-5080

2.2.2.1 The Bidders must supply samples that are pristine, although not necessarily new, and must not be pre-conditioned making it not representative of the systems that would be provided as part of the contract.

2.2.2.2 Bidders that do not provide two (2) complete samples, in the time allowed, will be deemed non-compliant and any partial sample(s) returned.

2.2.2.3 DND, through Public Service Procurement Canada (PSPC), will inform the Bidder(s) when samples are ready for pickup, and will pack the samples in the same manner as when they arrived.

2.2.3 The Bidders must provide no more than two (2) Field Service Representatives (FSR) for a two (2) day preparation, training, and testing period at PAMI.

2.2.4 The Bidder instruction and training will occur at the above address, where the samples were sent, on dates to be confirmed by the PSPC Contracting Authority (CA).

### **3.0 Bid Evaluation**

#### **3.1 Bid Selection Methodology**

3.1.1 It is Canada's desire to achieve an optimal capability at lowest possible cost. Therefore, a "Lowest Cost Compliant" approach will be employed for this acquisition process, and selection of the winning proposal will be based on the proposed lowest cost provided that meets all mandatory requirements.

3.1.2 PSPC CA will screen the bids for completeness, misplaced financial information and compliance with the general terms and conditions. The technical section of the compliant bids will then be provided to the Bid Evaluation Team for evaluation of technical compliance.

3.1.3 All valid bids will be evaluated against key mandatory requirements, detailed in this Annex C, based on the Bidder's supplied information and the evaluation trial results in order to determine technical compliance.

#### **3.2 Technical Evaluation of Compliance**

3.2.1 Phase 1: Evaluation of Key Mandatory Requirements

3.2.1.1 The evaluation team will use the Bidder's submitted proposal to determine compliance against key mandatory requirements. See the tables at 3.4 & 3.5 for more details.

3.2.2 Phase 2: Evaluation Trial

3.2.2.1 Testing and trials will be conducted using the complete samples supplied by Bidders having successfully moved onto Phase 2 Evaluation Trial.

3.2.2.2 Submitted samples will be utilized in accordance with the Original Equipment Manufacturers' recommended operating procedures and training provided by Bidders.

#### **3.3 Evaluation Trial**

3.3.1 The aim of the Evaluation Trial is to assess the performance of the submitted samples against the requirements identified in the tables at 3.6 & 3.7.

3.3.2 Canada will conduct the Evaluation Trial within the PAMI area, or at some other appropriate venue in Canada, under the supervision of DND.

3.3.3 Trial Personnel will include:

3.3.3.1 DND HRS-ROV Project Trials Officer(s).

3.3.3.2 DND/PAMI Subject Matter Experts.

3.3.3.3 Additional assistance to set up and monitor the trials will be provided by the DND TA as required.



3.3.4 Subject Matter Experts

3.3.4.1 Subjects will be drawn from experienced operators of similar equipment or members of the DND/PAMI scientific community.

3.3.5 Preparation, Training & Testing Period

3.3.5.1 Up to three (3) Subject Matter Experts will be provided.

3.3.5.2 The Bidders will each be allowed 11 hours (plus one hour for lunch) over a two (2) day period, as follows:

3.3.5.2.1 Day 1 – up to three (3) hours – Properly break-out the equipment from the packaging and prepare it for the next day.

3.3.5.2.2 Day 2 – up to eight (8) hours – Provide instruction in the correct use of the samples and perform equipment operation for certain tests in the trial.

3.3.5.3 The following sample trial schedule shows the schedule in a week:

|         | Monday  | Tuesday  | Wednesday  | Thursday   | Friday  |
|---------|---|--|--|--|---|
| 8:00am  |   | 1 <sup>st</sup> Bidder –<br>Training &<br>Testing  | 2 <sup>nd</sup> Bidder –<br>Training &<br>Testing  | 3 <sup>rd</sup> Bidder –<br>Training &<br>Testing  | 4 <sup>th</sup> Bidder –<br>Training &<br>Testing |
| 12:00pm | Lunch   | Lunch  | Lunch  | Lunch  | Lunch   |
| 1:00pm  |   |  |  |  |   |
| 2:00pm  | 1 <sup>st</sup> Bidder -<br>Meeting & Prep<br>for next day. | 1 <sup>st</sup> Bidder<br>Training &<br>Testing<br>2 <sup>nd</sup> Bidder -<br>Meeting & Prep<br>for next day. | 2 <sup>nd</sup> Bidder<br>Training &<br>Testing<br>3 <sup>rd</sup> Bidder -<br>Meeting & Prep<br>for next day. | 3 <sup>rd</sup> Bidder<br>Training &<br>Testing<br>4 <sup>th</sup> Bidder -<br>Meeting & Prep<br>for next day. | 4 <sup>th</sup> Bidder<br>Training &<br>Testing   |
| 5:00pm  |   |  |  |  |   |

**NOTE:** Overlapping areas on the schedule will not result in Bidders viewing each other's testing or equipment, as preparation area will be in a different area of the facility from the Training and Testing area.

3.3.6 Evaluation Trial Testing

3.3.6.1 See the tables at 3.6 & 3.7 for more details.

3.3.6.2 The following trial sequence shows the order the testing we expect the trial to follow. The order, outside of the portion done with the Bidder personnel, may change if required.

| Small ROV   |  | Large ROV   |  |
|---|--|---|--|
| Occurring during Bidder training and testing period | T3 – Mobility<br>(Operated by Bidder personnel)                      | T3 – Mobility<br>(Operated by Bidder personnel)                       |  |
|   | T6 – Drop-Charge Release Mechanism<br>(Operated by Bidder personnel) |   |  |
|   | T1 – Weight  | T1 – Weight   |  |
|   | T2 – Velocity<br>(Operated by Evaluator personnel)                   | T2 – Velocity<br>(Operated by Evaluator personnel)                    |  |
|   | T4 – Line of Sight<br>(Operated by Evaluator personnel)              | T6 – Manipulator Arm and Gripper<br>(Operated by Evaluator personnel) |  |
|   | T5 – Battery<br>(Operated by Evaluator personnel)                    | T4 – Line of Sight<br>(Operated by Evaluator personnel)               |  |
|   | T7 – Atmospheric<br>(Operated by Evaluator personnel)                | T5 – Battery<br>(Operated by Evaluator personnel)                     |  |
|   | T8 – Durability<br>(Operated by Evaluator personnel)                 | T7 – Mobile Comm Relay & Control<br>(Operated by Evaluator personnel) |  |
|   |  | T8 – Atmospheric<br>(Operated by Evaluator personnel)                 |  |

3.3.7 Assessment

3.3.7.1 Canada will assess each bidder's system, and results of all tests will be compiled by Technical Staff: DND Project Trials Officer(s) and Subject Matter Experts.

3.3.7.2 Results of compliance and non-compliance will be provided through PSPC CA.

### 3.4 Evaluation of Key Mandatory Requirements – Small ROV System

| Serial | Requirement Reference(s)  | Requirement Description   | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|---------------------------|---|--|------------------------------|--|------|
|        |                           |   |  |                              | "C"  | "NC" |
| M1     | ANNEX A – Para A1.1.1.1   | The Small Remotely Operated Vehicle System (Small ROV System) must be based on proven, fielded equipment, which is in-service with a North Atlantic Treaty Organization (NATO) or American, British, Canadian, Australian (ABCA) military partner or police agency of those countries.        | CS   |                              |  |      |
| M2     | ANNEX A – Para A1.1.3     | The Small ROV System must operate within either:<br><br>a. The commercial 2.4GHz bandwidth, or<br><br>b. The 4400-4900 MHz bandwidth (the 4800-4900MHz bandwidth section is currently the most open, so would be the preference) which is designated for Government of Canada use.            | CS   |                              |  |      |
| M3     | ANNEX A – Para A1.2.1.1.1 | The Small ROV must act as a mobile RF communication relay, in a mesh-type network, to assist with communication connection with other Small ROVs and Large ROVs in a non-line-of-sight, subterranean, or reinforced concrete buildings, or to extend the range in line-of-sight applications. | CS   |                              |  |      |
| M4     | ANNEX A – Para A1.2.1.2.2 | The Small ROV, not including the Drop Charge Release Mechanism, must have no less than an IP67 rating, or equivalent, IAW NEMA IEC 60529.   | TR   |                              |  |      |
| M5     | ANNEX A – Para A1.2.1.6.1 | The Small ROV must include a tactical rail meeting STANAG 4694 to provide an anchor point for payloads.   | CS   |                              |  |      |

| Serial | Requirement Reference(s) | Requirement Description  | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|--------------------------|--|--|------------------------------|--|------|
|        |                          |  |  |                              | "C"  | "NC" |
| M6     | ANNEX A – Para A1.2.1.7  | <b>Field of View</b><br><br>a. The Small ROV must have an <b>overall</b> front field of view with:<br>No less than a 60 degree horizontal field of view.<br>No less than a 120 degree vertical field of view.<br><br>If required, the vertical field of view range can be met by either the camera tilting, the Small ROV body tilting, or through a software-based tilt.<br><br>b. The Small ROV must have an <b>overall</b> rear field of view with:<br>No less than a 60 degree horizontal field of view.<br>No less than a 60 degree vertical field of view.<br><br>If required, the vertical field of view range can be met by either the camera tilting, the Small ROV body tilting, or through a software-based tilt. | CS   |                              |  |      |
| M7     | ANNEX A – Para A1.4.1    | <b>Climatic Conditions</b><br><br>The Small ROV and CCS components must operate in temperatures ranging from –19°C to +39°C.<br><br>The Small ROV and CCS components must operate in relative humidity ranging from 5% to 100%.  | CS   |                              |  |      |

| Serial | Requirement Reference(s)   | Requirement Description   | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|--|---|--|------------------------------|--|------|
|        |  |   |  |                              | "C"  | "NC" |
| M8     | ANNEX A – Para 4.3 & Annex D – Application for Spectrum Supportability | <p><b>Application for Spectrum Supportability</b></p> <p>For HRS-ROV Large ROV System and Small ROV System RF component (Transmitting and Receiving), the Contractor must provide the <b>Application for Spectrum Supportability</b> IAW CDRL HRS-ROV-ILS-202 at Appendix A4.7 and its associated DID HRS-ROV-ILS-202 at Appendix A5.7 to this ANNEX A and ANNEX D – Application for Spectrum Supportability.</p> <p>Information within the Application for Spectrum Supportability will be used to verify compliancy of ANNEX A SOW para. 4.3.1.1.</p> | DR   |                              |  |      |

### 3.5 Evaluation of Key Mandatory Requirements – Large ROV System

| Serial | Requirement Reference(s)  | Requirement Description   | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|---------------------------|---|--|------------------------------|--|------|
|        |                           |   |  |                              | "C"  | "NC" |
| M1     | ANNEX A – Para A2.1.1.1   | The Large Remotely Operated Vehicle System (Large ROV System) must be based on proven, fielded equipment, which is in-service with a North Atlantic Treaty Organization (NATO) or American, British, Canadian, Australian (ABCA) military partner or police agency of those countries.        | CS   |                              |  |      |
| M2     | ANNEX A – Para A2.1.3     | The Large ROV system must operate within either:<br><br>a. The commercial 2.4GHz bandwidth, or<br><br>b. The 4400-4900 MHz bandwidth (the 4800-4900MHz bandwidth section is currently the most open, so would be the preference) which is designated for Government of Canada use.            | CS   |                              |  |      |
| M3     | ANNEX A – Para A2.2.1.1.1 | The Large ROV must act as a mobile RF communication relay, in a mesh-type network, to assist with communication connection with other Large ROVs and Small ROVs in a non-line-of-sight, subterranean, or reinforced concrete buildings, or to extend the range in line-of-sight applications. | CS   |                              |  |      |
| M4     | ANNEX A – Para A2.2.1.2   | <b>Fibre Optic Cable and Mount</b><br><br>The Large ROV must carry and feed-out fibre optic cable of no less than two hundred (200m) meters +/- 2m.   | CS   |                              |  |      |

| Serial | Requirement Reference(s)  | Requirement Description   | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|---------------------------|---|--|------------------------------|--|------|
|        |                           |   |  |                              | "C"  | "NC" |
| M5     | ANNEX A – Para A2.2.1.3.1 | The Large ROV must have no less than an IP65 rating, or equivalent, IAW NEMA IEC 60529.   | TR   |                              |  |      |
| M6     | ANNEX A – Para A2.2.1.7.1 | The Large ROV must include a tactical rail meeting STANAG 4694 to provide an anchor point for payloads.   | CS   |                              |  |      |
| M7     | ANNEX A – Para A2.2.1.8   | <b>Field of View</b><br><br>The Large ROV must have an overall field of view, both front and rear, with: <ul style="list-style-type: none"> <li>a. Low-light and near-infrared illuminators</li> <li>b. No less than a 60 degree horizontal field of view, and</li> <li>c. No less than a 60 degree vertical field of view.</li> </ul> If required, the vertical field of view range can be met by either the camera tilting, the Large ROV body tilting, or through a software-based tilt. | CS   |                              |  |      |
| M8     | ANNEX A – Para A2.2.2.3.1 | The CCS must have no less than an IP64 rating, or equivalent, IAW NEMA IEC 60529.   | TR   |                              |  |      |
| M9     | ANNEX A – Para A2.2.5     | <b>Manipulator Arm and Gripper</b><br><br>The Manipulator Arm must have no less than four (4) degrees of freedom for precise maneuvering of the arm and gripper. <ul style="list-style-type: none"> <li>a. The gripper opening and closing must not count as one of the degrees of freedom required.</li> </ul>   | CS   |                              |  |      |

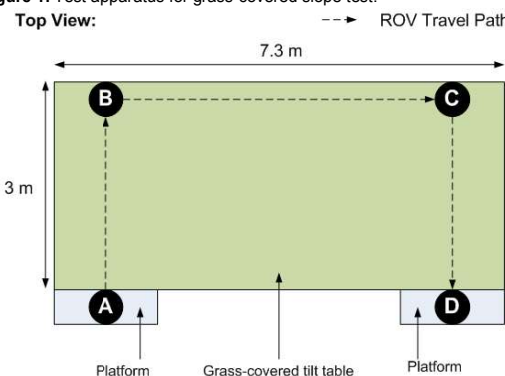
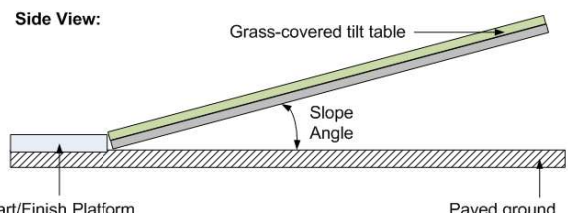
| Serial | Requirement Reference(s) | Requirement Description   | Compliance Documentation Required<br><br>DR - Draft<br>CS - Compliance Statement<br>TR - Test Report | Bidder's Response/References | Compliance (This column is for the Evaluation Team only) |      |
|--------|--------------------------|---|--|------------------------------|--|------|
|        |                          |   |  |                              | "C"  | "NC" |
| M10    | ANNEX A – Para A2.4.1    | <b>Climatic Conditions</b><br><br>The Large ROV and CCS components must operate in temperatures ranging from –19°C to +39°C.<br><br>The Large ROV and CCS components must operate in relative humidity ranging from 5% to 100%. | CS   |                              |  |      |



### 3.6 Evaluation Trial – Small ROV System

| Serial | Requirement Reference(s)  | Requirement Description  | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|---------------------------|--|--|---|------|
|        |                           |  |  | "C"   | "NC" |
| T1     | ANNEX A – Para A1.3.2.1   | <b>Weight</b><br><br>The Small ROV and CCS, with one (1) set of batteries each, must not exceed 10.00kg in combined weight.  | <b>Equipment Requirements:</b> One (1) Small ROV and CCS, with one set of batteries each; calibrated scale.<br><b>Small ROV Operator:</b> Not applicable.<br><br><b>Procedure:</b><br>The evaluator will use a calibrated scale to measure the following weights:<br>1. Small ROV with one (1) battery set.<br>2. CCS with one (1) battery set.<br><br><b>Compliance achieved if</b> Small ROV and CCS weighs less than or equal to 10.00 kg.  |   |      |
| T2     | ANNEX A – Para A1.2.1.3   | <b>Velocity</b><br><br>The Small ROV must maintain an average velocity of no less than five (5) km/h on a level pavement or concrete surface.  | <b>Equipment Requirements:</b> One (1) Small ROV and CCS, with one set of batteries each, concrete level surface, calibrated tape measure and stopwatch.<br><b>Small ROV Operator:</b> Evaluator personnel will set up and operate the Small ROV.<br><br><b>Procedure:</b><br>1. The Small ROV will be driven at full speed to cover a minimum distance of 15 m. The evaluator will measure the time to cover the distance using a stopwatch. The speed will then be calculated using the distance and measured time.<br>2. There will be sufficient track space for the Small ROV to reach the minimum speed by the time it passes the start line. The Small ROV will maintain this speed until the end of the track.<br>3. The Small ROV will perform the test three (3) times per direction (forward and reverse), and the speed will be averaged over three (3) trials.<br><br><b>Compliance achieved if</b> the calculated velocity of the Small ROV reaches 5 km/h in both directions.   |   |      |
| T3A    | ANNEX A – Para A1.2.1.4.1 | <b>Mobility</b><br><br>The Small ROV must climb and descend from obstacles (such as a road curb) of no less than a 10 cm rise while carrying the minimum payload weight, see ANNEX A para. A1.2.1.6.2 (page 20). | <b>Equipment Requirements:</b> One (1) Small ROV carrying the payload weight and CCS, with one set of batteries each, and a concrete block.<br><b>Small ROV Operator:</b> Bidder personnel.<br><br><b>Concept of Test - Road Curb:</b><br>The Small ROV will be required to climb and descend a concrete block (1.2 m long x 1.2 m wide and 100 mm high). A payload of 2.0 kg will be attached to the tactical rail. The 2.0 kg payload will be a cylinder approximately 75 mm diameter x 230 mm long mounted to a mating tactical rail. The Small ROV will have three attempts to complete the climb and three attempts to complete the descent.<br><br><b>Procedure:</b><br>1. The Small ROV will be operated to climb the concrete block. Once the Small ROV completes the climb or uses all three attempts, the Small ROV will descend concrete block.<br>2. During a climb, if the Small ROV cannot reach the top of the concrete block or the Small ROV is tipping over, the attempt will be considered unsuccessful. Tipping over on the descent will also be considered unsuccessful.<br><br><b>Compliance achieved if</b> the Small ROV ascends and descends the 100 mm high concrete block with the minimum payload. |   |      |

| Serial | Requirement Reference(s)             | Requirement Description   | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |      |
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|        |                                      |   |   | "C"   | "NC" |
| T3B    | ANNEX A – Para A1.2.1.4.2 & A1.2.1.5 | <p><b>Mobility and Automatic Brake</b></p> <p>The Small ROV must traverse a dry grass-covered slope of no less than 15 degrees (26.8% grade) while carrying the minimum payload weight, see ANNEX A para. A1.2.1.6.2 (page 20).</p> <p>The Small ROV must hold position when not commanded to move, including when the Small ROV is stopped on uneven ground or slopes and while carrying the minimum payload weight, see ANNEX A para. A1.2.1.6.2 (page 20).</p> | <p><b>Equipment Requirements:</b> One (1) Small ROV carrying the payload weight and CCS, with one set of batteries each, turf surface, tilt table, and a safety tether.</p> <p><b>Small ROV Operator:</b> Bidder personnel.</p> <p><b>Concept of Test - Grass (15° Traverse):</b><br/>The Small ROV will have to climb, traverse, and descend a 15° slope on an artificial turf surface that is dry to the touch. Furthermore, the Small ROV will have to stop and hold a stationary position during the climb and descent. The Small ROV will be allowed three attempts to complete the entire test. A payload of 2.0 kg will be attached to the tactical rail. The 2.0 kg payload will be a cylinder approximately 75 mm diameter x 230 mm long mounted to a mating tactical rail. The evaluator will provide a safety tether to minimize damage to the Small ROV.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>1. The evaluator will provide a safety tether for the test. Dry, artificial turf will be placed on a tilt table.</li> <li>2. The Small ROV will climb, traverse, and descend a turf-covered surface with a slope angle of 15°.</li> <li>3. The Small ROV will navigate path from A to B to C to D in forward and reverse motions respectively (see <b>Figure 1</b> below) according to <b>Table 1</b> (below). The Small ROV will stop and hold for five (5) seconds at each location noted in <b>Table 1</b> (below).</li> <li>4. The Small ROV will be given three (3) attempts to complete the test.</li> </ol> <p><b>Compliance achieved if the Small ROV completes the tasks identified in <b>Table 1</b> and <b>Figure 1</b> (below) with the 2.0 kg payload.</b></p>  |   |      |
| T3C    | ANNEX A – Para A1.2.1.4.3            | <p><b>Mobility</b></p> <p>The Small ROV must climb and descend dry grass-covered slopes of no less than 30 degrees (57.7% grade) while carrying the minimum payload weight, see ANNEX A para. A1.2.1.6.2 (page 20).</p> <p>The Small ROV must hold position when not commanded to move, including when the Small ROV is stopped on uneven ground or slopes and while carrying the minimum payload weight, see ANNEX A para. A1.2.1.6.2 (page 20).</p>             | <p><b>Equipment Requirements:</b> One (1) Small ROV carrying the payload weight and CCS, with one set of batteries each, turf surface, tilt table, and a safety tether.</p> <p><b>Small ROV Operator:</b> Bidder personnel.</p> <p><b>Concept of Test - Grass (30° Ascend and Descend):</b><br/>The Small ROV will have to climb and descend a 30° slope on an artificial turf surface that is dry to the touch. Furthermore, the Small ROV will have to stop and hold its position stationary during the climb and descent. The Small ROV will be allowed three attempts to complete the entire test. If the Small ROV completes the test on the first attempt, no further attempts will be performed. The evaluator will provide a safety tether to minimize damage to the Small ROV. A payload of 2.0 kg will be attached to the tactical rail. The 2.0 kg payload will be a cylinder approximately 75 mm diameter x 230 mm long mounted to a mating tactical rail.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>1. The evaluator will provide a safety tether for the test. Dry artificial turf will be placed on a tilt table.</li> <li>2. The Small ROV will climb and descend a turf-covered surface with a slope angle of 30°.</li> <li>3. The Small ROV will navigate path from A to B and B to A only in forward and reverse motions respectively (<b>Figure 1</b> below). The Small ROV will stop and hold for five seconds at locations A and B. The evaluator will observe if the Small ROV system has an early rollover detection alarm.</li> <li>4. The Small ROV will be given three (3) attempts to complete the test.</li> </ol> <p><b>Compliance achieved if the Small ROV completes path A to B only in forward and reverse directions as shown in <b>Table 1</b> and <b>Figure 1</b> (below) with the 2.0 kg payload.</b></p> |   |      |

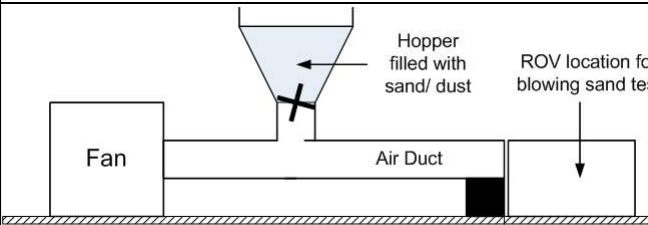
| Serial | Requirement Reference(s) | Requirement Description   | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
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|        |                          |   |   | “C”   | “NC”             |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
|        |                          |   | <p><b>Figure 1.</b> Test apparatus for grass-covered slope test.</p> <p><b>Top View:</b></p>  <p><b>Side View:</b></p>  <p><b>Table 1.</b> Small ROV navigation paths on grass-covered slopes.</p> <table><tr><th>Path</th><th>Motion Direction</th><th>Task</th></tr><tr><td>A to B</td><td>Forward</td><td>Small ROV to climb the slope.</td></tr><tr><td>At B</td><td>Forward</td><td>Small ROV stops and holds its position stationary for five seconds before making a turn.</td></tr><tr><td>B to C</td><td>Forward</td><td>Small ROV traverses the turf surface. During the traverse, the Small ROV must recover from a slide.</td></tr><tr><td>At C</td><td>Forward</td><td>Small ROV makes a turn, stops, and holds a stationary position for five seconds.</td></tr><tr><td>C to D</td><td>Forward</td><td>Small ROV to descend the slope.</td></tr></table> | Path  | Motion Direction | Task | A to B | Forward | Small ROV to climb the slope. | At B | Forward | Small ROV stops and holds its position stationary for five seconds before making a turn. | B to C | Forward | Small ROV traverses the turf surface. During the traverse, the Small ROV must recover from a slide. | At C | Forward | Small ROV makes a turn, stops, and holds a stationary position for five seconds. | C to D | Forward | Small ROV to descend the slope. |  |  |
| Path   | Motion Direction         | Task  |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
| A to B | Forward                  | Small ROV to climb the slope.   |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
| At B   | Forward                  | Small ROV stops and holds its position stationary for five seconds before making a turn.            |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
| B to C | Forward                  | Small ROV traverses the turf surface. During the traverse, the Small ROV must recover from a slide. |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
| At C   | Forward                  | Small ROV makes a turn, stops, and holds a stationary position for five seconds.                    |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |
| C to D | Forward                  | Small ROV to descend the slope.   |   |   |                  |      |        |         |                               |      |         |  |        |         |   |      |         |  |        |         |                                 |  |  |

| Serial | Requirement Reference(s) | Requirement Description   | Evaluation Trial Method/Plan  |         |   | Compliance<br>(This column is for the Evaluation Team only) |      |
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|        |                          |   |   |         |   | "C"   | "NC" |
|        |                          |   | A to B  | Reverse | Small ROV to climb the slope.   |   |      |
|        |                          |   | At B  | Reverse | Small ROV stops and holds a stationary position for five seconds before making a turn.              |   |      |
|        |                          |   | B to C  | Reverse | Small ROV traverses the turf surface. During the traverse, the Small ROV must recover from a slide. |   |      |
|        |                          |   | At C  | Reverse | Small ROV makes a turn, stops, and holds a stationary position for five seconds.                    |   |      |
|        |                          |   | C to D  | Reverse | Small ROV descends the slope.   |   |      |
| T4     | ANNEX A – Para A1.2.2.1  | <b>Line-of-Sight – Control and Communication</b><br>The CCS must maintain communication with and control of the Small ROV at a distance of no less than 200 meters on open terrain. | <b>Equipment Requirements:</b> One (1) Small ROV and CCS with one set of batteries each; calibrated tape measure.<br><b>Small ROV Operator:</b> The evaluator will set up the Small ROV and CCS and operate them.<br><br><b>Concept of Test:</b><br>This test focuses on the Small ROV's operating range via RF control and communication between the Small ROV and CCS via RF means (for example two-way camera and navigational control). The Small ROV will navigate a 200 m path with an RF line-of-sight.<br><br><b>Procedure:</b> <ol style="list-style-type: none"> <li>At the test site, evaluator personnel will unload the Small ROV system and set up the system for operation via RF control.</li> <li>The Small ROV will be placed near the CCS. The Small ROV operator will activate a camera before the Small ROV leaves the CCS. During the test, the evaluator will visually check the CCS monitor to ensure the Small ROV transmits sensor and camera data back to the control station.</li> <li>From the CCS, the Small ROV operator will navigate the Small ROV on a straight path to checkpoints (100 m, 150 m, 175 m) and finish line (200 m from the CCS). At each checkpoint, the Small ROV will stop and the evaluator will check that the operator has retained navigational control of the Small ROV.<br/>The operator must drive the Small ROV via its camera. If the operator loses live video feed (small fluctuations are allowable), or navigation control, the particular attempt will end. When the Small ROV arrives at the finish line or stops operating due to a lost RF signal, the evaluator will record the distance travelled and bring the Small ROV back to the control station.</li> <li>The Small ROV will have two attempts to complete this test.</li> </ol> <b>Compliance achieved if</b> the Small ROV operator maintains navigational control throughout the distance to the 200 m, and can view the terrain via the camera on the Small ROV. If the operator loses live video camera feed (small fluctuations are acceptable) or navigation control, then the Small ROV will be considered non-compliant for that particular attempt. |         |   |   |      |

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|        |                          |  |  | "C"   | "NC" |
| T5     | ANNEX A – Para A1.2.3.1  | <p><b>Battery Operation</b></p> <p>Each Battery Set of the CCS and Small ROV must provide no less than one (1) hour of operation at an approximate ideal temperature of 20°C (+/- 3 °C).</p> <p>Operation is defined as:</p> <ol style="list-style-type: none"> <li>Power-on and initialization sequence of the Small ROV and CCS.</li> <li>Movement of the Small ROV 'down range' for 100m, with periodic movements throughout the majority of the one (1) hour, and then returning back for 100m before the one (1) hour has expired, and</li> <li>Continuous video transmission (small fluctuations are acceptable) between the Small ROV and CCS throughout the one (1) hour.</li> </ol> | <p><b>Equipment Requirements:</b> One (1) Small ROV and CCS with one set of batteries each, calibrated tape measure, and calibrated stop watch.</p> <p><b>Small ROV Operator:</b> The evaluator will set up the Small ROV and CCS and operate them.</p> <p><b>Concept of Test:</b><br/>Testing will be conducted in a similar manner to 3.6 Evaluation Trial – Small ROV System - Serial T4.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>At the test site, evaluator personnel will unload the Small ROV system and set up the system for operation via RF control.</li> <li>The Small ROV will be placed near the CCS, and once powered on, begin the stopwatch. The Small ROV operator will activate the camera before the Small ROV leaves the CCS.</li> <li>From the CCS, the Small ROV operator will navigate (over pavement or concrete, and at a maximum speed that still maintains control) the Small ROV on a straight path to the next checkpoints (25 m, 50 m, 75 m, and 100 m from the control station). At each checkpoint, the Small ROV will stop and the evaluator will check that the operator has retained navigational control of the Small ROV.<br/>The operator must drive the Small ROV via its camera. If the operator loses live video feed (small fluctuations are acceptable), or navigation control, the particular attempt will end. If the Small ROV stops operating due to a lost RF signal, the evaluator will record the distance travelled and bring the Small ROV back to the control station.</li> <li>With the Small ROV 100 m from the CCS, the Small ROV will be periodically moved (no more than 50% of the time moving and the remaining time stopped) while observing through the camera. The Small ROV will drive back to the CCS (repeating Step 3) ensuring that it has operated for no less than one hour.</li> <li>The Small ROV will have two attempts (with new or re-charged batteries) to complete this test.</li> </ol> <p><b>Compliance achieved if</b> the Small ROV can maintain communication and control over a distance of 100 m for a duration of no less than one (1) hour.</p> |   |      |

| Serial | Requirement Reference(s) | Requirement Description   | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |      |
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|        |                          |   |  | "C"   | "NC" |
| T6     | ANNEX A – Para A1.2.5    | <p><b>Drop-Charge Release Mechanism</b></p> <p>Drop-Charge Release Mechanism must carry and actuate the physical release of a drop charge (defined as two taped blocks of C4 explosive and RF Initiator), at least 1.60 kg (approx. 3.53 lb) in weight and a maximum of 6 cm width x 6 cm height x 30 cm length (approx. 2.36 x 2.36 x 11.80 inches).</p> <p>The Drop-Charge Release Mechanism must support and hold the drop charge while performing the mobility requirements of ANNEX A para. A1.2.1.4 (page 19).</p> <p>a. It is acceptable to provide a system that attaches the drop charge to a disposable plate which is itself released from the ROV.</p> <p>Drop-Charge Release Mechanism must be controllable through the CCS.</p> | <p><b>Equipment Requirements:</b> One (1) Small ROV with Drop Charge Release Mechanism and CCS, with one set of batteries each; and a simulated payload (drop charge).<br/> <b>Small ROV Operator:</b> Bidder personnel.</p> <p><b>Concept of Test:</b><br/> A container (60 mm x 60 mm x 300 mm) will be constructed and material inserted until a weight of 1.60 kg is achieved. The Small ROV will need to support/hold the container. The Small ROV will be placed on a bed of grass (see 3.6 Evaluation Trial – Small ROV System – Serial T3) and the release mechanism be activated on the level portion after vehicle ascends, descends, and traverses the 15° and 30° slopes.</p> <p><b>Procedure:</b><br/> 3.6 Evaluation Trial – Small ROV System – Serial T3 will be repeated except using the simulated payload (drop charge) and the simulated payload (drop charge) will be released at the points identified here (see Figure 1 of 3.6 Evaluation Trial – Small ROV System – Serial T3):</p> <ul style="list-style-type: none"> <li>Immediately after descending the slope and reaching Position A (30° slope only).</li> <li>Immediately after reaching Position D (for 15° slope only).</li> </ul> <p><b>Compliance achieved if</b> the simulated payload (drop charge) remains attached to the Small ROV during the ascent, traverse, and descent, the Small ROV mobility is maintained, and the simulated payload (drop charge) is released on the level portion after travelling on the slope.</p> |   |      |
| T7A    | ANNEX A – Para A1.4.2.1  | <p><b>Atmospheric Conditions</b></p> <p>The Small ROV must operate in heavy rain up to 20 mm/hr and rain driven by wind gusts up to 40 km/h over a period of no less than one (1) hour operation.</p>   | <p><b>Equipment Requirements:</b> One (1) Small ROV and CCS with one set of batteries each, and test apparatus.<br/> <b>Small ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test - Heavy Rain:</b><br/> The Small ROV will be operated in a simulated rain of up to 20 mm/hr rainfall rate with wind of up to 40 km/h.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>The evaluator will set up the test apparatus to simulate rain up to 0.33 mm/min rainfall rate and up to 11.1 m/s wind.</li> <li>The Small ROV will be operated on a figure eight track for a total of 60 minutes with an operation pattern of 10-minute drive/10-minute park under the simulated rain. There will be one layer of 5 cm thick concrete slabs on the track. The Small ROV will be inspected at the 20 min and 40 min intervals during this evaluation.</li> <li>Small ROV inspection will include verification of Small ROV movements (wheels, camera tilt (if tilt is possible), drop-charge release mechanism), operation of video communication, operation of the wheel brakes, verification of the power-on and initialization sequence, and signs of damage and water accumulation in the Small ROV.</li> <li>The Small ROV will have two attempts to complete this test.</li> </ol> <p><b>Compliance achieved if</b> the Small ROV continues to operate and is fully functional throughout the entire heavy-rain test.</p>  |   |      |

| Serial                       | Requirement Reference(s) | Requirement Description  | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |                          |                    |           |                    |             |                              |          |                           |           |  |  |
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|                              |                          |  |  | “C”   | “NC”                     |                    |           |                    |             |                              |          |                           |           |  |  |
| T7B                          | ANNEX A – Para A1.4.2.2  | <p><b>Atmospheric Conditions</b></p> <p>The Small ROV must operate in blowing sand and dust caused by wind gusts up to 40 km/h over a period of no less than one (1) hour.</p> | <p><b>Equipment Requirements:</b> One (1) Small ROV and CCS with one set of batteries each, and test apparatus.<br/><b>Small ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test - Blowing Sand</b><br/>The Small ROV will make 360° turns in blowing sand environment with conditions shown in <b>Table 2</b>. After sand exposure, the evaluator will visually verify that the Small ROV is functional.</p> <p><b>Table 2.</b> Test conditions for the blowing sand test.</p> <table><tr><td>Material</td><td>Ground Calcium Carbonate</td></tr><tr><td>Particle size (µm)</td><td>150 - 850</td></tr><tr><td>Air velocity (m/s)</td><td>Up to ~11.1</td></tr><tr><td>Ambient air temperature (°C)</td><td>Up to 30</td></tr><tr><td>Sand concentration (g/m³)</td><td>2.2 ± 0.5</td></tr></table> <p><b>Procedure:</b></p> <ol style="list-style-type: none"><li>The Small ROV will be placed immediately in front of the test apparatus with the Small ROV's front chassis facing the apparatus (refer to <b>Figure 2</b> (below) for diagram of test chamber and apparatus), the hopper will be filled with sand particles and start the fan on the test apparatus.</li><li>The Small ROV will be exposed to the air/sand stream for 10 minutes. During the exposure, the Small ROV will repeatedly perform the following manoeuvres:<ol style="list-style-type: none"><li>360° pivot turn in a clockwise (CW) direction.</li><li>Tilting of the camera to the maximum angle (if camera tilts).</li><li>360° pivot turn in a counter-clockwise (CCW) direction.</li></ol></li><li>The Small ROV will be driven out of the air/sand stream.</li><li>Operation of the Small ROV will be verified by doing the following:<ol style="list-style-type: none"><li>The Small ROV operator will navigate the Small ROV on a straight path (two 5 m runs) with a U-turn at the end of first run.</li><li>The evaluator will visually verify normal operation of the Small ROV (including verification of Small ROV movements (wheels, camera tilt (if tilt is possible), drop-charge release mechanism), operation of video communication, operation of the wheel brakes).</li></ol></li><li>The Small ROV will have two (2) attempts to complete this test.</li></ol> <p><b>Compliance achieved</b> if the Small ROV continues to operate and is fully functional throughout the entire sand test.</p> | Material  | Ground Calcium Carbonate | Particle size (µm) | 150 - 850 | Air velocity (m/s) | Up to ~11.1 | Ambient air temperature (°C) | Up to 30 | Sand concentration (g/m³) | 2.2 ± 0.5 |  |  |
| Material                     | Ground Calcium Carbonate |  |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Particle size (µm)           | 150 - 850                |  |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Air velocity (m/s)           | Up to ~11.1              |  |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Ambient air temperature (°C) | Up to 30                 |  |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Sand concentration (g/m³)    | 2.2 ± 0.5                |  |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |

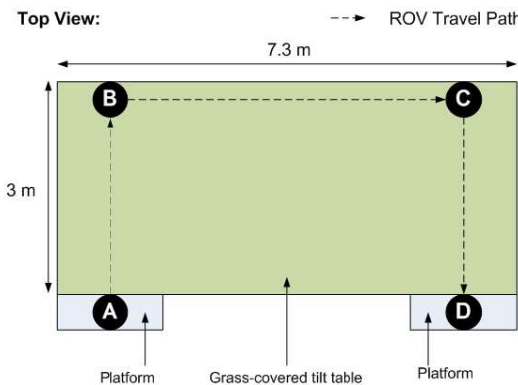
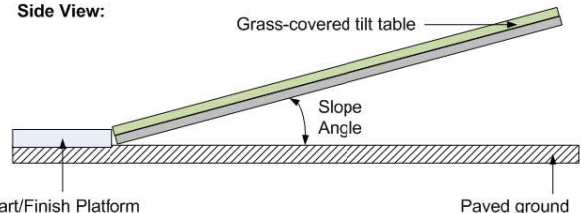
| Serial | Requirement Reference(s)  | Requirement Description   | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|---------------------------|---|--|---|------|
|        |                           |   |  | "C"   | "NC" |
|        |                           |   |  <p>Figure 2. Test Apparatus for blowing sand tests.</p>   |   |      |
| T8     | ANNEX A – Para A1.2.1.2.1 | <p><b>Durability</b></p> <p>The Small ROV must survive multiple drops from a height of no less than three (3) meters onto natural soil, and remain fully functional.</p> <ul style="list-style-type: none"> <li>a. This will include drops in horizontal body orientation only.</li> <li>b. No payloads or attachments will be attached to the Small ROV during the drops.</li> </ul> | <p><b>Equipment Requirements:</b> One (1) Small ROV with batteries, calibrated tape measure, and video camera.<br/><b>Small ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test:</b><br/>Testing will involve dropping the Small ROV, while in a horizontal body orientation, from a height of three (3) m onto the sand that was used in T7, which will have a depth of no less than 3 inches. Three (3) consecutive drops will be performed with the Small ROV. After each drop, all the functions of the Small ROV will be exercised to ensure that they are still operational.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>1. The Small ROV will be balanced, and held in a horizontal body orientation, at a height of three (3) m above the ground.</li> <li>2. The Small ROV will be dropped, and fall still in a horizontal body orientation, impacting the ground on all wheels/tracks.</li> <li>3. The functions of the Small ROV will be exercised to ensure that they are still operational.</li> <li>4. Testing will be repeated with the Small ROV a total of three (3) times, and the ground surface will be raked flat before each drop.</li> </ol> <p><b>Compliance achieved if</b> the Small ROV is fully functional after each of the three (3) drops.</p> |   |      |



### 3.7 Evaluation Trial – Large ROV System

| Serial | Requirement Reference(s) | Requirement Description  | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|--------------------------|--|---|---|------|
|        |                          |  |   | "C"   | "NC" |
| T1     | ANNEX A – Para A2.3.2.1  | <b>Weight</b><br><br>The Large ROV, Manipulator Arm and Gripper, (but not including the Fibre Optic Cable and Mount) and CCS, with one (1) set of batteries each, must not exceed 20.00 kg in combined weight. | <b>Equipment Requirements:</b> One (1) Large ROV and CCS with one set of batteries each, (but not including the fibre optic cable and mount) and a calibrated scale.<br><b>Large ROV Operator:</b> Not applicable.<br><br><b>Procedure:</b><br>Evaluator personnel will use a calibrated scale to measure the following weights:<br>1. Large ROV, Manipulator Arm and Gripper with one (1) battery set.<br>2. CCS with one (1) battery set.<br><br><b>Compliance achieved if</b> the Large ROV, Manipulator Arm and Gripper, and CCS, weighs less than or equal to 20.00 kg.  |   |      |
| T2     | ANNEX A – Para A2.2.1.4  | <b>Velocity</b><br><br>The Large ROV must maintain an average velocity of no less than five (5) km/h on a level pavement or concrete surface.  | <b>Equipment Requirements:</b> One (1) Large ROV and CCS with one set of batteries each, concrete level surface, calibrated tape measure, and a calibrated stopwatch.<br><b>Large ROV Operator:</b> Evaluator personnel.<br><br><b>Procedure:</b><br>1. The Large ROV will be driven at full speed to cover a minimum distance of 15 m. The evaluator will measure the time to cover the distance using a stopwatch. The speed will then be calculated using the distance and measured time.<br>2. There will be sufficient track space for the Large ROV to reach the minimum speed by the time it passes the start line. The Large ROV will maintain this speed until the end of the track.<br>3. The Large ROV will perform the test three (3) times per direction (forward and reverse), and the speed will be averaged over three (3) trials.<br><br><b>Compliance achieved if</b> the calculated velocity of the Large ROV reaches 5 km/h in both directions.   |   |      |
| T3A    | ANNEX A – Para A2.2.1.5  | <b>Mobility</b><br><br>The Large ROV must climb and descend stairs with no less than a 20cm rise while carrying the minimum payload weight, see ANNEX A para. A2.2.1.7.2 (page 26).                            | <b>Equipment Requirements:</b> One (1) Large ROV carrying the payload and CCS, with one set of batteries each, stairs, and a calibrated inclinometer or tape measure.<br><b>Large ROV Operator:</b> Bidder personnel.<br><br><b>Concept of Test – Stairs:</b><br>The Large ROV will be required to climb and descend stairs with a rise of 200 mm. The stairs will have a concrete surface and have an angle of 30°. The Large ROV will have three (3) attempts to complete the climb and three (3) attempts to complete the descent. A payload of 5.0 kg will be attached to the tactical rail. The 5.0 kg payload will be a cylinder approximately 75 mm diameter x 300 mm long mounted to a mating tactical rail. The evaluator will provide a safety tether to minimize damage to the Large ROV if it is unsuccessful.<br><br><b>Procedure:</b><br>1. A safety tether will be secured to the Large ROV.<br>2. The Large ROV will be operated to climb the 200 mm rise 346 mm run, 30° incline, and concrete surface stairs. Once the Large ROV completes the climb or uses all three (3) attempts, the Large ROV will descend the stairs, also having three (3) attempts. |   |      |

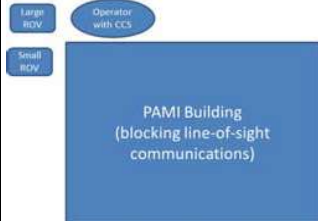
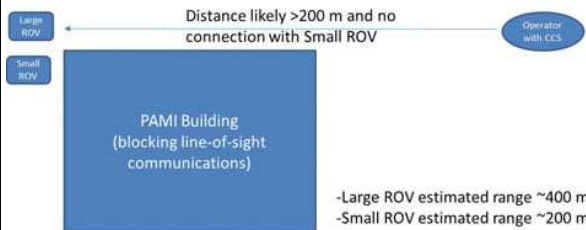
| Serial | Requirement Reference(s)             | Requirement Description   | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|--------------------------------------|---|---|---|------|
|        |                                      |   |   | "C"   | "NC" |
|        |                                      |   | <p>3. During a climb, if the Large ROV cannot reach the top of the stairs or the Large ROV is tipping over, thus tightening the tether, the attempt will be considered unsuccessful.</p> <p><b>Compliance achieved if</b> the Large ROV ascends and descends the complete staircase in complete control and without loading the tether.</p>   |   |      |
| T3B    | ANNEX A – Para A2.2.1.5.2 & A2.2.1.6 | <p><b>Mobility and Automatic Brake</b></p> <p>The Large ROV must traverse a dry grass-covered slope of no less than 15 degrees (26.8% grade) while carrying the minimum payload weight, see ANNEX A para. A2.2.1.7.2 (page 26).</p> <p>The Large ROV must hold position when not commanded to move, including when the Large ROV is stopped on uneven ground or slopes and while carrying the minimum payload weight, see ANNEX A para. A2.2.1.7.2 (page 26).</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV carrying the payload and CCS, with one set of batteries each, turf surface, tilt table and safety tether.</p> <p><b>Large ROV Operator:</b> Bidder personnel.</p> <p><b>Concept of Test - Grass (15° Traverse):</b><br/>The Large ROV will have to climb, traverse, and descend a 15° slope on an artificial turf surface that is dry to the touch. Furthermore, the Large ROV will have to stop and hold a stationary position during the climb and descent. The Large ROV will be allowed three (3) attempts to complete the entire test. A payload of 5.0 kg will be attached to the tactical rail. The 5.0 kg payload will be a cylinder approximately 75 mm diameter x 300 mm long mounted to a mating tactical rail. The evaluator will provide a safety tether for the test to minimize damage to the Large ROV.</p> <p><b>Procedures:</b></p> <ol style="list-style-type: none"> <li>The evaluator will use a safety tether for the test. Dry artificial turf will be placed on a tilt table.</li> <li>The Large ROV will climb, traverse, and descend a turf-covered surface with a slope angle of 15°.</li> <li>The Large ROV will navigate path from A to B to C to D in forward and reverse motions respectively (see <b>Figure 1</b> below) according to <b>Table 1</b> (below). The Large ROV will stop and hold a stationary position for five (5) seconds at each location noted in <b>Table 1</b> (below).</li> <li>The Large ROV will have three (3) attempts to complete the test.</li> </ol> <p><b>Compliance achieved if</b> the Large ROV completes the tasks identified in <b>Table 1</b> and <b>Figure 1</b> (below) with the 5.0 kg payload.</p> |   |      |
| T3C    | ANNEX A – Para A2.2.1.5.3            | <p><b>Mobility</b></p> <p>The Large ROV must climb and descend dry grass-covered slopes of no less than 30 degrees (57.7% grade) while carrying the minimum payload weight, see ANNEX A para. A2.2.1.7.2 (page 26).</p> <p>The Large ROV must hold position when not commanded to move, including when the Large ROV is stopped on uneven ground or slopes and while carrying the minimum payload weight, see ANNEX A para. A2.2.1.7.2 (page 26).</p>             | <p><b>Equipment Requirements:</b> One (1) Large ROV carrying the payload and CCS, with one set of batteries each, turf surface, tilt table and safety tether.</p> <p><b>Large ROV Operator:</b> Bidder personnel.</p> <p><b>Concept of Test – Grass (30° Ascend and Descend):</b><br/>The Large ROV will have to climb and descend a 30° slope on an artificial turf surface that is dry to the touch. Furthermore, the Large ROV will have to stop and hold a stationary position during the ascent and descent. The Large ROV will be allowed three (3) attempts to complete the entire test. A payload of 5.0 kg will be attached to the tactical rail. The 5.0 kg payload will be a cylinder approximately 75 mm diameter x 300 mm long mounted to a mating tactical rail. The evaluator will provide a safety tether to minimize damage to the Large ROV.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>The evaluator will provide a safety tether for the test. Dry, artificial turf will be placed on a tilt table.</li> <li>The Large ROV will climb and descend a turf-covered surface with a slope angle of 30°.</li> </ol>   |   |      |

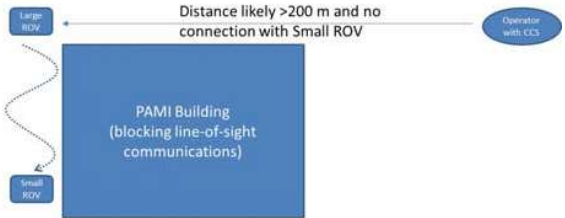
| Serial | Requirement Reference(s) | Requirement Description | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|--------------------------|-------------------------|--|---|------|
|        |                          |                         |  | "C"   | "NC" |
|        |                          |                         | <p>3. The Large ROV will navigate path from A to B and B to A only in forward and reverse motions respectively (see <b>Figure 1</b>). The Large ROV will stop and hold a stationary position for five (5) seconds at locations A and B.</p> <p>4. The Large ROV will have three (3) attempts to complete the test.</p> <p><b>Compliance achieved if</b> the Large ROV achieves path A to B only in forward and reverse directions as shown in <b>Table 1</b> (below) and <b>Figure 1</b> with the 5.0 kg payload.</p> <p><b>Top View:</b></p>  <p><b>Side View:</b></p>  <p><b>Figure 1.</b> Test apparatus for grass-covered slope test.</p> |   |      |

| Serial   | Requirement Reference(s)  | Requirement Description  | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only)  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
|--|---------------------------|--|--|--|------|--|------|------------------|------|--------|---------|-------------------------------|------|---------|---|--------|---------|--|------|---------|---|--------|---------|---------------------------------|--------|---------|-------------------------------|------|---------|---|--------|---------|--|------|---------|---|--------|---------|---------------------------------|--|--|
|  |                           |  |  | “C”  | “NC” |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
|  |                           |  | <table><tr><td colspan="3">Table 1. Large ROV navigation paths on grass-covered slopes.</td></tr><tr><th>Path</th><th>Motion Direction</th><th>Task</th></tr><tr><td>A to B</td><td>Forward</td><td>Large ROV to climb the slope.</td></tr><tr><td>At B</td><td>Forward</td><td>Large ROV to stop and hold a stationary position for five seconds before making a turn.</td></tr><tr><td>B to C</td><td>Forward</td><td>Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide.</td></tr><tr><td>At C</td><td>Forward</td><td>Large ROV to make a turn then stop and hold a stationary position for five seconds.</td></tr><tr><td>C to D</td><td>Forward</td><td>Large ROV to descend the slope.</td></tr><tr><td>A to B</td><td>Reverse</td><td>Large ROV to climb the slope.</td></tr><tr><td>At B</td><td>Reverse</td><td>Large ROV to stop and hold a stationary position for five seconds before making a turn.</td></tr><tr><td>B to C</td><td>Reverse</td><td>Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide.</td></tr><tr><td>At C</td><td>Reverse</td><td>Large ROV to make a turn then stop and hold a stationary position for five seconds.</td></tr><tr><td>C to D</td><td>Reverse</td><td>Large ROV to descend the slope.</td></tr></table>  | Table 1. Large ROV navigation paths on grass-covered slopes. |      |  | Path | Motion Direction | Task | A to B | Forward | Large ROV to climb the slope. | At B | Forward | Large ROV to stop and hold a stationary position for five seconds before making a turn. | B to C | Forward | Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide. | At C | Forward | Large ROV to make a turn then stop and hold a stationary position for five seconds. | C to D | Forward | Large ROV to descend the slope. | A to B | Reverse | Large ROV to climb the slope. | At B | Reverse | Large ROV to stop and hold a stationary position for five seconds before making a turn. | B to C | Reverse | Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide. | At C | Reverse | Large ROV to make a turn then stop and hold a stationary position for five seconds. | C to D | Reverse | Large ROV to descend the slope. |  |  |
| Table 1. Large ROV navigation paths on grass-covered slopes. |                           |  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| Path   | Motion Direction          | Task   |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| A to B   | Forward                   | Large ROV to climb the slope.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| At B   | Forward                   | Large ROV to stop and hold a stationary position for five seconds before making a turn.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| B to C   | Forward                   | Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide.   |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| At C   | Forward                   | Large ROV to make a turn then stop and hold a stationary position for five seconds.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| C to D   | Forward                   | Large ROV to descend the slope.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| A to B   | Reverse                   | Large ROV to climb the slope.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| At B   | Reverse                   | Large ROV to stop and hold a stationary position for five seconds before making a turn.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| B to C   | Reverse                   | Large ROV to traverse the turf surface. During the traverse, the Large ROV must be able to recover from a slide.   |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| At C   | Reverse                   | Large ROV to make a turn then stop and hold a stationary position for five seconds.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| C to D   | Reverse                   | Large ROV to descend the slope.  |  |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |
| T4   | ANNEX A – Para A2.2.2.1.1 | <p><b>Line-of-Sight – Control and Communication</b></p> <p>The CCS must maintain communication with and control of the Large ROV at a distance of no less than 400m on open terrain.</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV and CCS with one set of batteries each and a calibrated tape measure.</p> <p><b>Large ROV Operator:</b> The evaluator will set up the Large ROV and CCS and operate them.</p> <p><b>Concept of Test:</b><br/>This test focuses on the Large ROV's operating range via RF control and communication between the Large ROV and control station via RF means (for example one-way audio, camera, sensor data transmission). The Large ROV will navigate a 400 m path with an RF line-of-sight.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"><li>At the test site, evaluator personnel will unload the Large ROV system and set up the system for operation via RF control.</li><li>The Large ROV will be placed near the CCS, and the Large ROV operator will activate the cameras before the Large ROV leaves the CCS. During the test, the evaluator will visually check the control station monitor to ensure the Large ROV transmits sensor and camera data back to the CCS.</li><li>From the CCS, the Large ROV operator will navigate the Large ROV on a straight path to the next checkpoints (100 m, 200 m, 300 m) and finish line (400 m from the CCS). At each checkpoint, the Large ROV will stop, and the evaluator will check that:<ol style="list-style-type: none"><li>the operator still has navigational control of the Large ROV, and</li><li>the CCS can activate the manipulator arm and gripper.</li></ol>The operator will drive the Large ROV via its camera. If the operator loses live video feed (small fluctuations are acceptable), one-way audio, navigation control, or cannot activate the manipulator arm and gripper, the particular attempt will end. When the Large ROV arrives at the finish line or stops operating due to a lost RF signal, the evaluator will record the distance travelled and bring the Large ROV back to the control station.</li><li>An evaluator will follow the Large ROV to allow testing of the one-way audio communication between the Large ROV and the CCS.</li></ol> |  |      |  |      |                  |      |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |        |         |                               |      |         |   |        |         |  |      |         |   |        |         |                                 |  |  |

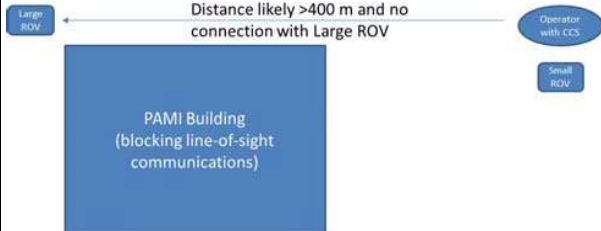
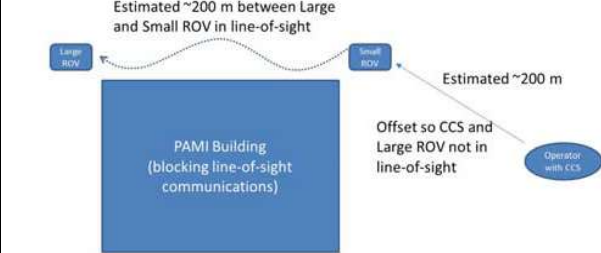
| Serial | Requirement Reference(s) | Requirement Description  | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|--------------------------|--|---|---|------|
|        |                          |  |   | "C"   | "NC" |
|        |                          |  | <p>5. The Large ROV will have two (2) attempts to complete this test.</p> <p><b>Compliance achieved</b> if the Large ROV operator maintains navigational and manipulator arm/gripper control throughout the distance to the 400 m, and can view the terrain via a camera on the Large ROV. If the operator loses the live video camera feed (small fluctuations are acceptable) or navigation or manipulator arm/gripper control, then the Large ROV will be non-compliant for that particular attempt.</p>   |   |      |
| T5     | ANNEX A – Para A2.2.3.1  | <p><b>Battery Operation</b></p> <p>Each Battery Set of the CCS and Large ROV must provide no less than two (2) hours of operation at an approximate ideal temperature of 20°C (+/- 3 °C).</p> <p>Operation is defined as:</p> <ol style="list-style-type: none"> <li>Power-on and initialization sequence of the Large ROV and CCS.</li> <li>Movement of the Large ROV 'down range' for 200m, with periodic movements throughout the majority of the two (2) hours, and then returning back for 200m before the two (2) hours has expired, and</li> <li>Continuous video transmission (small fluctuations are acceptable) between the Large ROV and CCS throughout the two (2) hours.</li> </ol> | <p><b>Equipment Requirements:</b> One (1) Large ROV and CCS with one set of batteries each, a calibrated tape measure, and a calibrated stop watch.</p> <p><b>Large ROV Operator:</b> The evaluator will set up the Large ROV and CCS and operate them.</p> <p><b>Concept of Test:</b><br/>Testing will be conducted in a similar manner to 3.7 Evaluation Trial – Large ROV System - Serial T4.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>At the test site, evaluator personnel will unload the Large ROV system and set up the system for operation via RF control.</li> <li>The Large ROV will be placed at the CCS. The Large ROV operator will activate the cameras before the Large ROV leaves the CCS. During the test, the evaluator will visually check the CCS monitor to ensure the Large ROV transmits sensor and camera data back to the CCS.</li> <li>From the CCS, the Large ROV operator will navigate (over pavement or concrete, and at a maximum speed that still maintains control) the Large ROV on a straight path to the next checkpoints (50 m, 100 m, 150 m, and 200 m from the CCS). At each checkpoint, the Large ROV will stop and the evaluator will check that: <ol style="list-style-type: none"> <li>the operator still has navigational control of the Large ROV, and</li> <li>the CCS can activate the manipulator arm and gripper.</li> </ol> <p>The operator will drive the Large ROV via its camera. If the operator loses live video feed (small fluctuations are acceptable), one-way audio, navigation control, or cannot activate the manipulator arm and gripper, the particular attempt will end. If the Large ROV stops operating due to a lost RF signal, the evaluator will record the distance travelled and bring the Large ROV back to the control station.</p> </li> <li>With the Large ROV 200 m from the CCS, the Large ROV will be periodically moved (no more than 50% of the time moving and the remaining time stopped) while observing through the camera. The Large ROV will drive back to the CCS (repeating Step 3) ensuring that it has operated for no less than two (2) hours.</li> <li>An evaluator will follow the Large ROV to allow testing of the one-way audio communication between the Large ROV and the CCS.</li> <li>The Large ROV will have two (2) attempts (with new or re-charged batteries) to complete this test.</li> </ol> <p><b>Compliance achieved</b> if the Large ROV can maintain communications and control over a distance of 200 m for a duration of no less than two (2) hours.</p> |   |      |

| Serial         | Requirement Reference(s)           | Requirement Description   | Evaluation Trial Method/Plan   | Compliance<br>(This column is for the Evaluation Team only) |               |                           |   |        |                |   |        |                        |  |  |
|----------------|------------------------------------|---|--|---|---------------|---------------------------|---|--------|----------------|---|--------|------------------------|--|--|
|                |                                    |   |  | “C”   | “NC”          |                           |   |        |                |   |        |                        |  |  |
| T6A            | ANNEX A – Para A2.2.5.3 & A2.2.5.4 | <p><b>Manipulator Arm and Gripper</b></p> <p>The Manipulator Arm and Gripper must lift from the ground and carry objects of no less than 4.50 kg in weight.</p> <p>The Manipulator Arm and Gripper, when fully extended, must lift objects of no less than 3.00 kg in weight.</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV with Arm &amp; Gripper, and CCS, with one set of batteries each, calibrated 3.0 kg and 4.5 kg weights with high-friction grip surfaces, and a calibrated tape measure.</p> <p><b>Large ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test - Lifting:</b><br/>The Large ROV will lift objects weighing 3.0 kg and 4.5 kg from the ground and carry them a distance of 5 m. The Large ROV will have three (3) attempts per object to complete the test.</p> <p><b>Procedure:</b></p> <p>1. 3.0 kg and 4.5 kg object lifts:</p> <p>a. The Large ROV will lift 3.0 kg and 4.5 kg objects in front of the Large ROV, according to <b>Table 3</b>.</p> <p><b>Table 3.</b> Test conditions for object lift.</p> <table><tr><th>Test Condition</th><th>Object Weight</th><th>Manipulator Arm Condition</th></tr><tr><td>1</td><td>3.0 kg</td><td>Fully Extended</td></tr><tr><td>2</td><td>4.5 kg</td><td>Ideal Lifting Position</td></tr></table> <p>b. The arm will be adjusted to an optimum position, and the Large ROV will be navigated around a 5 m square path while carrying the object.</p> <p>2. Note that the Large ROV cannot drag the object closer to itself to enable the lift. The lifting must be a clean, upward lift. If the Large ROV tips over during the lift, it will be considered unsuccessful. Once the Large ROV lifts and secures the object using its gripper, it must continue to hold the object while traversing the square path and not drop the object to the ground.</p> <p>3. The Large ROV will get three (3) attempts for each object.</p> <p><b>Compliance achieved if</b> the Large ROV can lift the 3.0 kg and 4.5 kg objects, traverse the 5 m square path, and then lower the objects.</p> | Test Condition  | Object Weight | Manipulator Arm Condition | 1 | 3.0 kg | Fully Extended | 2 | 4.5 kg | Ideal Lifting Position |  |  |
| Test Condition | Object Weight                      | Manipulator Arm Condition   |  |   |               |                           |   |        |                |   |        |                        |  |  |
| 1              | 3.0 kg                             | Fully Extended  |  |   |               |                           |   |        |                |   |        |                        |  |  |
| 2              | 4.5 kg                             | Ideal Lifting Position  |  |   |               |                           |   |        |                |   |        |                        |  |  |
| T6B            | ANNEX A – Para A2.2.5.5 & A2.2.5.6 | <p><b>Gripper</b></p> <p>The Gripper must have no less than 13.61 kg (approx. 30lb) of grip force.</p> <p>The Gripper must have no less than a 10 cm gripper opening to grasp objects.</p>  | <p><b>Equipment Requirements:</b> One (1) Large ROV with Arm &amp; Gripper, and CCS, with one set of batteries each, calibrated load cell and instrumentation, and a calibrated tape measure.</p> <p><b>Large ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test – Gripper:</b><br/>The Large ROV gripper will be opened to its maximum capability and its inside open dimension will be measured. Once opened, a load cell will be placed within the gripper and then closed, and then the grip force will be measured.</p> <p><b>Procedure:</b></p> <p>1. The gripper will be opened to the maximum capability.</p> <p>2. The evaluator will measure the gripper’s inside opening using a tape measure.</p> <p>3. With the gripper opened, a load cell will be placed between the grippers and then closed and the maximum sustained grip force will be measured.</p> <p><b>Compliance achieved if</b> the gripper can create a compressive force of no less than 133.5 N (30 lb) and open no less than 10 cm.</p>   |   |               |                           |   |        |                |   |        |                        |  |  |

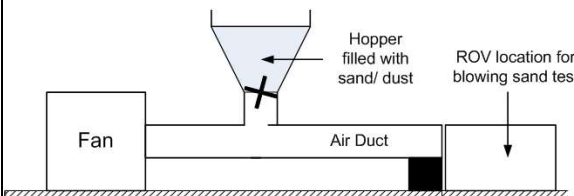
| Serial | Requirement Reference(s)           | Requirement Description  | Evaluation Trial Method/Plan  | Compliance<br>(This column is for the Evaluation Team only) |      |
|--------|------------------------------------|--|---|---|------|
|        |                                    |  |   | "C"   | "NC" |
| T7A    | ANNEX A – Para A2.2.1.1 & A2.2.2.7 | <p><b>Mobile Communication Relay &amp; Control - Large and Small ROV</b></p> <p>The Large ROV must continually act as a mobile RF communication relay, in a mesh-type network, to assist with communication connection with other Large ROVs and Small ROVs in a non-line-of-sight, subterranean, or reinforced concrete buildings, or to extend the range in line-of-sight applications.</p> <p>The CCS must be identical to the CCS used to control the Small ROV, and must switch between and operate either the Small ROV or Large ROV.</p> <p>The CCS, when not controlling a ROV, must display camera images from any other selected ROV within the mesh-type network.</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV, (1) Small ROV and CCS with one set of batteries each, calibrated tape measure, and a concrete building.</p> <p><b>Large and Small ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test:</b><br/>To activate the relaying abilities of the ROVs, a large distance will be used to break the communication link between the CCS and functional ROV. The relay ROVs will then be activated, and likely moved, to engage a connection between the functional ROV, relay ROV and CCS.</p> <p><b>Procedure:</b><br/>This test procedure assumes the relay feature will be automatically engaged and the user does not need to select between relaying and direct communications with a ROV.</p> <p><u>Ensure one ROV is in contact with the CCS and the other ROV is not</u></p> <p>1. Park the Large and Small ROV (<b>Figure 2</b>) at the outside corner of a building.</p>  <p><b>Figure 2.</b> Long-range relay test – initial set-up.</p> <p>2. Parallel to one side of the building (<b>Figure 3</b>), increase the distance between the CCS and both ROVs in 25 m increments.</p>  <p><b>Figure 3.</b> Long-range relay test – CCS movement.</p> |   |      |

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|--------|------------------------------------|--|--|---|------|
|        |                                    |  |  | "C"   | "NC" |
|        |                                    |  | <p>3. Turn off the first ROV and confirm connection between the second ROV and the CCS.</p> <p>4. Turn off the second ROV and turn on the first ROV to confirm the connection between the first ROV and the CCS.</p> <p>5. Repeat 2. through 4. until the connection between the CCS and one of the ROVs is lost.</p> <p>6. The ROV connected to the CCS will be designated as the relay ROV and the disconnected ROV will be designated the functional ROV.</p> <p><u>Determine if the relay ROV (Large ROV) can relay the CCS control to the functional ROV (Small ROV)</u></p> <p>7. With the connection between the relay ROV confirmed and the relay ROV turned on, the functional ROV will also be turned on.</p> <p>8. The functional ROV will then be commanded to travel perpendicular to the CCS and relay ROV (<b>Figure 4</b>) so that the CCS and functional ROV do not have line-of-sight.</p>  <p>Once Small ROV is out-of-sight with CCS and controlled via the Large ROV then it is compliant.</p> <p><b>Figure 4.</b> Long-range relay test – Functional ROV movement.</p> <p><b>Compliance achieved</b> if the functional ROV (Small ROV) can be controlled via the relaying ROV (Large ROV) and when images from either selected ROV can be displayed.</p> |   |      |
| T7B    | ANNEX A – Para A1.2.1.1 & A1.2.2.2 | <p><b>Mobile Communication Relay &amp; Control - Small and Large ROV</b></p> <p>The Small ROV must continually act as a mobile RF communication relay, in a mesh-type network, to assist with communication connection with other Small ROVs and Large ROVs in a non-line-of-sight, subterranean, or reinforced concrete buildings, or to extend the range in line-of-sight applications.</p> <p>The CCS must be identical to the CCS used to control the Large ROV, and must switch between</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV, (1) Small ROV and CCS with one set of batteries each, calibrated tape measure, and a concrete building.</p> <p><b>Large and Small ROV Operator:</b> Evaluator personnel.</p> <p><b>Concept of Test:</b><br/>To activate the relaying abilities of the ROVs, a large distance will be used to break the communication link between the CCS and functional ROV. The relay ROVs will then be activated, and likely moved, to engage a connection between the functional ROV, relay ROV and CCS.</p> <p><b>Procedure:</b><br/>This test procedure assumes the relay feature will be automatically engaged and the user does not need to select between relaying and direct communications with a ROV.</p>   |   |      |



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|--------|--------------------------|--|---|---|------|
|        |                          |  |   | "C"   | "NC" |
|        |                          | <p>and operate either the Small ROV or Large ROV.</p> <p>The CCS, when not controlling a ROV, must display camera images from any other selected ROV within the mesh-type network.</p> | <p><u>Determine if the relay ROV (Small ROV) can relay the CCS control to the functional ROV (Large ROV)</u></p> <ol style="list-style-type: none"> <li>1. The functional and relay ROVs will swap roles.</li> <li>2. The functional ROV (Large ROV) will be parked at the outside corner of a building.</li> <li>3. The CCS and the relay ROV (Small ROV, which will be turned off) will move parallel to one side of the building, increasing the distance between the CCS and functional ROV in 25 m increments (<b>Figure 5</b>). At each increment, communications between the functional ROV and the CCS will be confirmed.</li> </ol>  <p><b>Figure 5.</b> Short-range relay test – CCS and Relay ROV moving away from the functional ROV.</p> <ol style="list-style-type: none"> <li>4. Repeat step 3 until there is consistently no communication between the CCS and the functional ROV.</li> <li>5. Once there is no communication between the CCS and the functional ROV, the relay ROV from the location of the CCS will be turned on and travel towards the functional ROV (<b>Figure 6</b>).</li> </ol>  <p>Once Large ROV is out-of-sight with CCS and controlled via the Small ROV then it is compliant</p> <p><b>Figure 6.</b> Short-range relay test – relay ROV moving towards the functional ROV and CCS moving out of line-of sight with functional ROV.</p> |   |      |

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|--------|--------------------------|---|--|---|------|
|        |                          |   |  | "C"   | "NC" |
|        |                          |   | <p>6. At 25 m increments from the CCS, the relay ROV will stop, and a connection with the functional ROV will be attempted.</p> <p>7. When the CCS can communicate with the functional ROV and is confirmed to be completely functional, then the relay ROV will be compliant with acting a line-of-sight RF communication relay.</p> <p>8. Once the connection between the CCS and the functional ROV is established, the relay ROV will travel an additional 25 m to 50 m closer to the functional ROV, and the CCS will move perpendicular to the travelling relay ROV and out of line-of-sight with the functional ROV (building will be in the way).</p> <p><b>Compliance achieved if</b> the functional ROV (Large ROV) can be controlled via the relay ROV (Small ROV) and when images from either selected ROV can be displayed.</p> <p>NOTE: If the range of one of the ROVs is twice as great as the other, then there is a possibility that using distance to activate the ROVs relaying feature is not suitable. If this occurs, then an alternate test method using a building to block RF signals will be used to confirm the Small ROV's ability to be used as a non-line-of-sight communications relay.</p>  |   |      |
| T8A    | ANNEX A – Para A2.4.2.1  | <p><b>Atmospheric Conditions</b></p> <p>The Large ROV must operate in heavy rain up to 20 mm/hr and rain driven by wind gusts up to 40 km/h over a period of no less than one (1) hour operation.</p> | <p><b>Equipment Requirements:</b> One (1) Large ROV and CCS, with one set of batteries each, and test apparatus;</p> <p><b>Large ROV Operator:</b> Evaluator personnel will operate the Large ROV.</p> <p><b>Concept of Test - Heavy Rain:</b><br/>The Large ROV will be operated in a simulated rain of up to 20 mm/hr rainfall rate with wind of up to 40 km/h.</p> <p><b>Procedure:</b></p> <ol style="list-style-type: none"> <li>1. The evaluator will set up the test apparatus to simulate rain up to 0.33 mm/min rainfall rate and up to 11.1 m/s wind.</li> <li>2. The Large ROV will be operated on a figure eight track for a total of 60 minutes with an operation pattern of 10-minute drive/10-minute park under the simulated rain. There will be one layer of 5 cm thick concrete slabs on the track. The Large ROV will be inspected at the 20 min and 40 min intervals during this evaluation.</li> <li>3. Large ROV inspection will include verification of Large ROV movements (wheels/tracks, camera tilt (if tilt is possible), manipulator arm, and gripper), operation of video communication, operation of wheel brakes, verification of power-on and initialization sequence, and signs of damage and water accumulation in the Large ROV.</li> <li>4. The Large ROV will be given two (2) attempts to complete this test.</li> </ol> <p><b>Compliance achieved if</b> the Large ROV continues to operate and is fully functional throughout the entire heavy rain test.</p> |   |      |
| T8B    | ANNEX A – Para A2.4.2.2  | <p><b>Atmospheric Conditions</b></p> <p>The Large ROV must operate in blowing sand and dust caused by wind gusts up to 40 km/h over a period of no less than one (1) hour.</p>                        | <p><b>Equipment Requirements:</b> One (1) Large ROV and CCS, with one set of batteries each, and test apparatus;</p> <p><b>Large ROV Operator:</b> Evaluator personnel will operate the Large ROV.</p> <p><b>Concept of Test - Blowing Sand:</b><br/>The Large ROV will make 360° turns in blowing sand environment with conditions shown in <b>Table 4</b> (below). After the sand exposure, the evaluator will visually verify that the Large ROV is functional.</p>   |   |      |

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|------------------------------|--------------------------|-------------------------|--|---|--------------------------|--------------------|-----------|--------------------|-------------|------------------------------|----------|---------------------------|-----------|--|--|
|                              |                          |                         |  | "C"   | "NC"                     |                    |           |                    |             |                              |          |                           |           |  |  |
|                              |                          |                         | <p><b>Table 4.</b> Test conditions for the blowing sand test.</p> <table><tr><td>Material</td><td>Ground Calcium Carbonate</td></tr><tr><td>Particle size (µm)</td><td>150 - 850</td></tr><tr><td>Air velocity (m/s)</td><td>Up to ~11.1</td></tr><tr><td>Ambient air temperature (°C)</td><td>Up to 30</td></tr><tr><td>Sand concentration (g/m³)</td><td>2.2 ± 0.5</td></tr></table> <p><b>Procedure:</b></p> <ol style="list-style-type: none"><li>The Large ROV will be placed immediately in front of the test apparatus with the Large ROV's front chassis facing the apparatus (refer to <b>Figure 7</b> for diagram of test chamber and apparatus), the hopper will be filled with sand particles and start the fan on the test apparatus.</li><li>The Large ROV will be exposed to the air/sand stream for 10 minutes. During the exposure, the Large ROV will repeatedly perform the following manoeuvres:<ol style="list-style-type: none"><li>360° pivot turn in a clockwise (CW) direction.</li><li>Tilting of the camera to the maximum angle (if camera tilts).</li><li>360° pivot turn in a counter-clockwise (CCW) direction.</li></ol></li><li>The Large ROV will be driven out of the air/sand stream.</li><li>Operation of the Large ROV will be verified by doing the following:<ol style="list-style-type: none"><li>The Large ROV operator will navigate the Large ROV on a straight path (two 5 m runs) with a U-turn at the end of first run.</li><li>The evaluator will visually verify normal operation of the Large ROV (including verification of Large ROV movements (wheels/tracks, camera tilt (if tilt is possible), manipulator arm, and gripper), operation of video communication, operation of wheel brakes).</li></ol></li><li>The Large ROV will have two (2) attempts to complete this test.</li></ol> <p><b>Compliance achieved if</b> the Large ROV continues to operate and is fully functional throughout the entire sand test.</p>  <p><b>Figure 7.</b> Test Apparatus for blowing sand test.</p> | Material  | Ground Calcium Carbonate | Particle size (µm) | 150 - 850 | Air velocity (m/s) | Up to ~11.1 | Ambient air temperature (°C) | Up to 30 | Sand concentration (g/m³) | 2.2 ± 0.5 |  |  |
| Material                     | Ground Calcium Carbonate |                         |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Particle size (µm)           | 150 - 850                |                         |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Air velocity (m/s)           | Up to ~11.1              |                         |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Ambient air temperature (°C) | Up to 30                 |                         |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |
| Sand concentration (g/m³)    | 2.2 ± 0.5                |                         |  |   |                          |                    |           |                    |             |                              |          |                           |           |  |  |