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**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**

Letter of Interest

Lettre d'intérêt

**Vendor/Firm Name and Address**

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Armoured Vehicles Support/Soutien des véhicules  
blindés

11 Laurier St./11, rue Laurier

Place du Portage Phase III 6C1

Gatineau

Québec

K1A 0S5

<b>Title - Sujet</b> Next Generation Fighting Vehicle Pr Véhicule combat nouvelle génération	
<b>Solicitation No. - N° de l'invitation</b> W6399-19KH53/D	<b>Amendment No. - N° modif.</b> 003
<b>Client Reference No. - N° de référence du client</b> W6399-19KH53	<b>Date</b> 2021-11-18
<b>GETS Reference No. - N° de référence de SEAG</b> PW-\$\$BL-299-28290	
<b>File No. - N° de dossier</b> 325bl.W6399-19KH53	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Solicitation Closes - L'invitation prend fin</b> <b>at - à 02:00 PM</b> Eastern Daylight Saving Time EDT <b>on - le 2022-03-31</b> Heure Avancée de l'Est HAE	
<b>F.O.B. - F.A.B.</b> Specified Herein - Précisé dans les présentes <b>Plant-Usine:</b> <input type="checkbox"/> <b>Destination:</b> <input type="checkbox"/> <b>Other-Autre:</b> <input checked="" type="checkbox"/>	
<b>Address Enquiries to: - Adresser toutes questions à:</b> Parent, Derek	<b>Buyer Id - Id de l'acheteur</b> 325bl
<b>Telephone No. - N° de téléphone</b> (819) 790-8315 ( )	<b>FAX No. - N° de FAX</b> ( ) -
<b>Destination - of Goods, Services, and Construction:</b> <b>Destination - des biens, services et construction:</b> N/A	

**Instructions: See Herein**

**Instructions: Voir aux présentes**

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<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>



## Letter of Interest (LOI) W6399-19KH53/D

### Amendment 003

## Next Generation Fighting Vehicle (NGFV) Project

### INTRODUCTION

The purpose of this amendment (003) is to continue to share updated information as part of the Industry Engagement Strategy for the Next Generation Fighting Vehicle (NGFV) project and to notify Industry that the closing date of this LOI has been extended to **March 31, 2022** at 02:00 PM Eastern Standard Time (EST).

Industry is invited to review the following two (2) additional documents and provide feedback on or before **January 31, 2022**:

1. PROTECTION REQUIREMENTS

The example HLMR 1 Survivability Instructions in order to provide the required proof of compliance.

2. LOAD LIST, ELECTRICAL AND C5ISR INFORMATION

The NGFV Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) requirement in order to specify the expected equipment that is to be integrated, along with the suggested diagrams.

The intent of the industry engagement is to continue sharing additional information when it becomes available to better understand what industry has to offer, and to help the NGFV project team progress the requirement definition activities.

Industry is encouraged to provide, at any time during this solicitation, additional information or feedback that is felt to be relevant to the NGFV Project.

### ALL OTHER TERMS AND CONDITIONS REMAIN UNCHANGED

**DEPARTEMENT OF NATIONAL DEFENSE**

**PROTECTION REQUIREMENTS**

**INSTRUCTIONS TO BIDDER FOR PREPARATION OF THEIR PROPOSAL**

## TABLE OF CONTENT

1	General .....	5
2	Orientation and Axis Conventions.....	5
3	Definitions.....	7
4	General technical data on the armour protection System (APS).....	9
4.1	Vehicle images and technical data: .....	9
4.2	Vehicle orthogonal view images.....	9
4.3	Vehicle physical characteristics:.....	10
4.4	Occupant seating system & position: .....	11
4.5	Armour system technical data. ....	12
5	Kinetic Energy (KE) threat protection.....	16
5.1	KE test plan and target info.....	16
5.2	KE test results.....	17
5.3	KE Vulnerable Area (VA) Analysis. ....	19
5.4	Compliance criteria.....	22
6	Mine threat protection .....	23
6.1	Mine test plan parameters & test configuration.....	23
6.2	Mine test data and results. ....	28
6.3	Compliance criteria.....	30

## LISTE OF FIGURES

Figure 1: Azimuth view angles convention .....	6
Figure 2: Elevation views angles convention .....	6
Figure 3: Vehicle origin and reference axis convention .....	6
Figure 4: Example of vehicle orthogonal views .....	10
Figure 5: Example of a MAconf distribution image for the 90_0 view .....	14
Figure 6: Example of a SWAconf Distribution Image for the 90_0 View .....	15
Figure 7: Example Of A VA Distribution Image For The 90_0 View .....	21
Figure 8: Extracts Of The VA Image For Calculation Of The Projected Area .....	22
Figure 9: Example of ATD & Charge Position - Top view (90_90) .....	24

## LISTE OF TABLES

Table 1: Required vehicle orthogonal views .....	9
Table 2: Example Of Vehicle Physical Characteristics Summary For One Vehicle Variant .....	11
Table 3: Example Of Occupant Seating Systems And Positions.....	11
Table 4: Example Of Main Armour Configuration Summary .....	12
Table 5: Example of a fictitious Main Armour Configuration Details Table .....	12
Table 6: Required Views For The Armour Configuration Distribution .....	13
Table 7: Example of Structural Weak Armour Configuration Summary .....	14
Table 8: Example Of One Structural Weak Armour Configuration Details .....	15
Table 9: Summary of the Kinetic Energy Threat Protection .....	16
Table 10: Example Of Targets And Impact Angle Summary For MA And SWA .....	17
Table 11: Minimum Number of Fair Shoots for different KE Threat Levels .....	19
Table 12: Minimum Number Of VA Images For Various Protected Attack Angles .....	20
Table 13: Recommended Format For The VA Analysis Summary .....	22
Table 14: Summary of the Mine Threat Protection .....	23
Table 15: Summary Of ATD And Charge Position.....	24
Table 16: Example Of Target Vehicle Sub-System Summary .....	25
Table 17: Example Of Test Vehicle Mass Distribution Summary .....	25

## **1 General**

This appendix describe the information and physical items that the Bidder is required to prepare and present with regards to the survivability portion of its proposal to DND. It also provides information on the methodology and criteria used by DND to assess the compliance and to score the proposal. All the technical information related to the armour configuration, performance, test results and identification of vulnerability provided by the Bidder as part of its bid proposal shall be submitted in a separate Volume (Volume X) and shall be classified SECRET.

The Bidder must clearly provide proof the experimental data provided were produced using the test conditions specified in the referenced standards explicitly identifying any deviation(s) to the requested test conditions. When deviations exist bidders must provide technical documentations that demonstrate the test conditions used in their proof of compliance proposal data were as severe as or more severe than the conditions specified in the requested standards specified in this document.

The Bidder must clearly provide proof the experimental data provided were produced using the same vehicle configuration proposed for this acquisition contract. If deviations exist, the bidder must explicitly identify the deviations and must provide technical documentation that demonstrates the proposed vehicle configuration for this project will perform equally or better than the configuration version tested. The technical documentations provided must include comparative analysis specifically addressing the deviations and consist of one or several of the following studies: Experimental, numerical simulation and/or analytical studies.

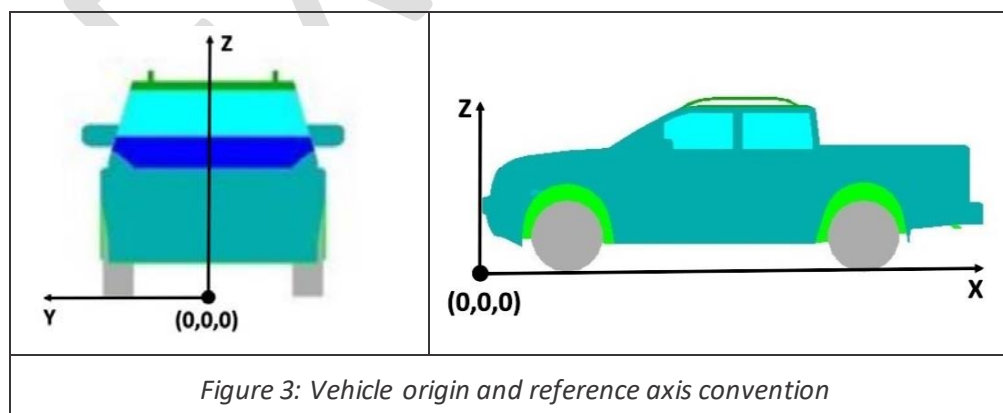
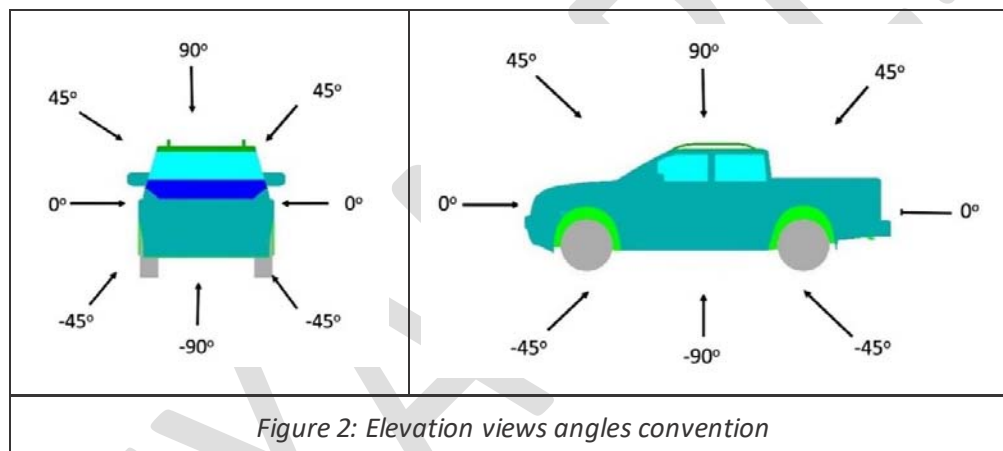
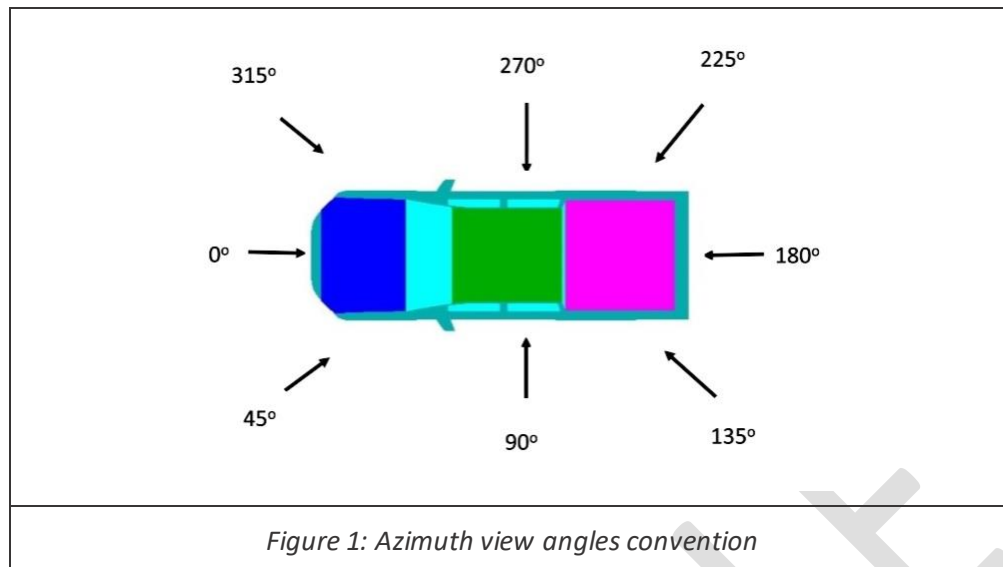
Throughout the documents figures and fictitious tables are provided as examples only.

## **2 Orientation and Axis Conventions**

In this document, the attack angle (Azimuth and Elevation) conventions and vehicle reference axis provided in Figure 1 to Figure 3 are used.

The bidders should use the herein described axis and orientation convention as well as the International System of units (SI) on their proposal. Otherwise, the bidder must provide and clearly describe the axis and unit convention used in their specific proposal.

Protection Requirements – Instructions to Bidders - *Example*





### 3 Definitions

The definition of common terms used throughout this document is provided below. Some of those definitions are extracted from AEP-55 Vol. 1, version 1, Edition C, April 2014 or Vol. 2 version 1, Edition C, May 2014.

**Occupant Space or Crew Compartment:** Is the volume in which the vehicle occupants (Crew, passengers, operators) are enclosed and offering the required level of protection. For this specific vehicle configurations, two (2) distinct crew compartments are defined:

**Driver Cabin** compartment: Protecting the driver and the co-driver (occupant)

**Operator Cabin:** Protecting the Crane Operator

**Main area (MA):** As defined in AEP-55 Vol. 1, Ed C, section 3.3.4, MA are relatively uniform armour panel areas that provides protection coverage against the specific threat levels. However, these MA's may not be fully homogeneous in their protection performance as that can contain zones of ballistic or structural weakness, such as Localized Weak Areas (LWA) and Structural Weak Areas (SWA).

**Localized Weak Area (LWA):** As defined in AEP-55 Vol. 1, Ed C, section 3.3.4, Where MA systems are constructed from a combination of materials or rely on geometrical effects to defeat a threat, the protection provided may not be fully consistent over the full armour area. A typical example is the use of ceramic tiles in composite armour where tile joints may present areas of potential weakness. Where present, LWA are typically distributed over the MA.

**Structural Weak Areas (SWA):** As defined in AEP-55 Vol. 1, Ed C, Section 3.3.4, SWA are armour panel discontinuities that are potentially ballistically or structurally weaker zones. SWA are generally edge oriented and not normally distributed in the MA. Classic examples are component interfaces (doors/windows) and main area panel intersections (clearance gaps, weld joints and associated heat affected zones).

**Armour configuration:** An armour configuration is defined as a recipe of armour, and composed of the same layering sequence, the same material(s), spacing and thicknesses. An armour configuration can be composed of the following types of sub-armour layers:

**Base armour:** A base armour (BA) layer is a layer that is part of the integral design of the vehicle and is not designed to be added or removed. The removal of a BA layer would normally require considerable resources and be done by specially qualified technicians.

**Add on Armour (AoA):** An add-on armour (AoA) or appliqué armour layer, is layer that is designed to be added or removed based on operational requirements. AoA are typically bolted on the exterior BA layer of the vehicle to increase the protection performance of the base armour of the vehicle.

**Main Armour Configuration (MAConf):** Main Armour Configuration is defined as an armour configuration for the main area of the protection system.

**Structural Weak Armour Configuration (SWAConf):** Structural Weak Armour Configuration is defined as an armour configuration for a structural weak area of the protection system.

**Expected Protection Capability (EPC):** The EPC is the potential of a protection system to resist an attack. The EPC can be expressed as the probability of a having a penetration inside the occupant space, assuming a penetration in vulnerable area (VA) and no penetration in protected area (Ap). The EPC is calculated for each attack view angle, as the ratio of the projected Protected Area (Ap) over the projected Total Area of (Ao) the occupant space.

**Local deformation loading:** Is the loading produced by the reaction of an area of the vehicle structure when directly or indirectly subjected to and overpressure loading. The local deformation loading is characterized by a fast reaction of the vehicle hull (Typically ranging from 10-100 m/s peak velocity, and between 20mm-200mm peak displacement), depending on the charge size, hull structure design and proximity of the detonation point.

**Global motion loading:** Is the loading produced by the reaction of the complete vehicle motion as a reaction to the total impulse generated by the overpressure loading. All occupants and components in the vehicle will be subjected to this loading. Its intensity will depend on the total impulse produced by the threat, the vehicle mass and Inertia properties (Mass, center of gravity & moment of Inertia matrix), the position of the threat and the position of the occupants or components. The global motion loading is characterized by a lower displacement velocity, but a higher displacement amplitude (typically ranging from 1-10 m/s peak velocity and 0.2-2m peak displacement).

**Test series:** A test series is defined as a series of consecutive shots performed using the same test conditions (Ammunition, impact velocity, impact angle) on a same armour configuration. A test series can be done on several representative engineered targets or area of a full vehicle, as required to conduct the requested number of shots to qualify an armour configuration.

**Still photo:** Still photos are important source of data that provides visual details of a set-up, results and can allow documentation and measurement of dimensions. The following photo types are referred within this document:

**Overall photo:** Overall photographs, as the name implies, capture the global aspects of the scene. Their purpose is to show exactly where the scene was, to the exclusion of any other location, and to show all boundaries of the scene. These photographs are typically taken in an overlapping fashion from the outside of the perimeter looking in, and from the center of the scene looking out, covering all areas of the scene. Items of evidence and their spatial relationships may be visible, but they are not the main subject of the photograph. (<https://www.l-tron.com/what-three-types-of-photographs-are-taken-at-crime-scenes/>)

**Mid-range photo:** Midrange photographs transition the viewer from an “outsider looking in” perspective to a more involved perspective. Items of evidence and their spatial relationships are shown, typically by depicting a single item in relation to a fixed object in the scene. Done correctly, this technique will show proper context, perspective, and scale. It will also show the precise position of each item of evidence.

**Close-up photo:** Close-up photographs are deliberate depictions of individual items of evidence. They show all sides of the item and clearly show any markings, defects, or other identifying features. Each photograph is usually taken twice: once with a scale, and once without a scale. The image sensor of the camera must be oriented parallel to the surface being photographed. The item must fill the frame of the camera. Shadows must be eliminated unless they are intentional (e.g., present from oblique lighting to show texture). Because of these requirements, close-up photography may be deferred until it can be accomplished under controlled conditions.

## 4 General technical data on the armour protection System (APS)

### 4.1 Vehicle images and technical data:

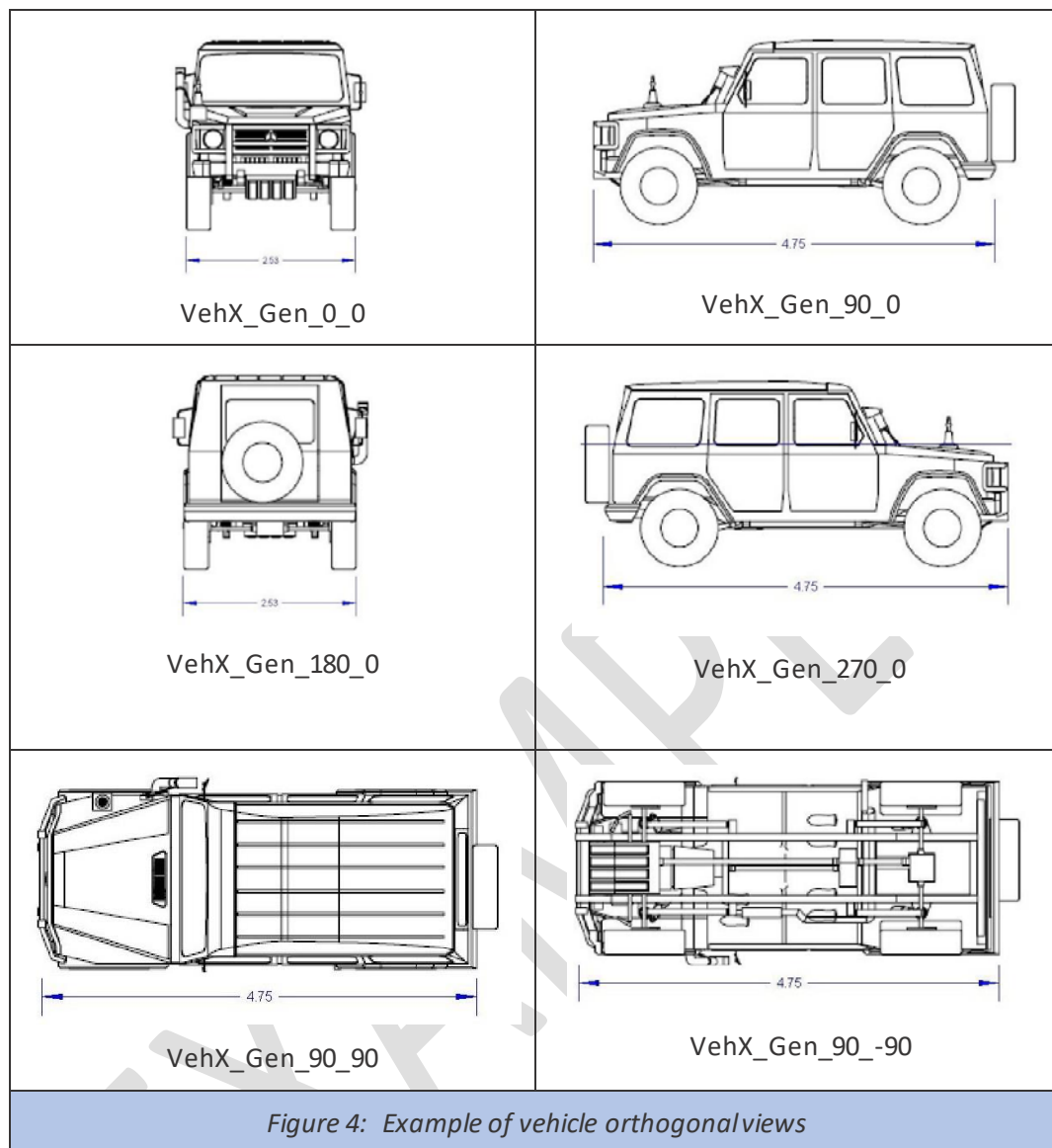
The bidder must provide the following data that will allow DND to have a specific and detailed description of each proposed vehicle configuration and have key physical characteristics of each vehicle configuration (variant) that are required to analyse its survivability capabilities.

### 4.2 Vehicle orthogonal view images.

The bidder must provide black and white images of the vehicle generated from CAD sketches, for each of the 6 orthogonal views identified in Table 1, and shown as examples in Figure 4. These images must be included in the technical proposal document, as well as individual electronic images in .jpeg format, with a minimum resolution of 600 pix x 600 pix. These images should be packaged in a file folder named: **VehID\_Gen\_Views**. Each individual image must include:

- Black and white CAD image showing the requested view, of the complete external view of the vehicle with features details such as doors, handles, panels boundaries, lights, tapping pads, etc.
- A reference measurement for scaling purpose.
- The name given to the individual images, should be of the following format: **VehID\_Gen\_Az\_El.jpg** (Example: VehXyz\_Gen\_90\_0.jpg for the left orthogonal view)

Table 1: Required vehicle orthogonal views			
View	View Name	Azimuth °	Elevation °
1	Front orthogonal view	0	0
2	Left orthogonal view	90	0
3	Rear orthogonal view	180	0
4	Right orthogonal view	270	0
5	Top orthogonal view	90	90
6	Bottom orthogonal view	90	-90



#### 4.3 Vehicle physical characteristics:

The following data relative to the mass and physical properties of each vehicle variant must be provided:

- Gross vehicle weight (GVW).
- Center of gravity (CoG) coordinate (x,y,z).
- Values of the moments of inertia ( $I_{xx}$ ,  $I_{yy}$ ,  $I_{zz}$ ,  $I_{xy}$ ,  $I_{xz}$ ,  $I_{yz}$ ), with respect to the CoG.
- Vehicle ground clearance reference point and value.

An example of a fictitious Vehicle Physical Characteristics summary is provided in Table 2

## Protection Requirements – Instructions to Bidders - *Example*

<i>Table 2: Example Of Vehicle Physical Characteristics Summary For One Vehicle Variant</i>	
Vehicle Variant:	VehX_Variant1
Parameter	Without Payload (Curb weight)
Curb weight (kg) (+/- 1kg)	
Gross vehicle weight (kg) (+/-1kg)	
CoG coordinates (m) (+/-0.01m)	
X	
Y	
Z	
Moment of Inertia wrt CoG (kg-m <sup>2</sup> ) (+/-1 kg-m <sup>2</sup> )	
Ixx	
Iyy	
Izz	
Ixy	
Ixz	
Iyz	
Ground clearance (m) (+/-0.01m)	
Ref Point (Example: Under front differential)	
Ref Point (Example: Under rear differential)	

### 4.4 Occupant seating system & position:

The following data relative to the seating systems and seating location must be provided for each of the vehicle occupant seats and for each vehicle variant:

- Seat ID number
- Seat description and occupant name (Driver, co-driver, passenger)
- Seat model and name.
- Coordinate of the seat pan center (x,y,z).
- Picture of each seat models.

An example of a fictitious occupant seating systems and positions summary is provided in Table 3

<i>Table 3: Example Of Occupant Seating Systems And Positions</i>					
Seat ID	Description	Model	Seat pan center coord (m)		
			X	Y	Z
Seat 1	Driver	Model ABC	1.75	-1.23	0.52
Seat 2	Co-Driver	Model ABC	1.75	1.23	0.52
Seat 3	Rear Right occupant	Model XYZ	2.78	1.23	0.54
Seat 4	Rear Center occupant	Model XYZ	2.78	0.02	0.54
Seat 5	Rear Left occupant	Model XYZ	2.78	-1.23	0.54

#### 4.5 **Armour system technical data.**

The bidder must provide the following data including a detailed description of the vehicle armour system characteristic. This information is required to assess and analyse its armour system performance. The armour system technical data must include the following:

**4.5.1 Main Armour configuration summary.** For each identified crew compartments, the bidder must provide a summary with identification and a general description and distribution of each main armour configurations (MA) of the protection system found on the vehicle (all around) including: the front, sides, rear, top and bottom.

An example of a fictitious Main armour configuration summary is provided in Table 4.

<i>Table 4: Example Of Main Armour Configuration Summary</i>			
Serial	ID or Code	MAconf Name	Description & General Location
1	MAconf_01	AoA1 and BA1	Composite armour on doors
2	MAconf_02	BA1_model xyz	Alloy armour on side and engine wall
3	MAconf_03	BA2_model kij	Alloy armour on rear wall & roof
4	MAconf_04	TA1_model x	Transparent armour _side windows
5	MAconf_05	TA2_model y	Transparent armour _winshield
6	MAconf_06	BA3_model frq	Alloy armour on floor

#### 4.5.2 **Main armour configuration details.**

For each main armour configuration identified in the MA configuration summary, a detailed description of the armour is required. This must include, layers sequence, layer type, layer material name, and layer material thickness. The layers sequencing must be ordered starting with the outside (strike face) layer, moving toward the inside of the vehicle. The requested information must contain the following information:

- Main armour configuration ID or code
- layers sequence
- Layer type (Base armour or Add-on Armour)
- Layer material class (Steel alloy, Aluminium alloy, Alumina ceramic, GFRP composite, etc)
- Thicknesses of the layer

An example of a fictitious Main armour configuration detail is provided in Table 5.

<i>Table 5: Example of a fictitious Main Armour Configuration Details Table</i>			
ID	MAconf_01		
Name	AoA1 and BA1		
Layer sequence	Layer type	Layer material Class	Layer thickness (mm)
1	AoA	Alumina-Ceramic	7.5
2	AoA	GFRP Composite	4.4
3	Base armour	Steel_Alloy	6.4

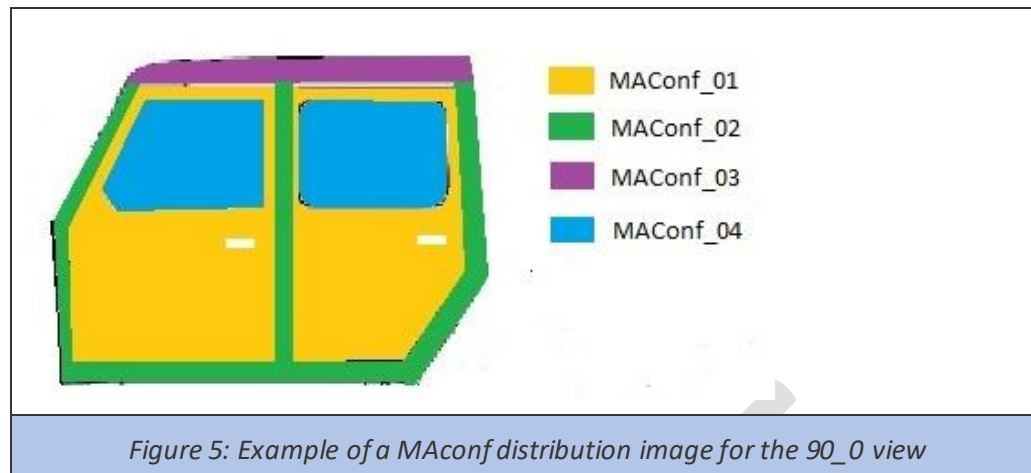
4	Base armour	GFRP Composite_Xz	4.7
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#### 4.5.3 **Main Armour configuration distribution.**

The bidder must provide technical data, for identification and distribution of each main armour configuration found on the vehicle. The distribution of the main armour configuration for the each specified protected occupant space, must be presented in the form of colored coded images. The CAD image must show details of the armoured shell (occupant compartment). Unless part of the protection system, all automotive and auxiliary components such as engine compartment, mirrors, soft skin components, must be hidden. The images must be included in the technical proposal document and provided in electronic format, in a folder named: **VehID\_MAcnf\_Views**. This folder must include the individual electronic images in .jpeg format, of minimum resolution of 600 x 600 pix, for each of the requested view identified in Table 6. Examples of images are provided in Figure 5. The following information must be provided:

- Armour configuration ID color legend
- CAD image showing the disposition of each armour configuration (using color mapping), and with reference measurement for scaling purpose.
- The name of the individual images should be of the following format:  
**VehID\_Armconf\_Az\_El.jpg** (eg: VehXYZ\_Armconf\_90\_0.jpg for the left orthogonal view)

<i>Table 6: Required Views For The Armour Configuration Distribution</i>			
View	View Name	Azimuth °	Elevation °
1	Front orthogonal view	0	0
2	Left orthogonal view	90	0
3	Rear orthogonal view	180	0
4	Right orthogonal view	270	0
5	Top orthogonal view	90	90
6	Bottom orthogonal view	90	-90



#### 4.5.4 Structural Weak Armour (SWAConf) Configuration summary.

The bidder must provide a summary with identification and the general description and distribution of each structural weak armour configuration of the vehicle protection system found on the vehicle (all around) including: the front, sides, rear, top and bottom. The definition of a SWA is provided in AEP-55 Vol.1, Ed C, V1.0 section 3.3.

An example of a fictitious Structural Weak Armour configuration summary is provided in Table 7.

Table 7: Example of Structural Weak Armour Configuration Summary		
Serial	ID or Code	Description & general location
1	SWAconf_01	MAconf_01 AoA panels intersection
2	SWAconf_02	MAconf_01 AoA attachment points
3	SWAconf_03	MAconf_01_AoA panel edges
4	SWAconf_04	MAconf_02 panel edges & welds
5	SWAconf_05	MAconf_04 frame & edges
6	SWAconf_06	MAconf_02 & MAconf_03 edges and weld
7	SWAconf_07	MAconf_02 & MAconf_06 edges and weld
8	SWAconf_08	Door perimeter gap

#### 4.5.5 Structural weak armour Configuration details.

For each structural weak armour configuration identified in the summary, a detailed description of the configuration is required. This description must include, layers sequence, layer type, layer material name, and layer material thickness. The layers sequencing must be ordered starting with the outside (strike face) layer, moving toward the inside of the vehicle. The requested information is provided below.

- SWA armour configuration ID or code
- layers sequence
- Layer type (Base armour or Add-on Armour)
- Layer material name



e. Layer thicknesses

An example of a fictitious Structural Weak Armour configuration details is provided in Table 8.

Table 8: Example Of One Structural Weak Armour Configuration Details			
ID			SWAconf_04
Layer sequence	Layer type	Layer material	Thickness (mm)
1	Base armour	Steel Trademark_Y_Weld & HAZ	6.7
2	Base armour	Composite_Xz	4.7

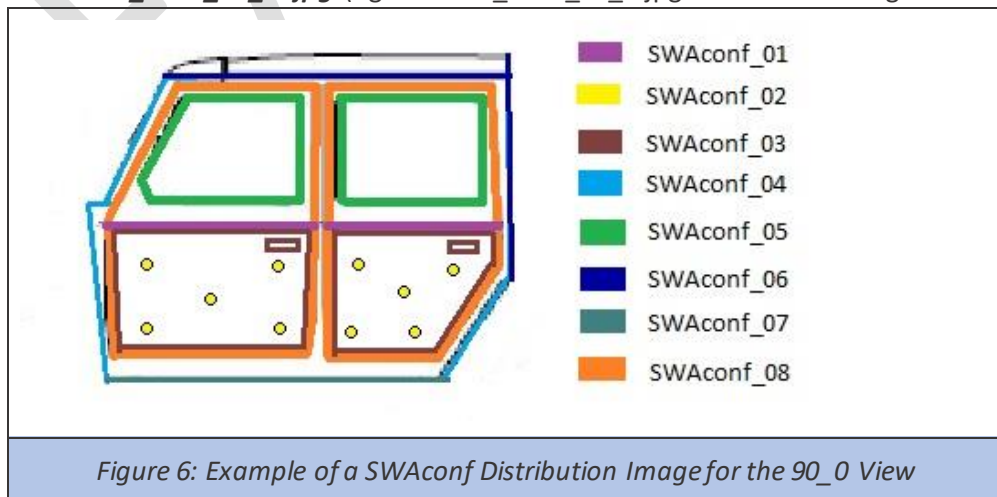
#### 4.5.6 Structural Weak Armour Configuration distribution.

The bidder must provide technical data required for identification and distribution of each structural weak armour configuration found on the vehicle. The distribution of the SWAconf for the required occupant spaces, must be presented in the form of colored coded images. The CAD image must show only the armoured shell (occupant compartment). Unless part of the protection system, all automotive and auxiliary components such as engine compartment, mirrors, soft skin components, must be hidden. The images must be included in the technical proposal document and provided in an electronic folder named:

**VehID\_SWAconf\_Views.** This folder must include the individual electronic images in .jpeg format, of minimum resolution of 600 pix x 600 pix, for each of the requested orthogonal views identified in Table 1. Examples of images are provided in Figure 6.

The following information must be provided:

- Structural weak armour configuration ID color legend
- CAD images showing the disposition of each structural weak armour configuration (using color mapping), and with reference measurement for scaling purpose.
- The name of the individual images should be of the following format:  
**VehID\_SWA\_Az\_EI.jpg** (eg: VehXYZ\_SWA\_90\_0.jpg for the left orthogonal view)



## 5 Kinetic Energy (KE) threat protection

Table 9: Summary of the Kinetic Energy Threat Protection					
KXX	The APS must provide the vehicle occupants a kinetic energy threat protection level KX [PARTIAL] IAW AEP 55 Vol 1 Ed C.	Mandatory Requirement	POC - Test procedure, test report, vulnerable area analysis.	Mandatory requirement. No points allotted.	Test (Canada) - Test Coupons

Unless otherwise specified, In order to demonstrate POC, the bidder must provide the following information and data for the requirement identified in Table 9.

### 5.1 KE test plan and target info.

The bidder must provide the following technical data relative to the selection of the KE test conditions, development of the KE test plan and the selection of the targets used to conduct the qualification tests. The bidder must follow the methodology described to the AEP-55 Vol.1, Ed C, V1.0 Phase 1, section 3.3. More specifically, the test plan must include the following:

5.1.1 For each MA and SWA configuration identified in section 4.5, and exposed to the defined angles of attack of the specific threat level, the Bidder must calculation of the worst case attack angle, considering the azimuth and elevation of the ballistic threat scenario and the inclination of the MA and SWA configuration on the vehicle, as prescribed in AEP-55 Vol.1, Ed C, V1.0 section 3.3.2.

5.1.2 A table summarizing the selection of the MA configurations, type of target (Engineered target or full vehicle), with worst case testing angle of impact selected for each MA configuration. If not all MA configurations are tested, a justification for why a MA configuration was not tested is required. The following information must be provided:

- MA configuration ID & Name (consistent with previous section);
- Type of target (Engineered target (coupon) or Full vehicle/ATP Module);
- If LWA are present in this MA configuration (Yes/No);
- The worst case angle of impact for this configuration;
- Any additional pertinent information on target and selected test conditions for evaluating this MA configuration.

An example of targets and impact angle summary is provided in Table 10.

5.1.3 A table summarizing the selection of the SWA configurations, type of target (Engineered target or full vehicle), with worst case testing angle of impact selected for each SWA configuration. If not all SWA configuration are tested, the Bidder must provide a justification why a SWA configuration was not tested. The following information must be provided by the Bidder.

- SWA configuration ID & Name (consistent with previous section);
- Target type (Engineered(coupon)/full vehicle/ATP Module);

## Protection Requirements – Instructions to Bidders - *Example*

- c. Is LWA present in this SWA configuration (Yes/No);
- d. Worst case angle of impact for this SWA configuration;
- e. Any additional pertinent information on target and selected test conditions for evaluating this MA configuration.
- f. An example of targets and impact angle summary is provided in Table 10.

Table 10: Example Of Targets And Impact Angle Summary For MA And SWA				
MA/SWA Conf ID	Target Type	LWA (Yes/No)	Worst Angle of impact (°)	Notes
MAConf_01	Eng_target	Yes	0	
MAConf_02	Eng_target	No	0	
MAConf_03	Eng_target	No	60	
MAConf_04	Veh_target	No	0	

5.1.4 For each fully engineered target (coupon) selected for testing, an assembly manufacturing drawing package with dimensions must be provided by the Bidder including:

- a. MA & SWA configuration ID and name;
- b. Sub-assemblies and part number;
- c. Welding assembly specifications;
- d. Part level drawings, including material bill data including:
- e. Material generic name;
- f. Standard and certification;
- g. Thickness and tolerances;
- h. Density;
- i. Hardness and tolerances.

### 5.2 **KE test results.**

The bidder must provide the following test data relative to the execution of the ballistic tests performed to demonstrate the vehicle meets the required protection level. The test must be done following the test procedures and test conditions specified in the AEP-55 Vol.1, Ed C, V1.0 Phase 2 and Phase 3, as per section 3.4 and 3.5, and specific to the associated threat level of the requirements.

The test results must include the following:

#### 5.2.1 General Info, test conditions and test results, including:

- a. Testing organization name and address
- b. Test date
- c. Test range identification
- d. Threat level tested
- e. Test range temperature & humidity
- f. Photo, schematic or drawing of the test set-up.

## Protection Requirements – Instructions to Bidders - *Example*

- g. Description of the velocity measurement systems including: Name, model & serial number, and calibration date.
- h. Witness panel information including: Material alloy and thickness.
- i. For each test series:
  - i. Test series number ID;
  - ii. Type of test: MA (Phase 2) or SWA (Phase 3);
  - iii. Name and ID of the MA or SWA configuration;
  - iv. Target pre-conditioned temperature (if different from range);
  - v. Launcher (barrel): Caliber (mm), length (mm), twist (#/ meter);
  - vi. Ammunition details: Caliber, name, manufacturer, Lot No.;
  - vii. Desired striking velocity (m/s);
  - viii. Desired Incident angle of impact (°);
  - ix. Target type: Engineered target (coupon) or full vehicle;
  - x. List of targets ID in this test series.
  - xi. For each shot in a test series:
    - a) Target number ID;
    - b) Shot number ID;
    - c) MA or SWA configuration Name & ID;
    - d) Projectile mass (g);
    - e) Measured striking velocity (m/s);
    - f) Measured incident angle of impact (°);
    - g) Measured Yaw angle (°);
    - h) If LWA was exploited in this shot: Yes/No;
    - i) If yes, the type of LWA: Sub-component: e.g. joint edge, triple point, heat affected zone (HAZ), other;
    - j) For MA, multi-hit series shot number (1-4 for Full, 1-3 for Partial);
    - k) For MA, multi-hit previous shot distance (mm) (N or L);
    - l) Shot compliancy with test requirements (Fair or Unfair);
    - m) Witness panel stand-off;
    - n) Shot results (CP or PP);
    - o) Shot damage description (Bulge, bulge & crack);
    - p) Shot Valid (Yes / No);
    - q) Shot result (Pass/fail);
    - r) Any additional information pertinent to this shot;
    - s) Pictures of the strike face, target back face and witness panel with clearly visible shot number ID.

### 5.2.2 A summary of the test series performed on the MA configurations, including:

- a. Test series number ID;
- b. Main armour configuration Name & ID;
- c. Number of FAIR shots;
- d. Number of CP;
- e. Test series results (Pass/Fail);
- f. Justification if the number of shots was reduced;
- g. Any additional information pertinent to this series.

## Protection Requirements – Instructions to Bidders - *Example*

### 5.2.3 A summary of the test series performed on the SWA configurations, including:

- a. Test series number ID;
- b. SWA configuration Name & ID;
- c. Number of FAIR shots;
- d. Number of CP;
- e. Test series results (Pass/Fail);
- f. Any additional information pertinent to this series.

Armour configuration Pass / Fail. To pass the test and be identified as a protected Area (Ap) an armour configuration must meet the minimum number of required FAIR shots with No CP, for the associated threat levels specified in Table 11.

Shot FAIRNESS is defines in AEP-55 Vol 1, Ed C, Vol Section 5.6.

<i>Table 11: Minimum Number of Fair Shoots for different KE Threat Levels</i>			
<b>Type of Armour Configuration</b>	<b>KE 1-3</b>	<b>KE 4</b>	<b>KE 5-6</b>
MAConf	22	12	12
SWAConf	10	5	3

### 5.2.4 The Bidder must provide a statement, signed by the testing organization authority, indicating that:

- a. The armour configurations presented were tested at the determined threat level, and in accordance with the applicable test conditions;
- b. A statement indicating if the armour configuration tested passed or failed the test.

### 5.3 **KE Vulnerable Area (VA) Analysis.**

In this section the bidder must provide the following technical data relative to the provision of the VA analysis of the vehicle in order to demonstrate the armours systems meets the required Expected Protection Capability (EPC) (refer to article 5.4 below) against the define threat and attack scenario.

The VA analysis must be done following the procedures described to the AEP-55 Vol.1, Ed C, V1.0 Phase 4, as per section 3.6. The VA is done by identifying and calculating the relative projected area on the vehicle that is not providing the requested protection (Unprotected Area) for the crew and passengers. The unprotected Areas, combine ballistic holes (area where there is no protection systems) and area protected by an armour configuration (MA or SWA) that failed the ballistic test. More specifically, the Vulnerable Area Analysis must include the following:

**5.3.1 Vulnerable area identification and distribution.** Based on the vehicle design and results from the ballistic tests, the bidder must provide technical data required for identification, distribution and measurement of the VA found on the vehicle. The distribution of the VA for the assessed occupant space, must be presented in the form of colored coded images. The CAD image must show details of the armoured shell (occupant compartment). Unless part of the protection system, all automotive and auxiliary components such as engine compartment, mirrors, soft skin components, must be hidden. The images must be included in the technical proposal document and provided in an electronic folder named: **VehID\_VA\_Views**. This folder must include the individual electronic images in .jpeg format, of minimum resolution of 600pix x 600 pix.

Images of views covering the complete required protected angle of attacks for a specific threat, are required. The images must be extracted at a maximum increment of 15° of Azimuth & Elevation. A summary of the minimum number of images for different protected angles of attack is provided in Table 12.

<i>Table 12: Minimum Number Of VA Images For Various Protected Attack Angles</i>	
Protected Attack angle	Minimum Number of Images
Az: 360°; Elev: 0°-90°	121
Az: 360°; Elev: 0°-30°	72
Az: 360°; Elev: 0°	24
Az: ±30° ; Elev: 0°	4

Examples of a VA view image is provided in Figure 7. The following information must be included on each images:

- a. CAD images showing the disposition of each VA and protected area (using color mapping), with reference measurement for scaling purpose. The following color legend is recommended for the analysis:
  - i. Ballistic gaps: Red (RGB: 255,0,0);
  - ii. Failed Armour configuration: Blue (RGB: 0,0,255);
  - iii. Protected area (successful Armour Configuration): Green (RGB: 0,225,0).
  - iv. The name of the individual images should be of the following format:  
VehID\_VA\_Az\_El.jpg (eg: VehXYZ\_VA\_90\_0.jpg for the left orthogonal view).

**5.3.2 Calculation of the Expected Protection Capability (EPC).** Based on the identification and characterization of the VA on each requested views, the Bidder must provide the data and analysis used for calculating the lowest (minimum) Expected Protection Capability of the vehicle, as described in AEP-55 Vol.1, Ed C, V1.0 Phase 4, section 3.6.1.

For each of the requested number of views, as defined in Table 6 , the bidder must provide the measured projected area of the VA ( $A_u$ ) and the protected area ( $A_p$ ), and the calculation of the EPC. The VA will be calculated by summing the projected area consisting of ballistic gap and the failed armour configuration areas (red + orange surfaces). The protected area ( $A_p$ ) will be calculated by measuring its projected protected area (Green surfaces). The total

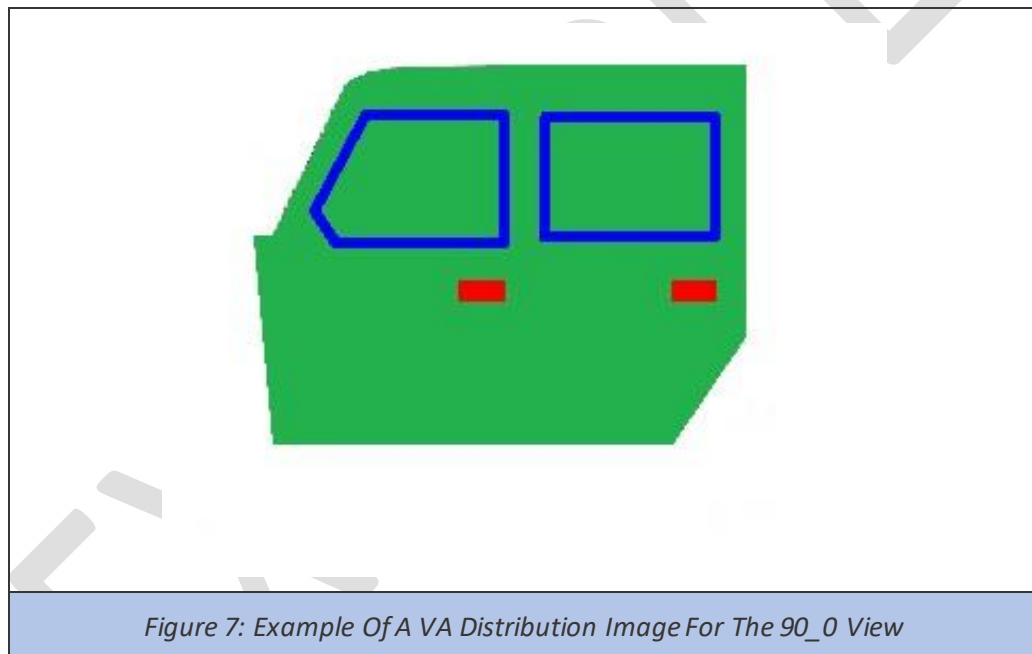
## Protection Requirements – Instructions to Bidders - *Example*

area ( $A_o$ ) will be calculated considering the interior surfaces of the armour configurations (back face of armour configurations) as boundaries for the occupant compartment. In such case, the total area ( $A_o$ ) is the sum of the protected ( $A_p$ ) and unprotected area ( $A_u$ ) ( $A_o = A_p + A_u$ ). An example of a fictitious image showing VA and  $A_p$  distributions is provided in Figure 8.

The EPC is calculated using Eq 1.

$$EPC = 100 \times \frac{A_p}{A_o} \quad (\text{Eq 1})$$

A summary table with values of  $A_u$ ,  $A_p$ ,  $A_o$  and ECP must be provided for each view. The values for  $A_u$ ,  $A_p$  and  $A_o$  should be scaled in physical units ( $\text{m}^2$ ). The minimum value of the EPC calculation must also be highlighted and provided as result of this analysis. An example of a fictitious VA analysis summary table format is provided in Table 13.



VA with ballistic gap	VA with failed armour	Protected area

Figure 8: Extracts Of The VA Image For Calculation Of The Projected Area

Table 13: Recommended Format For The VA Analysis Summary							
			$A_u$		$A_p$	$A_o$	EPC
View No	Az°	Elev°	Gap area (m2)	Failed area (m2)	Protected area (m2)	Total area (m2)	%
1	0	0	0.0648	0.398	4.805	5.228	91.9
...	...	...	...	...	...	...	...
9	90	0	0.061	0.384	4.678	5.123	91.3
...							
72	345	30	0.040	0.306	5.205	5.551	93.7
						Min EPC:	91.3

#### 5.4 Compliance criteria.

To be compliant for any identified KE Threat protection specified in Table 9, the bidder must:

- Provide all information specified in sections 4.1 and 4.2;
- For each specific vehicle, provide all information specified in section 5.1, regarding the **KXX** test plan and target data.
- For each specific vehicle, provide all information specified in section 5.2, regarding the **KXX** test results;
- For each specific vehicle, provide all the information specified in section 5.3 for the Vulnerability Area Analysis and demonstrate the vehicle EPC value is  $\geq 90\%$ .



## 6 Mine threat protection

Table 14: Summary of the Mine Threat Protection					
<b>MXX</b>	The APS must provide the vehicle occupants a mine threat protection level MXb IAW AEP 55 Vol 2 Ed C.	Mandatory Requirement	POC - Test procedure, test report, vulnerable area analysis.	To be defined - RFP Vol 1	Test (Canada) - Engineered Vehicle Target

Unless otherwise specified, In order to demonstrate POC, the bidder must provide the following information and data for **each** requirement identified in Table 14

### 6.1 **Mine test plan parameters & test configuration.**

The bidder must provide the following technical data relative to the selection of the mine test scenarios, the preparation of the vehicle targets used to conduct the qualification tests, the selection of the test method and the instrumentation details. The bidder must follow the methodology described to the AEP-55 Vol.2, Ed C, V1.0. More than one test may be required to qualify the vehicle. The test plan must include the following:

6.1.1 **Selection of the test scenarios.** The bidder must provide the assessed worst case scenario(s) Considering the floor Main armour (MA) configurations and Structural Weak Area (SWA), the internal components located on the floor, under the sub floor or inside the occupant compartment, and the seating position of the occupants and their susceptibility to local deformation and global motion loading, for the charges and occupant positions. The selection of the worst-case scenario test locations must be supported by one or several of the following analysis:

- a. Analytical or engineering studies;
- b. Validated numerical simulation studies;
- c. Previous experimental studies and results

6.1.2 **Assessed Worst Case Conditions.** The following information must be provided with regard of the assessed worst-case test conditions:

- a. A top orthogonal view showing the location of the charge and Anthropomorphic Test Dummy (ATD(s)) as per Figure 9;
- b. A bottom orthogonal view showing the location of the charge and ATD(s);
- c. CAD configuration drawings or image, showing the vehicle floor, and disposition of automotive components under the floor and sub-floor if any.
- d. CAD configuration drawing or images showing the disposition of all internal components inside the occupant compartment (ex: Stowage systems, AC units, console panels, etc...)
- e. The coordinates of the charge center (x,y,z) as per Table 15;
- f. The coordinates of the ATD(s) seat(s) pan center (x,y,z) as per Table 15

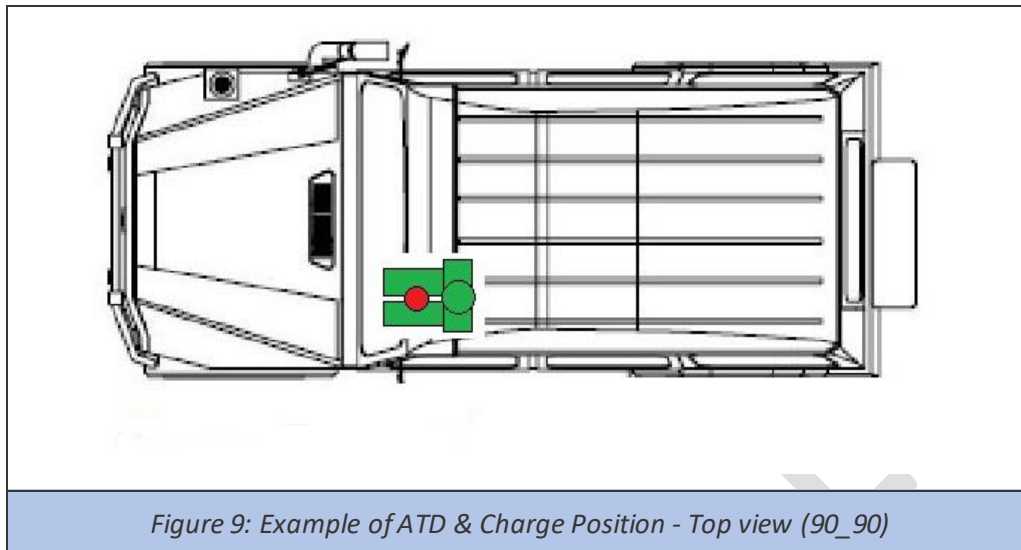


Table 15: Summary Of ATD And Charge Position

	Item	Description	Position		
			X (m)	Y (m)	Z(m)
Test 1	ATD 1	HIII 50 <sup>th</sup> percentile on driver's seat	1.75	-1.23	0.52
	Mine	Level MX mine	1.45	-1.23	0
Test 2	ATD 2	HIII 50 <sup>th</sup> percentile on driver's seat	2.78	1.23	0.54
	Mine	Level MX mine	2.48	1.23	0

6.1.3 Preparation of the representative test vehicle and internal configuration. For each test, the bidders must provide technical information regarding the vehicle target preparation and data to demonstrate the test vehicle is representative of an operational vehicle, as stated in AEP-55 Vol. 2 Ed C, and will provide realistic vehicle reaction during the test. The Internal components and structure, causing potential impact risk for the occupants at the locations being assessed are required to be provided. The test vehicle must be equipped, to a minimum, with the following sub-systems components:

- a. Base hull
- b. Under belly armour kit
- c. Side armour kit
- d. Wheels
- e. Suspension
- f. Engine
- g. Transmission
- h. Differential
- i. Drive shaft
- j. Drive line
- k. Steering and pedals
- l. Dashboard & Drivers console
- m. Seats & footrests

## Protection Requirements – Instructions to Bidders - *Example*

- n. Floor & sub-floor components
- o. Under sub-floor components

6.1.4 Unless part of the protection system, the vehicle speciality equipment, can be replicated by ballast weight. The ballast must be distributed as to provide the same operational weight distribution specified bellow. An example of the target vehicle subsystems summary is provided in Table 16.

<i>Table 16: Example Of Target Vehicle Sub-System Summary</i>					
Sub-System	Components	Installed (Y/N)	Real (R) or Surrogate (S)	GFE (Y/N)	Notes
Base hull	All	Y	R	N	
Belly armour	All	Y	R	N	
Side Armour	Opaque AoA	Y	S	N	Steel Surrogate for ballast
Side Armour	Transparent armour	Y	R	N	
Wheels	All	Y	R	N	
Suspension	All	Y	R	N	
Engine	Engine assy & auxiliary systems	Y	R	N	Can be non-serviceable
Transmission	Transmission assy	Y	R	N	Can be non-serviceable

6.1.5 The test vehicle must be ballasted to within 10% of the GVW, and with a Center of Gravity (CoG) located within a 75mm radius from the reference value provided in section 4.1 b. An example of the vehicle mass distribution summary is provided in Table 17.

<i>Table 17: Example Of Test Vehicle Mass Distribution Summary</i>				
	X (m)	Y (m)	Scale reading (kg)	Notes
Wheel No 1	$X_1$	$Y_1$	m1	
Wheel No 2	$X_2$	$Y_2$	m2	
Wheel No 3	$X_3$	$Y_3$	m3	
Wheel No 4	$X_4$	$Y_4$	m4	
Wheel No i	$X_i$	$Y_i$	mi	
CoG & GVW	$X_{COG}$	$Y_{COG}$	$\Sigma m1-mi$	

## Protection Requirements – Instructions to Bidders - *Example*

6.1.6 As specified in XXX-X04, the -XXX-X03, testing must be done using a Mine Buried in Water Saturated Sandy Gravel" method IAW AEP-55, Vol 2 Ed C.

6.1.7 Test Conditions. The bidder must provide the following data relative the test conditions used during the test:

- a. Soil characterisation data:
  - i. Test bed size (width, length, depth)
  - ii. Test bed granulometry analysis as per ASTM D422-63 or equivalent
  - iii. Test bed Modified Proctor optimum humidity value, as per ASTM D1557-10 or equivalent (%)
  - iv. Test bed Modified Proctor dry density value, as per ASTM D1557D-10 or equivalent ( $\text{kg/m}^3$ )
  - v. Test bed Modified Proctor dry density vs humidity curve.
- b. Test charge data:
  - vi. Main charge high explosive material
  - vii. Main charge material density ( $\text{g/cc}$ )
  - viii. Main charge shape: Cylindrical
  - ix. Main charge diameter (mm)
  - x. Main charge height (mm)
  - xi. Main charge mass (kg)
  - xii. Booster charge shape
  - xiii. Booster charge dimensions
  - xiv. Booster charge high explosive material
  - xv. Booster charge material density ( $\text{g/cc}$ )
  - xvi. Booster charge design mass
  - xvii. Detonator type and model
  - xviii. Charge casing material
  - xix. Charge casing thickness (mm)
  - xx. Pre-detonation picture of the charge assembly
  - xxi. X-Ray images of the charge assembly
  - xxii. Pre-detonation pictures showing the charge location with respect to the vehicle
- c. Test charge position details. The following additional measurements are required on the test charge positions:
  - i. Measurement of the charge depth of burial (DoB) (mm)
  - ii. For under wheel tests:
    - a) tire width (S) (mm)
    - b) Distance from charge center to center of the wheel or track (d) (mm)

6.1.8 Instrumentation details. The bidder must provide the instrumentation plan for measuring and assessing the qualification criteria specified in AEP-55 Vol. 2, Ed C, Section 6.4. For each test, the details of the instrumentation (sensors and settings) used for monitoring the event must be provided. The instrumentation detailed plan must include the following.

- a. Data acquisition system:
  - i. Manufacturer

## Protection Requirements – Instructions to Bidders - *Example*

- ii. Model
- b. ATD sensors and settings. For each ATD:
  - i. ATD ID
  - ii. ATD model
  - iii. List of ATD Clothing & personal protection equipment (PPE)
  - iv. ATD mass with clothing and PPE
  - v. For each channel/sensor on the ATD:
    - t) Body region
    - u) Channel name
    - v) Sensor type (accelerometer, load cell, potentiometer, ...)
    - w) Sensor manufacturer
    - x) Sensor model
    - y) Sensor sensitivity
    - z) Sensor gain
    - aa) Units of measurement
    - bb) Acquisition rate (Hz)
    - cc) Antialiasing filter
  - ii. ATD seating position (x,y,z)
  - iii. The following information relative to the ATD seating posture should be provided:
    - a) ATD neck angle setting
    - b) ATD pelvis angle measurement
    - c) ATD Head/helmet head clearance with vehicle roof/hatch
    - d) ATD foot clearance with floor
    - e) ATD torso angle with vertical
    - f) ATD femur angle with horizontal
    - g) ATD tibia angle with vertical
    - h) Pre-test Pictures of the ATD in its seating position
- c. High-speed camera and settings. For each high-speed camera:
  - i. Measurement description
  - ii. Camera ID
  - iii. Channel/file name
  - iv. Manufacturer
  - v. Model
  - vi. Serial no
  - vii. Resolution (pix x pix)
  - viii. Camera lens and focal
  - ix. Acquisition rate (Hz or fps)
  - x. Camera lens position in vehicle (x,y,z)
  - xi. Pictures of the hi-speed camera installation and position in the vehicle.
- d. Other dynamic instrumentation and settings. If additional dynamic instrumentations are used:
  - i. Measurement description
  - ii. Sensor type (accelerometer, load cell, potentiometer, ...)
  - iii. Sensor manufacturer

## Protection Requirements – Instructions to Bidders - *Example*

- iv. Sensor model
  - v. Sensor serial no
  - vi. Sensor sensitivity
  - vii. Sensor gain
  - viii. Units of measurement
  - ix. Acquisition rate (Hz)
  - x. Antialiasing filter
  - xi. Sensor position (x,y,z)
- e. Other static measurement systems. Information on the static measurement systems used to assess post detonation results such as hull rupture, floor deformation, and mass of secondary fragments or projectiles mass:
- i. Measurement description
  - ii. Sensor type (Scanner, micrometer, scale...)
  - iii. Manufacturer
  - iv. Sensor Model
  - v. Units of measurements.

### 6.2 Mine test data and results.

The bidder must provide the technical data and analysis of the test results, produced by a third-party test organization. The data and analysis must permit assessing that the vehicle meets the performance requirements as per AEP-55 Vol. 2 Ed C section 6.4. More specifically, the following data and analysis must be provided:

6.2.1 Post blast site observation results. The bidder must provide the following to provide a general view and understanding of the scene post detonation:

- a. Overall and mid-range photos of the vehicle post-blast;
- b. Mid-range photos of the ATD's position post-blast;
- c. Mid-range and close-up photos of the crater;
- d. Measurement of the apparent crater diameter and depth.

6.2.2 Occupant injury results. For each identified mandatory body regions in sub-para vi below, the bidder must provide:

- a. Signal post processing details of the raw data including:
  - i. Zero offset correction
  - ii. Filtration
  - iii. Decimation
  - iv. Graphical representation of the raw signal
  - v. Graphical representation of the processed/filtered signal
  - vi. Values of the for the following mandatory injury criteria:
    - i) Head Injury Criterion (HIC;
    - j) Neck compression time dependent curve (Fz-);
    - k) Neck tension criterion time dependent curve (Fz+);
    - l) Neck shear force time dependent curve (Fx,Fy);
    - m) Peak Neck flexion (Mocy+);
    - n) Peak Neck Extension (Mocy-);
    - o) Thorax Compression Criterion (TCC<sub>frontal</sub>);

## Protection Requirements – Instructions to Bidders - *Example*

- p) Thorax Viscous Criterion ( $VC_{frontal}$ );
- q) Spine Dynamic Response Index (DRI);
- r) Peak Femur compression axial force;
- s) Peak Tibia compression axial force;
- t) Chest Wall Velocity Predictor (CWVP);
- vii. The bidder should also provide the following recommended measurement results:
  - a) Lumbar spine axial force ( $F_z$ );
  - b) Lumbar spine shear forces ( $F_x$ ,  $F_y$ );
  - c) Lumbar spine moments ( $M_x$ ,  $M_y$ );
  - d) Femur shear forces ( $F_x$ ,  $F_y$ );
  - e) Femur moments ( $M_x$ ,  $M_y$ );
  - f) Lower tibia shear forces ( $F_x$ ,  $F_y$ );
  - g) Lower tibia moments ( $M_x$ ,  $M_y$ ).

**6.2.3 Fragment protection results.** In the case of a fragmentation mine, the bidder must provide:

- a. General near field and close-up photos of fragment impacts on the strike face (exterior) of the armour
- b. General near field and close-up still photos of the back face (interior) of the armour
- c. Number of Partial Penetration (PP) and number Complete Penetration (CP);
- d. For each CP:
  - i. Close-up photo of the penetration (strike face and back face);
  - ii. Indication of the armour configuration defeated;
  - iii. Identification of the penetration location (X,Y) on the 90,-90 (bottom orthogonal view) sketch of the vehicle;
- e. If Fragments or sub-fragments are found in the occupant compartment, forensic pictures of the fragments, with the mass of each fragment.

**6.2.4 Hull integrity results.** The bidder must provide:

- a. General mid-range and close-up photos of structural damages from the exterior view;
- b. General mid-range and close-up photos of the structural damages from the interior view;
- c. For each hull cracks or hull breaches:
  - i. Mid-range and close-up photo of the damage (exterior and interior face);
  - ii. Mid-range and close-up photo of any hull breach;
  - iii. Measurement of the hull breach length (mm) and width (mm);
  - iv. Identification of the hull breach location on the 90,-90 view (bottom orthogonal view) of the vehicle.
- d. The Bidder should also provide the following recommended measurements:
  - i. Local hull accelerations vs time at specified locations;
  - ii. Local hull displacements vs time at specified locations;
  - iii. Global hull acceleration vs time at specified locations;
  - iv. Global hull displacement vs time at specified locations.

6.2.5 **Secondary projectile results.** For all loose items found in the vehicle.

- a. Identification and ID of each item
- b. Description of the items;
- c. Description of the failure, and an indication if failure is due to a vehicle system component or government furnished equipment (GFE) system component failure;
- d. Mid-range and close-up photo showing the item location post detonation;
- e. Close-up photos of the item;
- f. Mass of each item;
- g. Description of the failure mechanism;
- h. If visible in high-speed video, the high-speed imagery analysis of the item trajectory and measurement of its velocity.

6.2.6 **Seat and restraint system integrity results.** The following must be provided for the seats on which ATD's are seated:

- a. General photos of the seat and seat belt post detonation;
- b. Mid-range and close-up photos of the seat with ATD removed;
- c. Mid-range and close-up photos of:
  - i. Each seat attachment points;
  - ii. Seat belt components;
  - iii. Energy attenuation system;
  - iv. Footrest;
  - v. Any structural seat damages.
- d. If seat damages are found, technical assessment, documenting:
  - i. General description of the damages;
  - ii. If any the type of failure and details of seat attachment point failures;
  - iii. If any, the type of failure and details of seat belt component failures;
- e. High-speed imagery analysis documenting:
  - i. General seat and seat belt reaction;
  - ii. Monitoring of failure and excessive occupant translation due to seat or seat belt component failure.
- f. The Bidder should also provide the following recommended measurements:
  - i. Seat attachment points area accelerations vs time;
  - ii. Seat pan acceleration vs time;
  - iii. Seat energy attenuation system displacement.

6.3 **Compliance criteria.**

To be compliant for any identified Mine Threat protection requirement specified in Table 14, the bidder must:

- a. Provide all the information specified in section 4.1 and 4.2.
- b. Provide all the information specified in section 6.1, for the Mine test plan and test configuration for **MXX**.
- c. Provide all the information specified in section 6.2 for the mine test results and analysis for **MXX**.



- d. For the **MXX**, the test results must demonstrate the following criteria are met:

**6.3.1 Occupant injury.** All the following injury criterion measured must be below the following injury assessment reference values (IARV) for all ATD's:

- e. Head Injury criterion ( $HIC_{15}$ )  $\leq 250$
- f. Upper neck compression force ( $F_z$ )  $\leq -4.0\text{kN}@0\text{ms} / -1.1\text{kN}@>30\text{ms}$ ;
- g. Upper neck tension force ( $F_z$ )  $\leq 3.3\text{ kN}@0\text{ms}/2.8\text{kN}@25-35\text{ms} / 1.1\text{kN}@>60\text{ms}$
- h. Upper neck shear forces ( $F_x, F_y$ )  $\leq 3.1\text{kN}@0\text{ms}/1.5\text{kN}@25-35\text{ms}/1.1\text{kN}@>45\text{ms}$
- i. Upper neck flexion moment ( $M_{ocx}$ )  $\leq 190\text{ Nm}$
- j. Upper neck extension moment ( $M_{ocy}$ )  $\leq -96\text{ Nm}$
- k. Thoracic Compression Criterion ( $TCC_{\text{frontal}}$ )  $\leq 30\text{mm}$
- l. Thoracic Viscous Criterion ( $VC_{\text{frontal}}$ )  $\leq 0.7\text{ m/s}$
- m. Pelvis dynamic response index (DRI)  $\leq 17.7$
- n. Femur compression force ( $F_z$ )  $\leq -6.9\text{ kN}$
- o. Lower tibia compression force ( $F_z$ )  $\leq -5.4\text{ kN}$  (Denton leg) or  $2.6\text{ kN}$  (Mil-Lx)
- p. Chest wall velocity predictor (CWVP)  $\leq 3.6\text{ m/s}$

**6.3.2 Fragment protection requirement.** There must be no CP of threat fragment, or any other fragments coming from the vehicle, into the occupant compartment.

**6.3.3 Hull integrity criteria.** There must be no indication of hull rupture, which allows penetration of injurious blast or eject inside the occupant compartment. A hull rupture is defined as:

- a. A failure of the occupant compartment structure, resulting in a structural opening having a permanent gap width of  $\geq 25\text{mm}$ ;
- b. The opening provides a path with the exterior underbody of the vehicle.
- c. Although not desirable, the opening of a roof or side hatches, doors or ramps will not be considered a hull breach, unless there is evidence, they are the entrance path of injurious overpressure into the occupant compartment.

**6.3.4 Secondary fragments criteria.** There shall be no indication of potentially injurious fragments or loose equipment, which was caused by the failure of a vehicle system component. An injurious secondary fragment is defined as:

- a. Any secondary fragment or loose item having a mass  $\geq 100\text{g}$
- b. Any secondary fragment or loose item having a  $10\text{g} < \text{mass} < 100\text{g}$  of and with a Kinetic Energy (KE)  $\geq 50\text{J}$
- c. All secondary fragments having a mass  $< 10\text{g}$  will be considered as non-injurious.

**6.3.5 Seat and restraint system integrity criteria.** The seats and restraint systems must maintain the occupants securely on their seat and the seats remain adequately attached to the vehicle. A seating system failure is defined as:

- a. A seat component(s) or seat attachment point(s) failure, which results in inadequate seat translation (X,Y,Z) and/or rotation ( $R_x, R_y, R_z$ ) of the seating system and occupant.

Protection Requirements – Instructions to Bidders - *Example*

- b. Any restraints system components, including anchor points, straps and buckles, that fails, detaches or is displaced, resulting in any seat belt components becoming loose, and failing to maintain the occupant properly restrained in its seat.

EXAMPLE

**LOAD LIST, ELECTRICAL AND C5ISR INFORMATION**

**DEPARTMENT OF NATIONAL DEFENCE**

**Table of Contents**

1	LOAD LIST .....	3
2	ELECTRICAL CIRCUITS LAYOUT .....	4
3	C5ISR EQUIPMENT LIST .....	5
4	CONCEPTUAL VEHICLE LAYOUT .....	11
5	PRELIMINARY WIRING DIAGRAM.....	13
6	CLARIFICATION ON INTERACTION WITH C2 SYSTEM .....	14

SAMPLE

## 1 LOAD LIST




Category	Item	Quantity	Weight Per Item (lbs)	Total Weight (lbs)
Personal Equipment	Individuals	4	189.16	756.63
	Personal Kit (Ammo, vest, gunbelt, clothes, etc)	4	89.55	358.21
	Rifle C8A3	4	9.04	36.16
	Sig 226	4	4.41	17.64
Weapons	M72 HEAT (per rocket)	2	5.10	10.20
	Machine gun Mk-48	1	18.26	18.26
Ammo	7.62 Box	4	18.00	72.00
C5ISR <sup>1</sup>	Communication Equipment	Kit	N/A	42.50
	ECM System	Kit	N/A	190.00
Sustainment	Rations 1 x Ration	24	2.00	48.00
	Water Full Jerry Can	2	47.30	94.60
	Diesel Full Jerry Can	9	40.70	366.30
	Day Pack	4	50.00	200.00
	PA Med bag (Vehicle Bag)	1	100.00	100.00
			<b>Total Weight (Lbs)</b>	<b>2310.54</b>

<sup>1</sup> Weight is estimated from known components weight.

## 2 ELECTRICAL CIRCUITS LAYOUT

C5ISR Equipment									
Equipment		Fuse		Power Management System			Notes		
Item #		24 V Current Draw (A)	Expected Fuse Capacity (A)	Expected Fuse Location	Control location	Control Type	Powered Shore Power		
Comm Circuit #1		-	15	Dash mounted - Central	Dash mounted - Central	Permanent On/Off	Yes	Part of comm circuit #1	
1	MRC-UVA #1	2.5	-	-	-	-	-	Part of comm circuit #1	
2	AR-50	7.5	-	-	-	-	-	Part of comm circuit #1	
Comm Circuit #2		-	10	Dash mounted - Central	Dash mounted - Central	Permanent On/Off	Yes	Part of comm circuit #2	
3	MRC-UVA #2	2.5	-	-	-	-	-	Part of comm circuit #2	
4	LTAC Slingshot Applique	0.2	-	-	-	-	-	Part of comm circuit #2	
Comm Circuit #3		-	10	Dash mounted - Central	Dash mounted - Central	Permanent On/Off	Yes	Part of comm circuit #3	
5	MRC-UVA #3	2.5	-	-	-	-	-	Part of comm circuit #3	
6	Shireen 70221	2.7	-	-	-	-	-	Part of comm circuit #3	
7	Powered Speaker #1	6	OEM to define	OEM to define	-	-	-	OEM Recommended: 7.5A	
8	Powered Speaker #2	6	OEM to define	OEM to define	-	-	-	OEM Recommended: 7.5A	
9	DAGR	0.1	OEM to define	OEM to define	-	-	-		
10	Blue Force Tracker	0.5	OEM to define	OEM to define	-	-	-		
11	ECM	60	OEM to define	OEM to define	-	-	-	Requires Independent fuse for this equipment	
Comm Circuit #4		-	TBD	TBD					
13	Network Switch	-	TBD	TBD					
Auxiliary Equipment - Expansion									
12	Fused Distribution Blocks #1	30	30	Occupant Compartment	-	-	-	Independent fuse - 6 terminals fused busbar	
13	Fused Distribution Blocks #2	-	25	Truck Bed	-	-	-	Independent fuse - 6 terminals fused busbar	

## 3 C5ISR EQUIPMENT LIST

Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/ GSM	Notes
1	LTAC Slinghot, Vehicle (kit, includes LTAC items below)		1					99-464-7713	Contractor to Supply	Kit
1a	LTAC UHF Vehicle Applique		1	1.08	17	8.7	3	99-975-8146	N/A	N/A, included in kit (Item 1)
1b	LTAC L-Band Antenna		1	1.47	14.6	14.6	7.2	99-154-6311	N/A	N/A, included in kit (Item 1)
1c	LTAC Power Supply Unit		1	0.64	10.7	6.8	3.8	99-483-3456	N/A	N/A, included in kit (Item 1)
1d	LTAC power supply cable		1					99-959-0514	N/A	N/A, included in kit (Item 1)
1e	LTAC Applique Coax Cable, SMA to SMA		1					99-731-2697	N/A	N/A, included in kit (Item 1)
1f	LTAC Applique Coax Cable, TNC to TNC		1					99-155-1162	N/A	N/A, included in kit (Item 1)
1g	LTAC Applique Coax Cable, BNC to TNC		1					99-861-4221	N/A	N/A, included in kit (Item 1)
2	RADIO Any of the following can be used:		3							

Communication Equipment

Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/ GSM	Notes
2a	AN/PRC-163 Multi-channel Handheld Radio		TBD					5820-01-681-8832	Contractor to Supply	
2b	AN/PRC-152A Wideband Networking Handheld Radio		TBD					5820-01-633-1917	Contractor to Supply	
2c	AN/PRC-148MBITR/JEM		TBD					5895-01-554-7949	Contractor to Supply	
2d	AN/PRC-117G(V)1(C) Multiband Networking Manpack Radio		TBD					5820-01-605-5854	Contractor to Supply	
2e	Shadow Radio?		TBD					TBD	Contractor to Supply	
2g	TNR2E - Rover Tactical Radio		TBD					TBD	Contractor to Supply	TRN2E will require two distinct antennas mounted on the NGFV vehicle, the first one for C, L and S bands operation, and the second antenna for Ku band operation from the same port on the radio.



Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/ GSM	Notes
2h	L-16 Radio TTR SFF (TacNet Tactical Radio Small Form Factor)		TBD					TBD	Contractor to Supply	
3	MRC-UVA (Radio Tray)		3	2.50	18.1	12.4	9	01-641-9938	Contractor to Supply	
4	AR-50-FK (AR-50 with Fan Kit Ready)		1	4.69	19.05	15.24	9.4	01-642-8912	Contractor to Supply	
5	FK-AR-50 (Fan Kit Only)		1	0.34	12.45	10.67	4.06	01-683-8938	Contractor to Supply	
6	Shireen 70221		1	1.7	19.01	8.89	2.54	20-A0W-4145	Contractor to Supply	
7	DAGR GPS		1	1	16.14	8.79	4.02	01-526-4783	GFE	

Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/ GSM	Notes
8	DAGR GPS mount		1	Not Available	Not Available	Not Available	Not Available	01-521-3063	Contractor to Supply	
9	DAGR GPS power cable		1	N/A	Not Available	Not Available	Not Available	01-521-6757	Contractor to Supply	
10	Blue Force Tracker		1	.66	13.5	6.1	3.5	99-739-9606	GFE	
11	Blue Force Tracker mount	Not Available	1	TBD	TBD	TBD	TBD	TBD	Contractor to Supply	
12	TCR-SPK-DUALv2 AMPLIFIED DUAL-NET SPEAKER		2	2.20	10.49	9.83	8.28	20-A0W-4146	Contractor to Supply	Cables to support Thales and L3 Harris Family of Radios are required
13	Public Address System		1	Not Available	Not Available	Not Available	Not Available	See Note	Contractor to Supply	Whelen model HHS3400 or a approved equivalent
14	Switch, RF 2 Way		1	.56	6.99	2.54	8.2	01-274-9259	Contractor to Supply	

ECM Equipment										
Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/GSM	Notes
15	ECM - Main Unit		1	150.00	Not Available	Not Available	Not Available	TBD	GFI	For information purpose only
16	ECM - Chiller		1	13.00	Not Available	Not Available	Not Available	TBD	GFI	For information purpose only
17	ECM - Main Unit Armor		1	20.00	Not Available	Not Available	Not Available	TBD	GFI	For information purpose only
18	ECMRCU		1	TBD	TBD	TBD	TBD	TBD	GFI	For information purpose only

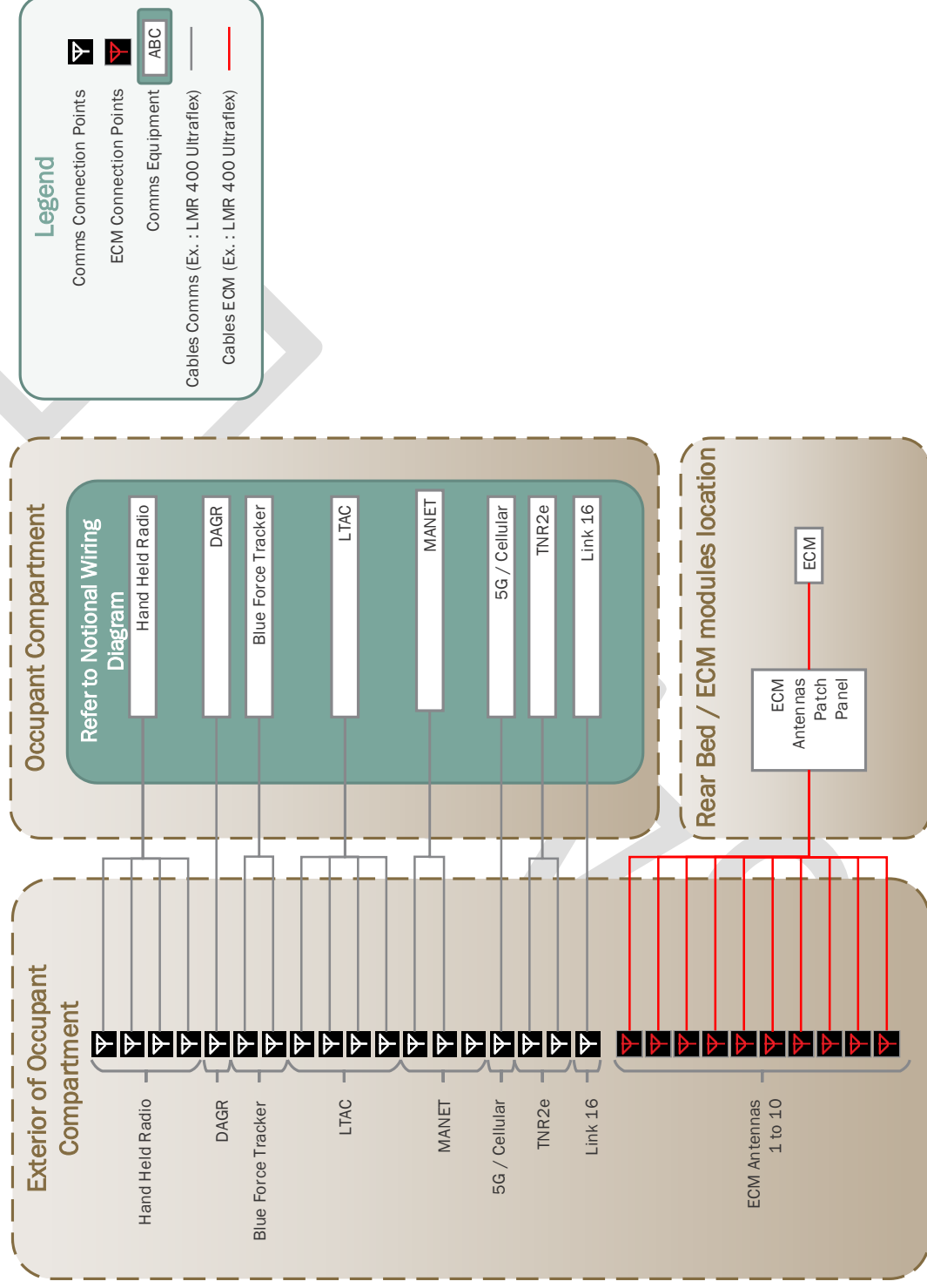
Item #	Equipment	Image	Qty	Item Weight (Lbs)	Length (cm)	Width (cm)	Height (cm)	NSN/PSCN	GFE/GFI/ GSM	Notes
19	Network Switch		1	TBD	TBD	TBD	TBD	TBD	TBD	
Internal Vehicle Network										

#### 4 CONCEPTUAL VEHICLE LAYOUT

### Note

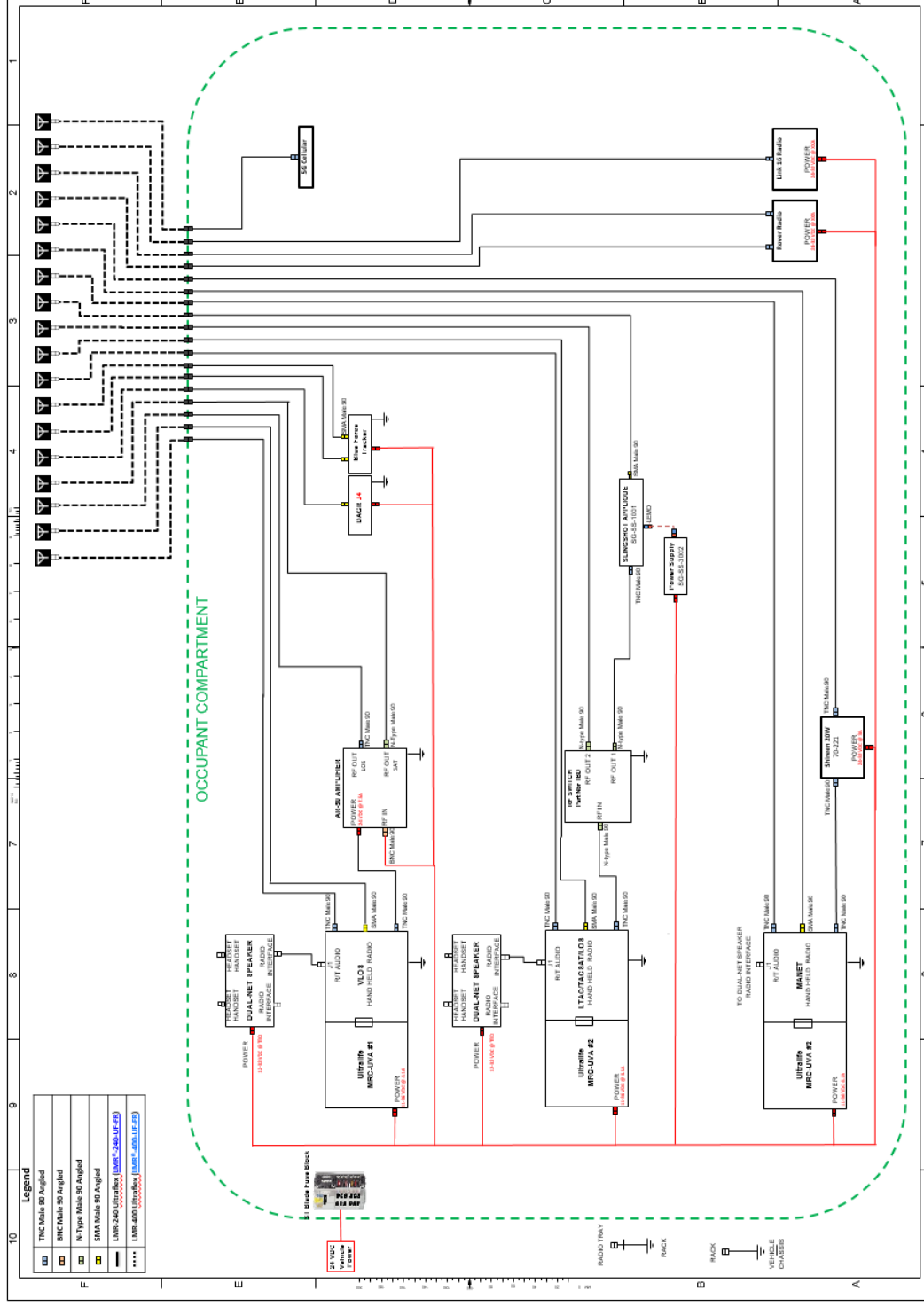
- This document represent a **conceptual layout** of the equipment, final placement will be determined during a collaborative approach between Canada and Contractor.
- Not Illustrated in this documents are the external components such as roof rack, winch, and weapon mounts.
- Connector types and cable type to be confirmed during design review.

# Antenna and ECM connections



Note: Notional placement; final design to be determined using established System Engineering approach

# 5 PRELIMINARY WIRING DIAGRAM



## 6 CLARIFICATION ON INTERACTION WITH C2 SYSTEM

Note there are two distinct information systems on board the vehicle:

1. C2 System has information relevant to the war fighter such as Battle Management Systems, Report, ISTAR, etc.
2. Vehicle native system includes vehicle electronic (vetronics) network, connectivity, and data with its vehicle electronics, CANBUS, RWS, etc;

There must be no possibility to exchange information between those two systems.

Information Management related to the C2 System is out of scope for vehicle - All needed C2 information including ISTAR feeds is already part of the C2 system;

In that context vehicle C5ISR integration ensures that:

- Vehicle provides power, antenna mount point, and cabling to install the C5ISR complete system;
- Vehicle provides system functional test including EMI / EMC of the C5ISR complete system;
- Vehicle transports the C2 system;
- Vehicle ensures C2 systems components (Computers, Networking appliance and radio) can be easily mounted and dismounted from Vehicle.