SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX A – VISUAL SYSTEM

VERSION 2.2.1

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Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

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Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

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1. SCOPE

This System Requirements Document (SRD) describes the visual requirements for all current Common Driver Trainer (CDT) Variants. CDT future variants will require updates when available.

2. APPLICABLE DOCUMENTS

PRF-PT-685 CDT Common SRD

3. REQUIREMENTS

3.1 Item Definition

The image generation and display systems shall consist of the computer image generation equipment, display devices and associated software required to simulate the CDT visual scene environment. The visual scene environment shall be visible through the driver vision blocks and driver sensors view of the CDT student training stations and on the visual displays associated with selected CDT consoles. Throughout this appendix, the term "host" shall define as the primary computer processor associated with each Student Training Station (STS) or console.

The following appendix covers the CDT and STS consoles:

a. STS:
   (1) Driver

b. Consoles with visual displays:
   (1) After Action Review (AAR)/Auxiliary Station (AS)
   (2) Instructor/Operator Station (IOS)

The configuration supported for each STS/workstation shall be the production configurations and deployed configurations in effect at the time of contract award.

3.1.1 Interface Definition

3.1.1.1 Mechanical Interface

The mechanical interface shall include all mechanical structures for housing the various components for the visual systems and structures to position and support the components.

3.1.1.2 Electronic Interface

The electronic interface shall provide all of the data, power, and control interfaces required to achieve the complete performance and functionality specified for the CDT system. The CDT system shall provide a compatible data transfer and control interface

interconnecting each STS or console image generation system and local host computer system. The interface shall provide necessary control signal generation, timing, logic level shifting, and signal buffering as required for proper image generator system operation. The interface between the image generation system and the local host computer shall utilize a common/standard interconnect and shall observe standard communication protocols.

3.1.1.3 Software Interface

The software interface shall include the software necessary to properly integrate each STS's and console's host and image generation systems in order to provide the complete performance specified for the CDT system. The image generation system shall interface with software as required by the Common SRD.

3.1.2 Major Visual System Components

The major visual system components for each STS/console shall be as specified below.

3.1.2.1 Computer Image Generation Subsystem

The Computer Image Generation (CIG) subsystem shall be included for each visually-equipped STS, workstation configuration, and necessary logistic support items.

The CIG subsystem shall provide image signals for the simulation of all of the display types as applicable to each individual STS and console. The CIG subsystem shall provide, as a minimum, the following functions:

a. Host processor interface
b. Local database storage including terrain, features and models
c. Real time scene content management
d. Image processing
e. Display processing

The CIG subsystem shall leverage advances in commercial computer graphics technology to provide a cost-effective and supportable CIG. Except as explicitly approved by the Government, the CIG subsystem shall maintain correlation with the existing simulation including: Semi-Automated Forces (SAF), environmental models, radio, Scenario Generation System (SGS), Joint Capabilities Release (JCR), and maps, so that the supporting databases will not have to be changed to accommodate the CIG.

To support the reconfiguration capability provided by STS variant kits, the CIG subsystems for each series (e.g. TWV, TV, TEV, MRAP, SV, HMMWV, MTVR, MATV, Buffalo, LVSR, and JLTV) shall be designed to support multiple configurations in the series (e.g. TV series have M1A1, M1A2 SEPv2).

3.1.2.2 Installation Kit

There shall be no need to use special tools for equipment installation. Any special tools shall require Government approval.

3.1.2.3 Logistic Support Items

Logistics items shall provide, as necessary, to support each delivered CIG System configuration.

3.1.2.4 Government Provided Items

Reference the latest version of the CDT Common SRD.

3.1.2.5 Image Display Subsystems

The image display subsystems shall convert the signals from the image generator into visual images which depict the appearance of the physical environment. The image display subsystem shall include the following display types as applicable to each individual STS or console:

a. Driver vision blocks
b. Thermal imagery and sensor systems
c. Console visual displays
d. Camera views

3.1.2.6 Image Databases

CDT visual systems shall utilize government furnished, stored digital representations of the training environment's physical characteristics, vehicles, military units and special effects.

3.1.2.7 Operating and Maintenance Software and Hardware

The contractor shall provide all software and hardware needed to operate and maintain the system.

3.2 Characteristics

The CDT shall provide real-time color computer generated visual images to train vehicle-driving students. In addition, the visual simulation shall provide the essential cues required by the student to assess simulated vehicle position and velocity, characteristics of the terrain, and other information necessary to operate the simulated vehicle in training scenarios. The visual system shall consist of the image generation system, display system, terrain database(s), static and dynamic models, and any associated hardware and/or software required to simulate the vehicle visual/sensor scene environment. The terrain databases shall simulate an area, at a minimum, of 20km x 20km to satisfy the requirements for the training tasks, procedures, postures, terrain features and conditions for the vehicle variant been trained. In addition, the terrain features shall provide terrain details, contents, features, and varieties to meet the requirements for the training tasks for each vehicle variant.

3.2.1 Performance

The image generation and display system for each STS and console shall provide real-time visual and sensor displays of the training environment for all simulated viewpoint positions and attitudes. The computer image generator imagery shall change with and be dictated by real-time movement through the environment, engagement actions taken, and the actions of all STSs and consoles in the battle scenario. The system shall provide visual and sensor information concerning the environment, other units, and events relevant to the scenario and vehicle system operation as would be available under the corresponding real world conditions. Unless otherwise specified, all of the specified performance and image generator capabilities shall be available simultaneously at any time during the training scenario(s).

3.2.1.1 Training Scene Requirements

Training visual imagery shall be consistent with depiction of the real-world environment. The simulated features shall be similar to the real-world area in appearance, frequency of occurrence and other characteristics. Sufficient detail shall be available to provide this information and to provide realistic depth perception over terrain surfaces as it provides in the real world. Training scene features shall display with sufficient fidelity to allow the users to visually recognize them by shape, size, relationship to other objects, and texture.

The displayed images shall depict the speed, path, and attitude of the simulated vehicle using vehicle dynamics calculations from the host. The movement of units shall be correctly influenced by the terrain slope, surface material (soil type), and water depth, so that the same limitations on motion exist as in the real world. The dynamics of the moving parts on the vehicles, e.g. turret and tube shall depict with the motion systems. The displayed images shall depict orientation and surrounded environments. The simulated vehicles shall be capable of being placed anywhere in the gaming environment at initialization. The host shall control the movements and functions for the vehicles.

3.2.1.2 Ground Mounted Combat

The CDT visual system shall generate, in real-time, displayed images of the simulated battlefield which depict the movement and engagement of all stationary and moving vehicles (friendly and enemy), whether in the open or partially concealed. The CDT visual system shall also provide visual scenes for ground unit engagement of air targets.

3.2.1.3 Terrain Databases

Each CDT shall contain all existing CDT terrain databases and any new CDT terrain databases required by the specific product requirements specification. Each CDT terrain database shall be a continuous representation of terrain elevation, terrain features (trees, rivers, soil type, etc.) and cultural data. Each CDT terrain database shall be required to smoothly blend the terrain and the features comprising the database (e.g. connect and/or continue rivers, roads, power lines and hilly areas) to avoid unrealistic discontinuities. Each CDT terrain database shall model at a resolution that is consistent with the type of terrain depicted and which provides the appropriate terrain/vehicle interaction for the

type of terrain traversed. In areas of some regions, this will be equivalent to Digital Terrain Elevation Data (DTED) Level 5 (1m), in other areas DTED Level 2 (30m) or Level 1 (1km). Each CDT terrain database shall contain a database surround area of low resolution, generic terrain that will extend out to the visual range beyond the edge of the primary training environment. The database surround shall prevent seeing the edge of the database.

3.2.1.3.1 Terrain Database Attributes

Each database shall have all terrain skin surface polygons properly flagged as terrain and attributed with CDT-compatible basic terrain types. A Traction Coefficient (TC) parameter defines the amount of traction between a normal rubber tire on an average mid-sized automobile and a particular type of terrain under the environmental conditions described. Perfect traction would be 1.0 and no traction is 0.0. The terrain TC shall be alterable during runtime via the Environmental Controls Window. A slider bar shall be available to raise or lower the TC (100% to 0%) of all terrain tiles. For example, when the TC slider moves to the left, the TC factor of each terrain tile shall lower by the same percentage and when the slider moves to the right, the roughness factor of each terrain tile shall increase.

The Roughness Factor defines the probability of a driver receiving a noticeable jerk through the steering wheel force feedback system and vehicle dynamics due to irregularities in the terrain surface such as potholes, rocks, road seams, ruts and other similar irregularities. For the Roughness Factor, 0.0 indicates a very smooth, glasslike terrain with no irregularities and 1.0 represents an extremely rough, impassable terrain. The terrain roughness factor shall be alterable during runtime via the Environmental Controls Window. A slider bar shall be available to raise or lower the roughness factor of all terrain tiles equally. For example, when the roughness slider moves to the left, the roughness factor of each terrain tile shall lower by the same percentage (i.e. less jerk in the steering wheel) and when the slider moves to the right, the roughness factor of each terrain tile shall increase.

3.2.1.3.2 Existing Terrain Databases (DBs)

All existing CDT terrain DBs shall convert to use One Semi-Automated Forces (OneSAF) and the Synthetic Environment Core (SE Core) environment. Each database shall be with a nominal visibility range of 5,000 meters. Each database shall be optimized to run on all image generators used in the CDT product line at a frame rate of 60 Hertz (Hz) with at least 30% spare rendering capacity using a per-channel field of view (FOV) of 60 (H) x 45 (V) degrees and 5,000 meter visibility range.

The following existing CDT terrain databases:

a. CDT Common. The CDT Common databases:

    1. mountain region
    2. military base
    3. desert
    4. urban

5. plain

b. Ft. Leonard Wood Training Area-244 (TA-244). The CDT TA-244 database contains areas of different terrain types (dirt, mud, cultivated field and sand) and terrain features (trenches, bomb craters, minefields) needed to train drivers and commanders of the Assault Breacher Vehicle (ABV) and the Joint Assault Bridge (JAB) to properly employ their vehicle equipment using the CDT Tank Engineering Variant (TEV)

c. Afghanistan. The CDT Afghanistan database is an SE Core geo-specific database containing an area of Afghanistan. It is used primarily to familiarize drivers of the Mine Resistant Ambush Protected (MRAP) All Terrain Vehicle (M-ATV) with the types of terrain they will encounter prior to deployment into the Afghanistan Theater

d. Ft. Bragg Driver Training Course 1 and 2 databases. The CDT Ft. Bragg databases are geo-specific databases containing an area of Ft. Bragg, NC. Each database contains a separate Driver Training Course used primarily to familiarize drivers of the Mine Resistant Ambush Protected (MRAP) family of vehicles with the full extent of the vehicle's capabilities to traverse various terrain types and obstacles

e. Ft Benning Driver Training Course: The CDT Ft. Benning database is a geo-specific database containing an area of Ft. Benning, GA. The database contains a beginning and advanced Driver Training Course used primarily to familiarize the full extent of the vehicle's capabilities to traverse various terrain types and obstacles

f. Ft Bliss Driver Training Course: The CDT Ft. Bliss database is a geo-specific database containing an area of Ft. Bliss, TX

g. Ft Polk Driver Training Course: The CDT Ft. Polk database is a geo-specific database containing an area of Ft. Polk, LA

h. 29 Palms Driver Training Course: The CDT 29 Palms database is a geo-specific database containing an area of 29 Palms, CA.

i. Cp. Pendleton Driver Training Course: The CDT Cp. Pendleton database is a geo-specific database containing an area of Cp. Pendleton, CA.

3.2.1.3.3 <u>New Terrain Databases</u>

The CDT architecture shall allow the integration of additional SE Core terrain databases into the CDT system (i.e. Scenario Generation System (SGS), STS, and runtime software). Any new terrain databases developed for use on the CDT shall submit to SE Core for evaluation thirty calendar days prior to CDT acceptance testing. Any new terrain databases developed for use on the CDT shall integrate into the SGS. The CDT synthetic environment shall utilize the Environment Runtime Component (ERC) software services from the SE Core Virtual OneSAF baseline. The ERC component shall replace all CDT legacy Height Above Terrain (HAT) and collision capabilities. Unless

superseded by a specific requirements document, all new CDT terrain databases shall meet the following requirements:

a. Each database shall be with a nominal visibility range of 5,000 meters;
b. Each database shall be optimized to run on all image generators used in the CDT product line at a frame rate of 60 Hz with at least 30% spare rendering capacity using a per-channel field of view of 60 (H) x 45 (V) degrees and 5,000 meter visibility range.

3.2.1.3.4 Terrain Databases Extent and Size

Each database shall have an extent and location as stated in the product requirements specification. Unless otherwise specified, the minimum size for all new CDT terrain databases shall be 20 km x 20 km.

3.2.1.3.5 Geo-Specific Features

Each database shall contain geo-specific three dimension (3D) models (i.e. buildings and other structures) for which suitable photo texture imagery is available. All other 3D features in the Area Of Interest (AOI) shall be populated in the terrain utilizing geo-typical library models. All 3D features in the database shall have bounding box collision volumes with CDT-compatible collision result codes assigned (e.g. soft vs. hard collision volumes). Unless otherwise specified, all bridges in new CDT terrain databases shall have a posted weight limitation sign and shall stress, sway and then collapse if a vehicle having a vehicle weight greater than the weight limitation attempts to cross the bridge.

3.2.1.3.6 Terrain Databases Attributes

Each database shall have all terrain skin surface polygons properly flagged as terrain and attributed with CDT-compatible basic terrain types as defined in Table 1 below. The CDT Terrain Types Table shall use to define the base values for each terrain tile.

Table 1 - CDT Terrain Types

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Concrete (dry)	Primary Roads, Expressway, Urban Roads, 4 lane roads, sidewalk	Dry, 0% rain	0.7	0.05 – 0.45 0.10
Concrete (damp)	Primary Roads, Expressway, Urban Roads, 4 lane roads, sidewalk	Light rain, 1%-24%	0.65	0.05 – 0.45 0.10

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Concrete (wet)	Primary Roads, Expressway, Urban Roads, 4 lane roads, sidewalk	Medium rain, 24%-74%	0.55	0.05 – 0.45 0.10
Concrete (very wet)	Primary Roads, Expressway, Urban Roads, 4 lane roads, sidewalk	Heavy rain, > 75%	0.5	0.05 – 0.45 0.10
Bridge (dry)	All bridges	Dry, 0% rain	0.7	0.05 – 0.45 0.10
Bridge (wet)	All bridges	Raining, 1-100% rain	0.35	0.05 – 0.45 0.10
Bridge (ice)	All bridges	Snowing, 1-100% snow, 33% chance of polygon being ice	0.07	0.05 – 0.45 0.10
Asphalt (dry)	Secondary Roads, Motorpool, Docks, 2 lane roads	Dry, 0% rain	0.5	0.05 – 0.45 0.10
Asphalt (damp)	Secondary Roads, Motorpool, Docks, 2 lane roads	Light rain, 1%-24%	0.45	0.05 – 0.45 0.10
Asphalt (wet)	Secondary Roads, Motorpool, Docks, 2 lane roads	Medium rain, 24%-74%	0.4	0.05 – 0.45 0.10
Asphalt (very wet)	Secondary Roads, Motorpool, Docks, 2 lane roads	Heavy rain, > 75%	0.35	0.05 – 0.45 0.10
Cobblestone (dry)	European cobblestone roads, brick roads, closely packed stones	Dry, 0% rain	0.5	0.20 - 0.55 0.35
Cobblestone (damp)	European cobblestone roads, brick roads, closely packed stones	Light rain, 1%-24%	0.4	0.20 - 0.55 0.35

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Cobblestone (wet)	European cobblestone roads, brick roads, closely packed stones	Medium rain, 24%-74%	0.3	0.20 - 0.55 0.35
Cobblestone (very wet)	European cobblestone roads, brick roads, closely packed stones	Heavy rain, > 75%	0.3	0.20 - 0.55 0.35
Rocky terrain (dry)	Off road rocky mountain	Dry, 0% rain	0.5	0.70 - 0.95 0.70
Rocky terrain (damp)	Off road rocky mountain	Light rain, 1%-24%	0.4	0.70 - 0.95 0.70
Rocky terrain (wet)	Off road rocky mountain	Medium rain, 24%-74%	0.3	0.70 - 0.95 0.70
Rocky terrain (very wet)	Off road rocky mountain	Heavy rain, > 75%	0.3	0.70 - 0.95 0.70
Trail (dry)	Off road trails in dirt or grass	Dry, 0% rain	0.5	0.25 - 0.45 0.30
Trail (damp)	Off road trails in dirt or grass	Light rain, 1%-24%	0.45	0.25 - 0.45 0.30
Trail (wet)	Off road trails in dirt or grass	Medium rain, 24%-74%	0.4	0.25 - 0.45 0.30
Trail (very wet)	Off road trails in dirt or grass	Heavy rain, > 75%	0.35	0.25 - 0.45 0.30
Grass (dry)	Off road without trails	Dry, 0% rain	0.45	0.20 - 0.40 0.30
Grass (damp)	Off road without trails	Light rain, 1%-24%	0.4	0.20 - 0.40 0.30
Grass (wet)	Off road without trails	Medium rain, 24%-74%	0.3	0.20 - 0.40 0.30
Grass (very wet)	Off road without trails	Heavy rain, > 75%	0.25	0.20 - 0.40 0.30
Gravel, loose rocks (dry)	Off road rocky areas with or without trails, rocky road	Dry, 0% rain	0.4	0.20 - 0.55 0.35
Gravel, loose rocks (damp)	Off road rocky areas with or without trails, rocky road	Light rain, 1%-24%	0.35	0.20 - 0.55 0.35

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Gravel, loose rocks (wet)	Off road rocky areas with or without trails, rocky road	Medium rain, 24%-74%	0.25	0.20 - 0.55 0.35
Gravel, loose rocks (very wet)	Off road rocky areas with or without trails, rocky road	Heavy rain, > 75%	0.2	0.20 - 0.55 0.35
Dirt (dry)	Off road solid packed dirt areas with or without trails, Afghan database dirt roads	Dry, 0% rain	0.5	0.25 - 0.45 0.30
Dirt (damp)	Off road solid packed dirt areas with or without trails, Afghan database dirt roads	Light rain, 1%-24%	0.45	0.25 - 0.45 0.30
Dirt (wet)	Off road solid packed dirt areas with or without trails, Afghan database dirt roads	Medium rain, 24%-74%	0.3	0.25 - 0.45 0.30
Dirt (very wet)	Off road solid packed dirt areas with or without trails, Afghan database dirt roads	Heavy rain, > 75%	0.15	0.25 - 0.45 0.40
Cultivated field (dry)	Off road plowed, loose dirt areas with or without trails, soft shoulder	Dry, 0% rain	0.4	0.35 - 0.55 0.45
Cultivated field (damp)	Off road plowed, loose dirt areas with or without trails, soft shoulder	Light rain, 1%-24%	0.35	0.25 - 0.45 0.45
Cultivated field (wet)	Off road plowed, loose dirt areas with or without trails, soft shoulder	Medium rain, 24%-74%	0.25	0.25 - 0.45 0.45

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Cultivated field (very wet)	Off road plowed, loose dirt areas with or without trails, soft shoulder	Heavy rain, > 75%	0.15	0.25 - 0.45 0.45
Mud (base)	Basic muddy areas with or without trails	Dry, 0% rain	0.4	0.25 - 0.45 0.40
Mud (damp)	Muddy areas with or without trails	Light rain, 1%-24%	0.35	0.25 - 0.45 0.40
Mud (wet)	Muddy areas with or without trails	Medium rain, 24%-74%	0.25	0.25 - 0.45 0.40
Mud (very wet)	Muddy areas with or without trails	Heavy rain, > 75%	0.15	0.25 - 0.45 0.40
Hard Sand (dry)	Packed sand areas with or without trails	Dry, 0% rain	0.4	0.05 - 0.45 0.15 **
Hard Sand (damp)	Packed sand areas with or without trails	Light rain, 1%-24%	0.35	0.05 - 0.45 0.15
Hard Sand (wet)	Packed sand areas with or without trails	Medium rain, 24%-74%	0.4	0.05 - 0.45 0.20
Hard Sand (very wet)	Packed sand areas with or without trails	Heavy rain, > 75%	0.4	0.05 - 0.45 0.30
Loose Sand (dry)	Loose sand areas with or without trails, dune sand	Dry, 0% rain	0.15	0.20 - 0.45 0.30 **
Loose Sand (damp)	Loose sand areas with or without trails, dune sand	Light rain, 1%-24%	0.25	0.20 - 0.45 0.30
Loose Sand (wet)	Loose sand areas with or without trails, dune sand	Medium rain, 24%-74%	0.4	0.15 - 0.45 0.20
Loose Sand (very wet)	Loose sand areas with or without trails, dune sand	Heavy rain, > 75%	0.45	0.05 - 0.45 0.30
Swamp (All)	Swamp areas with or without trails	All weather conditions	0.15	0.05 – 0.15 0.05

Terrain Type	Location/Type	Environmental Conditions **	Traction Coefficient	Roughness Factor *
Snow (dry)	Off road trails in snow areas	Dry, 0% snow	0.25	Same as underlying terrain roughness
Snow (wet)	Off road trails in snow areas	All snowing conditions	0.2	Same as underlying terrain roughness
Ice (dry)	All roads in snow areas	Dry, 0% snow, 5% chance of polygon being ice	0.07	0.05 – 0.15 0.05
Ice (wet)	All roads in snow areas	Snowing, 1-100% snow, 12% chance of polygon being ice	0.07	0.05 – 0.15 0.05
River Ford	All water covered fording areas on trails	Equivalent to Trail (wet)	0.4	0.25 - 0.45 0.30
River Ford Shore	All shore areas leading into fords	Equivalent to Trail (damp)	0.45	0.25 - 0.45 0.30
River	All non-fordable areas on rivers	Equivalent to Water	0	0.00
Water (impassable)	All lakes and ocean areas	Impassable to wheeled and tracked vehicles	0	0.00

NOTES:

1. The Roughness Factor provides three values that represent the amount of vibration and jerk a driver would feel in the steering wheel and vehicle handling when travelling over that terrain type. The first two numbers represent a range for that terrain type with the lowest value representing the smoothest of that terrain type and the larger number representing the roughest. The third number represents the nominal or most expected value for that terrain type.
2. Since most roads in the United States are well-maintained, a nominal value of 0.10 might apply to all concrete and asphalt terrain tiles in a U.S. database but roads in foreign countries may be much rougher and require a nominal value throughout the database of 0.25 or higher.

3.2.1.3.7 Testing Terrain Databases

Each database shall assess the visual appearance, performance, and functionality of the terrain database. The test procedures shall test the following:

a. Freedom from distracting visual artifacts (e.g. missing or flashing polygons, noticeable texture discontinuities)
b. Ownship and other entities conforming properly to the terrain surface
c. Ownship colliding properly with 3D objects in the terrain
d. Vehicle ownship model responding appropriately to varying terrain types in the terrain
e. Speed limit related warnings and scoring deductions generated as expected, i.e. when the vehicle goes above the speed limit by 5 mph.
f. Image Generator (IG) render load within prescribed limits

3.2.1.3.8 Deliverable Terrain Databases

Each new terrain database and all associated textures, models shall deliver to the government as part of deliverables. No runtime DBs shall exceed more than 15 minutes to install per IG.

3.2.1.4 Models

The CDT shall use current CDT models and SE Core Common Moving Models (CM2). The contractor shall develop new models IAW SE Core CM2 if a specific model is not available in the SE Core library. At a minimum, the Government will provide a Vehicle Description Document (VDD) and an OpenFlight specification IAW the latest SE Core model specifications. The contractor shall submit all new models back into the SE Core CM2 for future use. The following is the list of models:

Scenario Generation System (SGS) – Legacy Entity Listing:

Ownships:

- (MRAP) Caiman
- (MRAP) M-ATV
- (MRAP) M-ATV w/Turret
- (MRAP) Maxxpro
- (MRAP) RG31MK5
- (MRAP) RG33L
- (MRAP) Cougar
- (MRAP) Buffalo
- (Stryker) ATGM M1134
- (Stryker) ATGM M1134 SLAT
- (Stryker) CV M1130
- (Stryker) CV M1130 SLAT
- (Stryker) ESV M1132
- (Stryker) ESV M1132 Plow
- (Stryker) ESV M1132 Plow SLAT
- (Stryker) ESV M1132 Roller
- (Stryker) ESV M1132 Roller SLAT
- (Stryker) ESV M1132 SLAT

- (Stryker) FSV M1131
- (Stryker) FSV M1131 SLAT
- (Stryker) ICV M1126
- (Stryker) ICV M1126 SLAT
- (Stryker) MCV 1129
- (Stryker) MCV 1129 SLAT
- (Stryker) MEV
- (Stryker) MEV SLAT
- (Stryker) MGS 1128
- (Stryker) MGS 1128 SLAT
- (Stryker) NBC M1135
- (Stryker) NBC M1135 SLAT
- (Stryker) RV M1127
- (Stryker) RV M1127 SLAT
- (Stryker) MICLIC Trailer
- (Tank) Abrams M1A1 SA Tank
- (Tank) Abrams M1A1 SA Plow
- (Tank) Abrams M1A1 SA Roller
- (Tank) Abrams M1A2 SEPV2/V3/V4 Tank
- (Tank) Abrams M1A2 SEPV2/V3/V4 Plow
- (Tank) Abrams M1A2 SEPV2/V3/V4 Roller
- (Tank Engineering) ABV with HLA
- (Tank Engineering) ABV with CDB
- (Tank Engineering) ABV with FWMP
- (Tank Engineering) JAB without MLC70
- (Tank Engineering) JAB with MLC70
- (Tactical Wheeled Vehicle – TWV) M1083A, Medium Tactical Vehicle (MTV) with the attached trailer
    - M1095, 5 Ton, Medium Tactical Vehicle Trailer (MTVT)
    - MTVR, Family of Vehicles
- (Tactical Wheeled Vehicle – TWV) M1120A4, Heavy Expanded Mobility Tactical Truck (HEMTT)
    - M1076, Palletized Load System Trailer (PLST)
    - M1077, Palletized Load System (PLS)
    - LVSR, Family of Vehicles

- (Tactical Wheeled Vehicle – TWV) M915A3, Line Haul Tractor Truck
    - M872A4, 34 Ton, Semitrailer

- (Tactical Wheeled Vehicle – TWV) M915A5, Line Haul Tractor Truck
    - M872A4, 34 Ton, Semitrailer
- (Tactical Wheeled Vehicle – TWV) HMMWV, Family of Vehicles

Scripted: the contractor shall include all SE Core CM2 models, and must have the below

list

- Dog
- Sheep
- Bicycle
- Scania Bus
- Volvo Cargo Bus
- EMS Ambulance
- Ambulance Van
- Motorcycle
- Taxi
- Red Toyota Pickup
- FedFX truck
- Brown F150
- Blue VW Van
- Volkswagon Golf
- Volkswagon Passat
- Vespa
- Fire
- Multi state building
- Smoke
- Smoke/Fire
- Explosion Ground
- Civ Opforce w/ RPG Flyout
- Child
- Child Muslim
- Civ Opforce w/ Ak47
- Civ Opforce w/ RPG
- Civ Unarmed Female
- Civ Unarmed Female Muslim
- Civ Unarmed Male
- Civ Unarmed Male Muslim
- Ground Guide
- Soldier w/ AK47
- Steve camo digital
- Steve camo digital ready
- BPM2 APC
- HETTs
- HET
- HET Trailer
- M939
- M977
- M977 liquid
- M978
- PLS

- Caiman
- M-ATV
- M-ATV w/ Turret
- Maxxpro
- RG31MK5
- RG33L
- ATGM M1134
- ATGM M1134 SLAT
- CV M1130
- CV M1130 SLAT
- ESV M1132
- ESV M1132 Plow
- ESV M1132 Plow SLAT
- ESV M1132 Roller
- ESV M1132 Roller SLAT
- ESV M1132 SLAT
- FSV M1131
- FSV M1131 SLAT
- ICV M1126
- ICV M1126 SLAT
- MCV 1129
- MCV 1129 SLAT
- MEV
- MEV SLAT
- MGS 1128
- MGS 1128 SLAT
- NBC M1135
- NBC M1135 SLAT
- RV M1127
- RV M1127 SLAT
- Abrams M1A1 Tank
- Abrams M1A1 Plow
- Abrams M1A1 Roller
- Abrams M1A2 SEP Tank
- Abrams M1A2 SEP Plow
- Abrams M1A2 SEP Roller
- ABV with HLA
- ABV with CDB
- ABV with FWMP
- JAB without MLC70
- JAB with MLC70
- AMX10RC ARV
- BRDM2
- MBT M1A1 Abrams

- Mounted Ground Guide
- Challenger
- Chieftan
- EFV
- Leopard II
- Gait Leclerc
- Patton
- Merkava IV
- T72
- T80UK

Immobile: The contractor shall include all SE Core CM2 models, and must have the below list

- Dog
- Sheep
- Bicycle
- Scania Bus
- Volvo Cargo Bus
- EMS Ambulance
- Ambulance Van
- Motorcycle
- Taxi
- Red Toyota Pickup
- FedFX truck
- Brown F150
- Blue VW Van
- Volkswagon Golf
- Volkswagon Passat
- Vespa
- Fire
- Multi state building
- Smoke
- Smoke/Fire
- Explosion Ground
- Civ Opforce w/ RPG Flyout
- Child
- Child Muslim
- Civ Opforce w/ Ak47
- Civ Opforce w/ RPG
- Civ Unarmed Female
- Civ Unarmed Female Muslim
- Civ Unarmed Male
- Civ Unarmed Male Muslim
- Ground Guide

- Soldier w/ AK47
- Steve camo digital
- Steve camo digital ready
- BPM2 APC
- HETTs
- HET
- HET Trailer
- M939
- M977
- M977 liquid
- M978
- PLS
- Caiman
- M-ATV
- M-ATV w/ Turret
- Maxxpro
- RG31MK5
- RG33L
- ATGM M1134
- ATGM M1134 SLAT
- CV M1130
- CV M1130 SLAT
- ESV M1132
- ESV M1132 Plow
- ESV M1132 Plow SLAT
- ESV M1132 Roller
- ESV M1132 Roller SLAT
- ESV M1132 SLAT
- FSV M1131
- FSV M1131 SLAT
- ICV M1126
- ICV M1126 SLAT
- MCV 1129
- MCV 1129 SLAT
- MEV
- MEV SLAT
- MGS 1128
- MGS 1128 SLAT
- NBC M1135
- NBC M1135 SLAT
- RV M1127
- RV M1127 SLAT
- Abrams M1A1 Tank
- Abrams M1A1 Plow

- Abrams M1A1 Roller
- Abrams M1A2 SEP Tank
- Abrams M1A2 SEP Plow
- Abrams M1A2 SEP Roller
- ABV with HLA
- ABV with CDB
- ABV with FWMP
- JAB without MLC70
- JAB with MLC70
- AMX10RC ARV
- BRDM2
- MBT M1A1 Abrams
- Mounted Ground Guide
- Challenger
- Chieftan
- EFV
- Leopard II
- Gait Leclerc
- Patton
- Merkava IV
- T72
- T80UK
- APT
- Bagram bldg2
- Bagram bldg3
- Bagram portable
- Barn 1
- Barn 3
- Church
- Donut Shop
- Gar Cmp Light port
- Gar Fob guardbuild
- House 11
- House 14
- House 15
- House 16
- House 17
- House 21
- Hospital
- Munitions bldg1
- Munitions bldg2
- Box
- Car burnt
- Cart broken

- Chair
- Char 2
- Cargo containers
- Crater 1
- Crater 2
- Crater 5
- Crater 10
- Crater 15
- Filing cabinet 1
- Filing cabinet 2
- Filing cabinet 3
- Garbage bag
- Garbage pile
- Grocery cart
- Mailbox
- Power pylon
- Propane tank
- Shipping containers
- Table 1
- Table 2
- Tin cans
- trash truck burnt 1
- Truck burnt 2
- Tire
- Comm tower
- Miclic
- Miclic breach
- Miclic breach 5m
- Miclic trailer
- AVLB open
- SRB open
- Ordinance IED
- ICV M1126 dmg
- MEV dmg
- Trailer
- Van 3
- Van 4
- Van 5
- A 10 damaged
- C130
- C17
- C5
- Algol
- Cimmaron

- (minefield) Mine marker
- (minefield) Post
- (minefield) Fence
- (minefield) Lane marker
- (minefield) Left
- (minefield) Marker
- (minefield) Right
- (minefield) LMS marker Pole
- Road puddle
- Rock boulder
- Rock formation
- Rock sand formation
- Rock1
- Rock2
- Rock3
- Rock4
- Bush brown med
- Bush green large
- Bush green med
- Bush green small
- Shrub social garlic
- Tree
- Elm oak brown
- Oak dark brown
- Oak dark green
- Oak light green
- Oak green
- Oak orange
- Palm
- Pine
- Pine snow
- Spruce
- Spruce snow1
- Spruce snow2
- Yucca
- Tumbleweed
- Abatis
- Log 21bates
- Barbed wire
- Concertina wire
- Dragon tooth
- Guardrail
- Jersey barrier
- Jersey barrier tall

- Log
- Log crib
- Log large
- Tank wall
- Traffic cone
- Tree fallen
- Street light
- Traffic light
- (euro sign) 1 way sign
- (euro sign) children
- (euro sign) curve left
- (euro sign) curve right
- (euro sign) dead end
- (euro sign) do not enter
- (euro sign) left turn only
- (euro sign) MVP
- (euro sign) no parking
- (euro sign) right turn only
- (euro sign) speed limit 30
- (euro sign) speed limit 40
- (euro sign) speed limit 50
- (euro sign) speed limit 60
- (euro sign) speed limit 90
- (euro sign) STO
- (euro sign) STO2
- (euro sign) Stop
- (euro sign) yield
- (euro sign) yield RTO
- (us signs) 1 way
- (us signs) arrow dbl
- (us signs) arrow left
- (us signs) arrow right
- (us signs) curve
- (us signs) curve ahead
- (us signs) curve left
- (us signs) curve left 35
- (us signs) curve right
- (us signs) curve right 35
- (us signs) dead end
- (us signs) divided hwy ahead
- (us signs) divided hwy end
- (us signs) don not enter ww
- (us signs) freeway ends
- (us signs) lane merge

- (us signs) mark
- (us signs) merge
- (us signs) military left
- (us signs) military right
- (us signs) reduced speed ahead
- (us signs) rest area
- (us signs) rlmter
- (us signs) rollout
- (us signs) RR
- (us signs) RRX
- (us signs) school speed limit
- (us signs) speed limit 25
- (us signs) speed limit 30
- (us signs) speed limit 40
- (us signs) speed limit 45
- (us signs) speed limit 55
- (us signs) stop
- (us signs) yield
- (us signs) weight limit 10
- (us signs) weight limit 30
- (us signs) welcome to perryman

Movable:

- Chain link fence
- Jersey barrier
- Jersey barrier tall
- Rubble pile
- Stacked vehicle tires
- Stone wall 42 inch
- Vehicle blockade civilian

Detachable:

- ABV Combat dozer blade
- ABV Full Width Mine Plow
- JAB MLC70 Bridge

3.2.1.4.1 Interactive Human Models

The CDT shall use current Interactive Human Models or the SE Core CM2. A host controlled, animated, interactive human model(s) shall be provided that gives visual hand and arm signals to direct vehicle movement or vehicle equipment configuration. The animated, interactive human model(s) shall have the capability of executing a minimum of 30 animated; smooth; human like; realistic hand and arm signals that correspond to real-world directions when performing vehicle maneuvering or configuration tasks. Interactive human model(s) positioning relative to the vehicle and signals shall associate

with the simulated vehicle. The signals shall include both day and night (military flashlight in hand) military hand and arm signals.

The interactive human model(s) signals shall control the simulated vehicle's movement and position relative to a pre-defined desired path and the position relative to the interactive human model. The pre-defined path that the vehicle is supposed to follow shall have a tolerance depending on the location of the vehicle in the database. In areas that have other objects such as a motor pool stall openings, a row of vehicles and a tight passage between objects, the actual vehicle location compared to the pre-defined path shall have a tolerance of +/- six inches. In less dense, open areas, the deviation of the vehicle from the pre-defined path shall have a tolerance of +/- three feet. The interactive human model(s) to vehicle positioning shall evaluate for distance and offset (position in the field of view). Parameters for distance and offset shall be configurable for the simulated vehicle. The frequency of interactive human model halts and repositions shall minimize in order to maintain realistic progress for vehicle movements. When the simulated vehicle moves outside the acceptable tolerance or the interactive human model is outside the acceptable field of view, the interactive human model shall halt the movement and refer the student to the instructor. The interactive human model movement animations such as walking and turning shall be realistic. The interactive human model path shall not go through any database object. When directing a vehicle to back up, the front (visible) interactive human model shall act as if receiving signals from a second, rear ground guide. The simulated interactive human model(s) shall conduct safe, procedurally correct actions.

For vehicle configuration tasks, the interactive human model(s) shall correctly position itself in front of the vehicle and shall provide hand and arm signal configuration commands consistent with the vehicle, vehicle equipment, and equipment status. When multiple steps are required for equipment configuration, the interactive human model shall provide commands only when prerequisite actions have accomplished.

For convoy commands, the animated human model(s) shall portray a lead vehicle commander, typically from the waist up in the lead vehicle hatch or waving out the passenger window. The lead vehicle commander shall be able to give hand signal to vehicles following the lead vehicle. The lead vehicle commander's hand signals or mounted signals shall be in response to scenario requirements and triggered at specific points on the lead vehicle path.

3.2.1.4.2 Moveable Models

The CDT architecture shall support the inclusion of moveable objects within the CDT training scenarios. Moveable objects shall define as any object which can move, push, lift, place, or transport during runtime by another entity which has the capability to perform that action of that object. The CDT SGS shall support the initial placement of moveable objects within a scenario during scenario development.

3.2.1.4.3 Relocatable Objects

The CDT architecture shall support the insertion of relocatable objects within the CDT training scenarios during scenario runtime. Relocatable objects shall define as any object or feature which can create, place, modify, or remove in a scenario during runtime. Examples of relocatable objects include but are not limited to jersey barriers, shipping containers, barricades, buildings, static vehicles, craters, fighting positions and debris piles. The CDT SGS shall support the initial placement of relocatable objects within a scenario during scenario development. The CDT software shall support the creation, placement, modification, or removal of relocatable objects during scenario runtime. This includes Ultra-High Resolution buildings (UHRB).

3.2.1.4.4 Moving/Repositionable/Switchable Models, Animations and Special Effects

The CIG shall be capable of displaying a combination of dynamic and static models, as appropriate, to simulate the full complement of vehicles, trailers, buildings, bridges, and fixed and movable obstacles, realistically moving human models, animations and special effects with no performance degradation. A minimum of 100 dynamic (six degree of freedom) models, animations, and special effects shall provide. It shall be possible to reassign the moving coordinate systems to different displayed objects.

3.2.1.4.4.1 Traffic Models

Urban traffic on highways and secondary roads shall provide to aid in training convoy tasks and defensive driving tasks.

3.2.1.4.4.2 Weapon Impact, Animation, and Special Effects

All weapon impact points on the own vehicle shall be detected. Other incoming weapons effects scripted and/or IOS triggered such as artillery explosions, IED (buried and exposed), cannon fire, all ownship weapons (i.e. M2, M240, and all crew-serve weapons), and missiles shall be random in location, size, effect, and number (i.e. single or multiple depending on weapon) and shall design as distractions to the student with visual, motion, and aural cues.

3.2.1.4.5 Other Models

The CDT shall achieve interoperability and fair fight with current force, future force, and future virtual simulators by providing a common synthetic environment, common virtual coordinate system, CM2, and common SAF/Computer Generated Force (CGF) provided by SE Core.

The CDT shall use the SE Core Virtual OneSAF baseline to meet system requirements. The design shall support and be functional with the capabilities of OneSAF. For those requirements not met by OneSAF and to enhance the SAF capabilities of the simulator, the contractor can supplement with an alternate SAF system.

SAF entities shall follow the road network to include paved and unpaved roads with roads varying in size from simple trails to a four lane freeway/autobahn. SAF entities shall obey vehicle traffic regulations for the terrain specified. SAF entities shall include pedestrians (friendly, threat and neutral forces). These entities shall support additional

distractions for the crew, such as, weapons effects (including firing on the own vehicle to include hits and near misses or firing weapons into the air), pedestrians or children walking or running into the street, and aggressive driving (speeding, weaving in and out of traffic, cutting in front of the own vehicle).

The CDT shall provide real-time color computer generated visual images supported by OneSAF and SE Core with details to train vehicle-driving crews. The visual simulation shall provide essential cues required by the crew member(s) to assess simulated vehicle position and velocity, characteristics of the terrain, and other information necessary to operate the module(s)/appended subsystem(s) in training scenarios.

SAF entities shall include static and dynamic models, and any associated software required to simulate the SAF entity appended subsystem(s) visual/sensor scene environment. Critical SAF entities include but are not limited to SE Core CM2 moving models, realistic high resolution animation, dismounted human models, particle based special effects, and animation shall render in high level of detail to facilitate Warfighter's immersion in the synthetic environment and maximize training objectives.

3.2.1.4.6 Deliverable Models

All models and all associated textures and models shall deliver to the Government as part of deliverables. The runtime for all models shall not take more than 15 minutes to install per CIG and once for all DBs.

3.2.1.5 Special Real-Time Processing

The image generator shall have the capability to provide high-fidelity simulation of atmospheric and meteorological effects, illumination conditions, special light characteristics, and tactical smoke. The specified effects and conditions shall realistically reflect in the simulation of all imagery.

3.2.1.5.1 Atmospheric and Meteorological Effects

Simulation of atmospheric and meteorological effects shall provide. Atmospheric and meteorological effects shall include clouds, overcast, fog, rain, and snow. Atmospheric and meteorological effects shall be cognizant of the database area simulated, i.e. no rain inside of tunnels or buildings. Precipitation effects shall be capable of accumulating on the ground over time to create rain puddles and snowdrifts. The color of the snow shall be white.

3.2.1.5.2 Illumination

The CDT system shall simulate the illumination of the visual scene by both natural and artificial sources. Natural illumination shall include day, dusk/dawn, and night.

3.2.1.5.3 Visual Simulation of Motion

Visual simulation of own vehicle and visual scene element motion shall be as follows:

3.2.1.5.3.1 Own Vehicle Dynamics

Visual simulation shall provide own vehicle motion equal to the complete range of motion capability of the design basis vehicle along and about all axes without any degradation in scene content or scene quality unless otherwise specified. The motion effects shall be applied to the visual simulation associated with each own vehicle eye-point.

3.2.1.5.3.2 Moving, Repositionable and Switchable Models

The image generator shall be capable of displaying a combination of dynamic and static vehicles as modeled in the CDT terrain DBs which represent a full complement of vehicles and other objects to simulate any potential scenario required as part of the CDT system. Dynamic models shall have unrestricted movement in six-degrees of freedom. Dynamic models representing vehicles with moving parts shall have articulated components, which move in the visual scene.

A scene management process shall provide to allow real-time reallocation of processing resources to accommodate other combinations of entities. Ground vehicles shall follow the contour of the terrain, as commanded by the local host computer. Air vehicles shall follow flight paths computed by the related vehicle consoles.

3.2.1.6 Image Quality – General

The CDT system, when integrated with the visual system, shall provide the performance specified below. The performance specified applies to the total contributions of all parts of the complete integrated system.

There shall not be any variations or degradation in brightness, color, sharpness, position, or other visual characteristics, which are not typical of the scene simulated except as specified.

3.2.1.6.1 Visual Image Field of View

The true field of view (FOV) for each design eye-point and the associated sensors and vision blocks shall be as specified in each student training station and console.

The IOS total FOV shall present to the student in the driver's compartment. The monitors shall arrange to provide the FOV listed in the CDT Common SRD and Variant-Specific appendices SRD. When an auxiliary viewing device (e.g. Drivers Vision Enhancer) is in use by the driver in the driver's compartment, the center CGI monitor shall display the imagery for that auxiliary device.

3.2.1.6.2 Visual Image Sharpness

The ratio of vertical to horizontal resolution (in arc-minutes/Optical Line Pair) shall vary no more than 0.8 to 1.2. Image motion of up to 15 degrees per second shall not degrade sharpness by more than 20 percent.

3.2.1.6.3 Luminance

Luminance shall provide no less than 250 lumens of light output onto a VDU of 21 square feet and deliver 14.4 foot-Lambert (ft.-L) at the center of each display channel.

3.2.1.6.4 Contrast

The minimum contrast ratio for all displayed images shall be 150:1 for each display channel.

3.2.1.6.5 Color

The visual imagery shall provide an approximation of the full visible color spectrum as limited by commercial color display devices. Each Image Generation (IG) channel shall provide a minimum of 24 bits per color component (i.e. red, green, blue), allowing for 16.78 million unique colors to be represented.

Luminance and chrominance information processing shall be accomplished with resolution and accuracy to ensure stable, continuous color at the display with minor discernible abrupt transitions and Mach banding except as demanded by the phenomena being simulated. The visual system shall also preclude visible instantaneous changes in color and intensity due to changes in fading and shading as the eye-point moves through the scene. The computed color and intensity shall be a function of reflectance, luminance, illumination magnitude and direction, range and atmospheric effects.

3.2.1.6.6 Image Perspective and Geometric Accuracy

The CDT visual systems shall generate and display true perspective images of the three-dimensional visual scene. The scene perspective shall be correct for all simulated eye-point positions and viewing angles. Visual features which obscure from view by other objects and the hidden back sides of objects shall not be visible in the display. Spurious images and object outlines shall not result from the occultation, back-face elimination or any other image generation process.

3.2.1.6.6.1 Total Geometric Accuracy

Total geometric distortion for each display shall minimize the error in apparent location for any point in the scene relative to the true projected position.

3.2.1.6.6.2 Relative Geometric Errors

Geometric errors in scene points relative to nearby scene points shall not exceed six arc minutes at the center of the display(s). The relative geometric error at the edges of the display(s) shall not exceed ten arc minutes.

3.2.1.6.7 Vernier Resolution

Vernier resolution shall be less than 20 percent of the resolution (Optical Line Pair spacing) specified for each display.

3.2.1.6.8 Adjacent Channel Matching

The gap (i.e. discontinuity) in what should be a continuous scene shall be minimal using commercial off the shelf (COTS) monitors as measured from the design eye-point.

Variation of sky/horizon/terrain imagery in color, brightness, contrast, and resolution between adjacent displays shall not be noticeable for the full range of simulated conditions. Special emphasis shall be given to matching brightness and contrast in barely visible portions of the dusk and night scene. Variation in color, brightness, contrast, resolution, and collimation between adjacent channel displays shall not be noticeable for the full range of simulated conditions. For displays with adjacent channels, that part of the scene which would fall within the gap in what should be a continuous scene shall display the surrounding displays. Adjacent channels shall design to minimize the appearance of discontinuity.

Where the scene presented is a combination of multiple channels, variations in color, brightness, contrast, resolution, and collimation between adjacent channels shall minimize for the full range of simulated conditions. All channels in the IG shall update and the updated image displayed synchronously.

3.2.1.6.9 Image Stability

The displayed image shall not drift in position more than one pixel per four hours of continuous operation. Peak to peak short term image deviations such as jitter and oscillation shall not exceed 0.04 percent of the display diagonal measurement for the specified operating conditions. There shall not be any discernible relative motion between fixed objects in the visual scene except as demanded by the equations of motion for the operator/trainee viewpoint(s).

3.2.1.6.10 Video Rate

The video refresh rate shall be sufficient to prevent any noticeable display artifacts. A non-interlaced raster is preferred.

3.2.1.6.11 Update Rate and Channel Synchronization

The position and attitude data for the viewpoint and all moving models shall update and a complete scene shall compute at a rate that is sufficient to support the CDT training tasks. The displayed scene shall generate from updated position and attitude data for the viewpoint and all moving entities at a rate not less than 60 Hz. All channels shall update and the updated image displayed synchronously.

3.2.1.6.12 Occulting (Hidden Surface Elimination)

Each IG channel shall provide partial or total occulting, as appropriate, of surfaces and light points by surfaces nearer to the simulated viewpoint. Occulting surfaces shall be unrestricted in orientation with no restrictions in viewing angle. The IG shall properly occult all objects in the simulated environment with respect to the viewpoint (including sensors). Sufficient occulting levels shall provide to properly occult all of the surfaces that draw in the channel. There shall be no ghost images or shadows in the image (static or dynamic) from occulting errors. The system shall not show back plain occulting.

Light points shall occult properly at boundaries between polygons of a multiple polygon surface.

3.2.1.6.13 Smear

Smear due to image motion shall not degrade resolution in image quality nor be noticeable in the displayed images.

3.2.1.6.14 Flicker

Flicker due to image refresh rate shall not be noticeable for the image luminance as specified.

3.2.1.6.15 Stepping

Stepping or other discrete image motion shall not be noticeable all displays.

3.2.1.7 Image Quality - System Capacity

Distracting artifacts caused by digital processing errors shall minimize or eliminated. Anomalies shall eliminate or reduce to the extent that they shall not degrade the effectiveness of exercise execution.

The following artifacts shall control to the extent specified below. Exceptions shall require explicit approval of the government.

a. Image ringing – none
b. Convergence errors – imperceptible
c. Mach banding – non-distracting
d. Moiré patterns – non-distracting
e. Scintillation of texture – imperceptible
f. Scintillation of small features – imperceptible
g. Flashing of polygons or texture or other anomalies such as that caused by depth buffer accuracy – imperceptible
h. Inter-raster edge flicker – imperceptible
i. Image swimming – non-distracting
j. Quantization of scene elements (stair-stepping and line crawling of edges and breakup of long narrow surfaces) – imperceptible
k. Multiple ghost images – non-distracting beyond 30 Hz double-imaging
l. Frame-rate reduction – non-distracting
m. Delay to visually represent temporal special effects – imperceptible except as specified
n. Dynamic resolution/sharpness degradation with image motion – imperceptible
o. Field tracking – imperceptible
p. Raster line pairing – imperceptible
q. Aliasing such as that caused by interactions of scene elements with the raster structure – imperceptible
r. Flashing and streaking of entire polygons and scan line segments – imperceptible
s. Abrupt transition of scene elements between adjacent pixels – imperceptible

t. Flashing and streaking by visual features due to logic errors and other causes – imperceptible
u. Abrupt changes in illumination, color, or intensity, e.g., flicker, and flashing – imperceptible, except in image intensified views minimized
v. Level of detail transitions – imperceptible
w. Feature popping – non-distracting
x. Disappearing Features – imperceptible
y. Occulting errors – imperceptible
z. Terrain gaps/holes – none
aa. Terrain spikes – none
bb. Floating/buried features – none

3.2.1.8 Electro-Optics (EO) Sensor Image Simulation

The visual system shall have sensor simulation capability. The sensor simulation capability shall include thermal imaging and low light amplification in the form of Night Vision Goggles (NVG)/Driver's Vision Enhancer (DVE) and appropriate installable/switchable devices (those available in the actual vehicles). Sensor simulation modes shall be available at all times, where appropriate, during a simulation session. The selection time to and from sensor modes shall not exceed selection times in the actual vehicle.

3.2.1.8.1 Sensor Image Database

The electro-optic sensors simulation shall utilize and simulate the visual database with additional descriptors and object data necessary to generate images with the fundamental characteristics of the sensor. Use of the visual database for sensor image generation shall not result in degradation of the capabilities of either the standard visual or sensor image generation.

3.2.1.8.2 Thermal Sight Image Simulation

The thermal images shall generate about the instantaneous optical line-of-sight of the thermal receiver optics. For the DVE, the thermal conditions shall provide a generally correct appearance for all objects for a given time of day, temperature, and atmospheric condition. Thermal signature simulation may be absolute in thermal representation and simplified by creating generic thermal signatures by type of model e.g. tank, armored personnel carrier, wheeled armored and truck. Simulation of thermal signatures emitted through tactical smoke, fog, and vegetation is required. The effect of atmospheric attenuation shall utilize a fading function appropriate to infrared. The simulated thermal image shall simulate thermal noise to the thermal imagery video to produce a realistic appearance. The thermal image simulation shall exhibit the response to operator manipulation of sensitivity, gain, contrast, and other controls applicable to each vehicle to approximate the relationship between control settings, environmental conditions, and the displayed imagery. The CDT system shall simulate both white-hot and black-hot modes.

3.2.1.8.3 Night Vision Image Intensifier

The visual system shall provide a realistic simulation of the use of low light level vision intensification equipment. For DVE, the intensification simulation shall utilize a simulated look and feel of operational equipment. The CDT system shall simulate instruments of the operational intensification equipment, operational mechanical adjustment features, and electrical controls. When existing display assets are used, the CDT system shall simulate all electrical controls and fields of view restrictions. The lunar phase and illumination levels shall correspond to real world conditions.

3.2.1.9 STS and Console Specific FOV and Resolution Requirements

The STS displays shall provide FOV (including up and down orientation of the vertical FOV, resolutions, detection ranges, and recognition ranges as required in the subparagraphs which follow. The resolution values specified are the maximum values acceptable. The location, size, and orientation of all the driver vision blocks, cameras, and sensors shall conform to the STS physical and dimensional characteristics.

Target detection and recognition ranges specify in meters and based on the standard 2.5 meter high target. The terms detection and recognition define below and are equivalent to their definitions in Johnson's Criteria:

a. Detection – An object is present and requires 1.5 active scan lines across the object
b. Recognition – The class to which an object or target belongs may be discerned, e.g. a small vehicle (like a jeep), a mid-sized vehicle (like an M1) and a transport aircraft. Requires 7.5 active scan lines across the object

FOV (instantaneous and total) specify as degrees horizontal x degrees vertical. The FOV requirements refer to the computed FOV. The physical (measurable at the eye-point) FOV shall be equal to the computed FOV unless otherwise specified below.

Resolution is the average vertical resolution specified in arc-minutes per optical line pair. The worst case vertical resolution shall be no greater than 110 percent of the specified average vertical resolution.

3.2.1.9.1 TV (M1A1/ M1A2 SEP Tank) and TEV (JAB) STS

The following requirements apply to the M1A1, M1A2 SEPv2 STSs. The paragraphs specify the variant to which the requirements apply.

a. Driver's Vision Enhancer (DVE) (Thermal)

(1) Instantaneous FOV, 1X	40 x 30
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

b. Driver's Rear View Sensor System (DRSS) Driver's Video Display. (M1A2

SEPv2)

(1) Instantaneous FOV, 1X	54 X 40
(2) Resolution FOV, 1X	14.3 arcmin/OLP
(3) Detection Range, 1X	750 meters
(4) Detection Range, 1X (Man-sized Target)	6-225 meters
(5) Recognition Range, 1X	150 meters

c. Camera view DVE Wide (JAB)

(1) Instantaneous FOV, 1X	107 X 27
(2) Resolution FOV, 1X	14.3 arcmin/OLP
(3) Detection Range, 1X	750 meters
(4) Detection Range, 1X (Man-sized Target)	6-225 meters
(5) Recognition Range, 1X	150 meters

d. Camera view DVE UL (JAB)

(1) Instantaneous FOV, 1X	40 X 30
(2) Resolution FOV, 1X	14.3 arcmin/OLP
(3) Detection Range, 1X	750 meters
(4) Detection Range, 1X (Man-sized Target)	6-225 meters
(5) Recognition Range, 1X	150 meters

e. Camera view DVE UW (JAB)

(1) Instantaneous FOV, 1X	114 X 98
(2) Resolution FOV, 1X	14.3 arcmin/OLP
(3) Detection Range, 1X	750 meters
(4) Detection Range, 1X (Man-sized Target)	6-225 meters
(5) Recognition Range, 1X	150 meters

f. Driver's Vision Blocks (OTW)

(1) Instantaneous FOV, 1X	180x45
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

3.2.1.9.2 TWV

a. Driver's Vision Blocks (OTW)

(1) Instantaneous FOV, 1X	180 x 45
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

b. Driver's Vision Enhancer (DVE) (Thermal)

(5) Instantaneous FOV, 1X	40 x 30
(6) Resolution FOV, 1X	6.1
(7) Detection Range, 1X	2,400
(8) Recognition Range, 1X	500

3.2.1.9.3 MV

a. Driver's Vision Blocks (OTW)

(1) Instantaneous FOV, 1X	180 x 45
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

3.2.1.9.4 SV

a. Driver's Vision Blocks (OTW)

(1) Instantaneous FOV, 1X	180 x 45
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

b. Driver's Vision Enhancer (DVE) (Thermal)

(1) Instantaneous FOV, 1X	40 x 30
(2) Resolution FOV, 1X	6.1
(3) Detection Range, 1X	2,400
(4) Recognition Range, 1X	500

3.2.1.9.5 AAR – Full Screen Visual Display

For the Full Screen AAR console, there shall have a direct view display, which together provide an instantaneous FOV of 180 by 45 degrees. The AAR visual display shall be available during real-time and playback modes. For the AAR console, the displayed scene shall be operator selectable as unaided, thermal, and light intensifier. The displayed image shall repeat the associated characteristics of the selected displayed image including magnification, reticle and displayed data.

For the AAR console, a one-channel display system with the following characteristics shall provide:

a.	Instantaneous FOV per channel (normal)	60 x 45
b.	Resolution, 1X (normal)	6.8
c.	Detection range, 1X (normal)	2,400
d.	Recognition range, 1X (normal)	500

3.2.2 Functional Training

A continuous visual scene shall provide for seamless unrestricted movement throughout the entire synthetic environment.

3.2.3 General Training Scene

Training visual imagery with the capabilities specified in this document shall provide for all visual displays. Definitions of the specific environment databases, the geographic regions of coverage, and supporting model databases provide as part of SE Core DB requirements. Training visual imagery shall be consistent with the real-world environment depicted. The simulated features shall be similar to the real-world area in appearance, frequency of occurrence and other characteristics. Details of simulated features shall be available to provide this information and to provide realistic depth perception over terrain surfaces as it would provide in the real world.

3.3 Major Component Characteristics

3.3.1 Image Generator Subsystem

The IG shall consist of real-time computer image generation and image processing equipment. Computer image generation shall include the class of system that provides true perspective two-dimensional displays of stored three-dimensional databases. Image processing refers to operations performed on pixel image data. The requirements of this section are applicable to the visual scene as seen through the windshield, mirrors, vision blocks, and sensor utilized within the vehicles. The system shall provide imagery for each STS or console for all of the following that are applicable.

a. Vision blocks
b. Thermal sensors (DVE)
c. Image intensifier night vision devices (DVE)
d. CDT consoles and stealth (IOS)
e. After action review station
f. Direct view displays with simulated mirror viewports

3.3.1.1 CIG Hardware Requirements

3.3.1.1.1 Fans

If electrical fans utilized for cooling, the fans shall be fitted with finger guards on all exposed sides for safety and nothing about the cabinet shall prevent air leaving through the top of the unit. If dust filters utilized, the dust filters shall be disposable or reusable.

3.3.1.1.2 Cable Slack and Accessibility

Adequate cable slack and cable bending features shall provide to allow for maintenance access of all assemblies. All cable connections and connectors shall be easily accessible. Video and network cables that run from each computer should be easily accessible from the back of the rack to support future cable upgrade and replacement.

3.3.1.1.3 Shock

The Computer Image Generator (CIG) system shall design such that it will not damage, nor shall degrade the performance, when it subjects to infrequent non-repetitive shocks or transient vibrations encountered during handling, transportation, and service environments. This shall explicitly include the mobile CDT designs.

3.3.1.1.4 Vibration

The CIG system shall design such that it will not damage, nor shall degrade the performance, when it subjects to vibration stresses encountered during handling, transportation, and normal use. This shall explicitly include the mobile CDT designs.

3.3.1.1.5 Interchangeability

The design tolerance of parts within the CIG System shall permit parts, subassemblies, and/or assemblies to use in their parent assembly without regard to source of supply or manufacturer. No interchangeable parts, subassemblies, and/or assemblies shall require matching to a particular parent assembly in order to achieve functionality.

The CIG system shall be interchangeable with all existing CDT CIG's, with at most, minimal changes to the video distribution systems, host computer interface or host software.

3.3.1.1.6 Materials, Processes and Parts

Best commercial practices (e.g. methods, processes, procedures, and usage) shall apply to all components and software in the CIG system.

3.3.1.1.7 Improved IG performance

The image generator designs shall provide for straightforward upgrade by modular expansion of the system. Spare card slots shall provide in the image generator for expansion flexibility. The image generator expansion capability shall allow for a higher processing and storage capacity to provide coverage of larger areas with higher resolution data and increased density.

3.3.1.1.8 Electromagnetic Radiation

3.3.1.1.8.1 Electromagnetic Compatibility (EMC)

The CIG System shall be mutually compatible with other CDT sub-systems and systems within the CDT fixed base and mobile operational environment. The system shall successfully operate in its intended worst case environment without suffering degradation from or causing unacceptable degradation to other systems.

3.3.1.1.8.2 Electromagnetic Interference (EMI)

The CIG System shall perform normally and meet all specific performance requirements when exposed to the operational electromagnetic environment at both fixed and mobile sites.

3.3.1.1.8.3 Electrostatic Discharge (ESD)

Provisions shall implement to avoid and to protect against the effects of static electricity generation and discharge in areas containing electrostatic sensitive devices such as microcircuits. CIG system equipment shall be grounded and shall include provisions for maintenance personnel to be appropriately grounded while maintaining the CIG System, e.g. through the employment of wrist straps.

3.3.1.1.9 Identification and Marking

Units, assemblies, and subassemblies in the CIG system shall identify by identification markings and warning labels consistent with CDT design standards as expressed for similar equipment in the CDT Technical Data Package (TDP).

3.3.1.1.9.1 Cable and Wire Markings

The following cable and wire marking requirements apply only to cables and wires which interconnect the CIG to other systems. Cables and wires shall mark permanently and legibly at connection points to facilitate installation and maintenance. Types of connections include plugs, jacks, lugged terminals and push-on captivated wires. Ground wires, jumpers, or links located on terminal boards, jacks or plugs are exempt from such marking. Soldered or wire wrap connections shall be exempt from such marking. The underlying criteria for wire and cable marking shall be ease of maintenance and reduction of chances of misconnection.

3.3.1.1.9.2 ESD Marking

Electrostatic discharge sensitive assemblies shall be marked in accordance with common industry standards.

3.3.1.1.10 Use of Commercial Components

a. The contractor shall define and deliver hardware configuration specifications that allow the Government to separately procure the IG hardware that are fully functional.
b. The CIG shall minimize the use of custom components or systems that are available from only one source. Any customized components shall be identified to the Government.
c. Individual CIG assemblies at the Line Replaceable Unit (LRU) level shall certify by a recognized national laboratory. If commercial technology is utilized, industrial or server class quality is required for enhanced reliability and durability.

3.3.1.1.11 CIG Power & Ground Interface

3.3.1.1.11.1 Power & Ground

The CIG shall interface to facility power and ground as listed in the CDT Common SRD under Facility Power section.

3.3.1.1.11.2 Power On

The CIG subsystem shall power on and initialize to the point of operation under host control solely through application of AC input power. A local power on/off switch shall provide at the CIG. Powering up of an individual CIG shall not cause interference on the simulator network that affects the performance of other operating simulators.

3.3.1.1.11.3 Power Loss

The CIG subsystem shall design such that it shall not damage by sudden withdrawal of the primary power. Powering down of an individual CIG system shall not cause interference on the host STS/workstation or on the simulator network, which affects the performance of the host STS/workstation or other operating simulators.

3.3.1.1.12 CIG Facility Mechanical Interface

3.3.1.1.12.1 Size

External dimensions of the CIG cabinet shall not exceed 23.5" W x 36.12" D x 79" H.

3.3.1.1.12.2 Location

The CIG shall be located within the footprint and space constraints of the current image generator cabinet.

3.3.1.1.12.3 Weight

The weight of the CIG together with the host rack shall not exceed 900 pounds. The distributed floor load from the CIG shall not exceed 200 pounds per square foot. The concentrated floor load from the CIG shall not exceed 500 pounds/square inch.

3.3.1.1.13 Acoustical Noise

The acoustical noise level of the CIG shall be no greater than 50 dB.

3.3.1.1.14 CIG Over-Temperature Protection.

CIG system shall detect over-temperature conditions and automatically shut down the affected assembly to reduce the possibility of damage to the CIG.

3.3.1.1.15 CIG System Maintenance Access

Maintenance access shall be equivalent or improved over the current fielded EPX-50 and video distribution system, for both fixed base and mobile applications. The CIG System shall include provisions for movement of the CIG cabinet if necessary to accommodate this required maintenance access in Mobile Shelters.

3.3.1.1.16 CIG System Environmental

3.3.1.1.16.1 Operational Climatic Environment

The CIG System shall operate to full specifications in the following environment:

a. Temperature Range 5° to 35° C (40° to 95° F)
b. Humidity Range 8 to 85 percent, non-condensing

3.3.1.1.16.2 Non-Operational Climatic Environment

The CIG System shall withstand non-operation and storage without damage in the following environment:

a. Temperature Range -40° to 65° C (-40° to 149° F)
b. Humidity Range 20 to 80 percent, non-condensing

3.3.1.1.16.3 CIG Cooling

The CIG shall utilize the ambient conditioned air as provided by the facility or trailer.

3.3.1.1.16.4 CIG Heat Load

A CIG heat load analysis shall compute and compare to the current equivalent CDT image generator for each respective configuration.

3.3.1.1.16.5 CIG System Electromagnetic Environment Interface

The CIG system shall be fully compatible with itself and the electromagnetic environment of the CDT system at each fixed and mobile installation.

3.3.1.1.16.6 CIG System Mobile Shelter Environment

The CIG system shall be fully compatible with the operating and movement/transport environment of the mobile CDT systems.

3.3.1.1.16.7 CIG Cabinet Assembly

The CIG shall be contained in a single CIG cabinet assembly that shall securely house and protect the CIG in both fixed and mobile applications and facilitate cooling airflow using facility ambient air. The cabinet shall have casters to facilitate movement in the facility and shall utilize adjustable feet for leveling and stability. The cabinet shall utilize attaching points necessary for secure mounting and protection from shock in mobile shelter applications. Doors to enclose the front and rear of the CIG cabinet are optional.

3.3.1.1.16.8 CIG Internal Communication

The CIG shall include necessary internal communication and internal video distribution equipment to meet specified requirements.

3.3.1.2 CIG Software Requirements

The CIG software shall design for hardware scalability as technology progresses.

3.3.1.2.1 CIG Software

A CIG common software set shall design to support all STS/workstation configurations specified. Setup software shall auto configure the IG for the intended configuration. Selection of any supported configuration shall be possible by host command designation and by the operator using the CIG Maintenance Tool. This will allow similarly equipped CIG's to reconfigure to support a different simulator type if the need arises. The CIG

common software set shall include run time executable, support, maintenance, utilities software, supporting databases and models.

3.3.1.2.1.1 CIG Run Time Software

The run time software shall provide in executable form, including the visual application, operating system, and configuration controlled device drivers.

3.3.1.2.1.2 CIG Support Databases

Supporting databases shall provide for the CIG including:

a. Reticle and symbology files (DVE)
b. CIG parameter files
c. CIG setup and viewport definition files
d. CIG test and maintenance databases

3.3.1.2.1.3 CIG Initialization

The CIG shall automatically initialize with a generic database displayed for daily readiness check and be ready to commence operation via Host control within three minutes of activation from a "power off" state.

After the CIG System is operational, the time that any database is ready for training shall not exceed three minutes from host command.

3.3.1.2.2 System Timing

3.3.1.2.2.1 Transport Delay

The CIG transport delay, defined as the time from receiving viewpoint data from the host to completing display of the first field based on that data, shall not exceed 105 milliseconds for ground systems.

Transport delay shall minimize and must be sufficient to support the vehicle training tasks and satisfy the overall system transport delay. Transport delay requirements shall apply to all visual scene updates unless explicitly stated otherwise.

3.3.1.2.2.2 Asynchronous-Specific Protocol

The CIG shall be configurable to support an asynchronous communication protocol, where the host data receives by the IG anytime during a real-time field. The CIG shall extrapolate from the motion systems and viewport data to time-correct the packet for the current field.

3.3.1.2.2.3 Synchronous-Specific Protocol

The CIG shall configure to support synchronous communication protocol. Sync packets shall be provided by the CIG for synchronization with the Host computer to eliminate overall visual system transport delay at a non-changing rate equal to the specified image update rate, regardless of the instant update rate or overload condition in the CIG.

3.3.1.2.3 CIG Performance Requirements

The CIG system shall conform to the requirements of the CDT System Specification as a subsystem of the CDT system, except as specified herein.

3.3.1.2.3.1 Positional Accuracy and Range

These requirements apply to computations of the location, orientation, positioning, and dynamics of own vehicle, models (e.g. tanks and weapons) and special effects relative to, and as affected by, the terrain surface and objects on the terrain. The results of the computation are generally data for animation or data needed by the host for computations, which applies on the image database to ensure correlation of all simulation components.

The CIG shall generate each object in the image that positions within the following computational tolerances. These tolerances are with respect to the position inputs from the local host that is supplied to the visual system for own vehicle, models and special effects.

a. Simulated angular position for all axes: +/- 0.001 degree
b. Simulated elevation: +/- 0.01 cm
c. Simulated North-South and East-West position: +/- 0.01 cm
d. Moving object simulated angular position for all axes: +/- 0.01 degree
e. Moving object simulated elevation: +/- 0.01 cm
f. Moving object simulated North-South and East-West position: +/-0.01 cm
g. Surface elevation: +/- 0.01 cm

3.3.1.2.3.2 Image Generation System Throughput

System and channel capacity throughout the image generator shall support the specified polygon and pixel capacity for all operating conditions. There shall be no computational, memory, data transfer, or other limitations anywhere in the image generator or the database design, which would limit the ability of the system to display the specified quantity of potentially visible polygons and pixels. The polygon and pixel performance shall be independent of the number of channels generated by a single image generator. The polygon and pixel capacity shall satisfy the IG requirements regardless of the displayed image geometrical arrangement; distribution of polygons within the displayed image; number and distribution of moving models; and the worst case combination of special processing and display features invoked. The polygon and pixel capacity shall not restrict by polygon complexity attributes (i.e. texture, anti-aliasing, and shading).

3.3.1.2.3.3 Image Perspective & Geometric Accuracy

The CIG shall generate and display true perspective images of the three-dimensional visual scene. The scene perspective shall be correct for simulated eye-point positions and viewing angles. Visual features that obscured from view by other objects and the hidden backsides of objects shall not be visible in the display. Spurious images and object

outlines shall not result from occultation, back-face elimination or any other image generation process. The CIG shall allow for maximum use of Z buffer accuracy provided by the graphics card.

3.3.1.2.3.4 Pixel Fill Rate

Pixel fill shall be sufficient to satisfy the image update rate specification under all specified scene conditions in each view. This pixel capacity shall be satisfied regardless of the displayed image geometrical orientation, distribution of polygons within the displayed image, number and distribution of moving models and the worst case combination of special processing display features invoked, and/or polygon complexity attributes, i.e. texture, anti-aliasing, and shading.

The CIG shall provide a scene depth complexity sufficient to meet the image update rate requirement for the training databases operating at the specified model load.

3.3.1.2.3.5 Polygon Capacity

Polygon capacity shall be sufficient to satisfy the image update rate specification under specified scene conditions in each view for all of the CDT and SE Core databases and model products. The polygon capacity shall satisfy the image update rate specification regardless of the displayed image geometrical orientation, distribution of polygons within the displayed image, number and distribution of moving models and the worst case combination of special processing and display features invoked.

The image generator shall provide the ability to have more than 100 active moving models and training conditions, active simultaneously and concurrently with providing Dynamic Terrain effects.

3.3.1.2.3.6 Range of Vision

At full visibility, the image generation system shall display visibility not less than 5 km for prominent terrain and any tactically significant cultural features that serve as navigation landmarks on the terrain. For the terrain surface, moving models, special effects, cultural objects and static objects, the image generator shall support object detection within a range of 2 km for unmagnified views. The transition in the detail portrayed from ‘close in’ to the ‘full 5 km range’ shall be subtle and non-distracting to the trainee.

3.3.1.2.3.7 Database Paging

The CIG shall allow for real time paging of model selects, fast model paging and fast paging of new areas. The CIG shall accommodate translation rate at least 100 Nm per hour for ground systems. The system shall allow for instantaneous movement (teleporting) throughout the database. For eye-point movement less than the clipping range, 5 km, the visual system update time shall not exceed two seconds. For eye-point movement greater than two times the clipping range, 10 km, the system update time shall not exceed 15 seconds. Database paging during real time operation shall not present any

anomalies to the viewer. Database paging priority shall be the highest for the near scene at the eye-point and lowest at the database far clipping range.

3.3.1.2.3.8 Viewport and Video Control

Viewport concurrency for all configurations shall maximize to the extent of the current technology at the time of procurement. New configurations shall define to maximize viewport concurrency based on new CIG hardware delivered. Viewport concurrency shall be at least equivalent to the current CDT systems. Any changes to viewport concurrency shall require Government approval. The CDT system shall increase viewport concurrency to improve training realism and reduce the complexity of maintenance support.

3.3.1.2.4 Visual System Functionality

The following visual system functionality shall be equivalent or improved compared to that in the current CDT systems as it affects trainee performance for each respective configuration, unless explicitly specified otherwise in this specification:

a. System and/or STS/workstation functionality
b. View switching performance
c. Instant and total field of view
d. Symbology and reticles appearance, size, location and function
e. Sensor imagery simulation depiction detail and effects
f. Terrain database paging functionality
g. Moving model functionality and geometry
h. Placeable model functionality
i. Special effects activation times and geometry
j. Environmental effects on trainee performance

All changes that affect trainee performance shall explicitly approve by the government.

3.3.1.2.4.1 Reference Eye-Point

Multiple, simultaneous views (eye-points) shall be supported with the quantity being established by the channel concurrency requirement for each CDT STS/IOS configuration.

3.3.1.2.4.2 Viewport Definition & Control

View orientation shall be dynamically modifiable in response to host inputs. Latency for view switching shall not exceed 100 millisecond measured from time of receipt of the host computer command in the CIG input to the completion of the first frame of the updated view.

3.3.1.2.4.3 Channel Synchronization

Channel synchronization shall not adversely affect the training task. There shall be no distraction to the trainee. For display systems, channel synchronization shall be gen-

locked with the display of the first line of video within one microsecond between adjacent channels.

3.3.1.2.5 Surfaces and Surface Effects

The system shall have sufficient special processing features such as shading, transparency, etc. to meet the functional and performance requirements herein.

3.3.1.2.5.1 Shaders

The image generator shall support the smooth and curved surface polygon shading of terrain and cultural features and models. Shading shall not result in any Mach banding or other color discontinuities in smooth surfaces.

3.3.1.2.5.2 Surface Lighting

The CIG shall independently, realistically and simultaneously model the transparency, shading, and illumination effects for polygons.

3.3.1.2.5.3 Directional and Diffuse Illumination

The total illumination in the visual scene shall be a combination of directional and diffuse illumination. The attenuation of illumination shall simulate clouds, fog, rain, and haze.

3.3.1.2.5.4 Illumination & Shading

a. The CIG shall provide a natural illumination model and artificial illumination model based on the ambient illumination
b. The CIG shall support flat, fixed, smooth, and curved surface polygon and object shading. Shading shall not result in any Mach band or other color discontinuities in smooth surfaces
c. The CIG shall support independent positional illumination sources such as flares
d. The CIG shall support direct illumination simulation based on the direction of the light source such as vehicle headlights and searchlights
e. The CIG shall support host controllable area lights which consist of urban/city lights and rural lights
f. The CIG shall support host controllable fixed model lights (features on the terrain) which consist of static anti-collision lights
g. The CIG shall support host controllable lights on moving models, which includes position lights, and anti-collision lights
h. The CIG shall support flares. Flare lighting shall result in a lobe shaped lighting pattern on the terrain surface modeled for each individual flare and that is occulted where appropriate by any interfering terrain objects or terrain elevation to produce realistic shading effects. Lobe size shall be affected by dynamic height of the flares
i. The CIG shall support strobe lights, approach lights, runway edge white lights
j. The CIG shall support runway lights, helipad perimeter lights, and taxiway definition from three statute miles (4.8 kilometers)

k. The CIG shall support threshold lights and touchdown zone lights from two statute miles (3.2 kilometers)
l. The CIG shall support landing lights, and searchlights. Lobe shapes and positions shall be representative of the aircraft lobe shapes
m. The CIG shall support threshold traffic lights from one statute miles (1.6 kilometers)

3.3.1.2.5.5 Gouraud Shading

CIG shall support vertex-rate lighting which is Gouraud shading. The CIG shall use Gouraud shading to produce the effects of brightness, color, and shading over the surface of a polygon. The shading shall include ambient light and diffuse light sources.

3.3.1.2.5.6 Transparency

The CIG subsystem shall support at least 32 levels of polygon transparency ranging from transparent to fully opaque.

The CIG shall independently, realistically and simultaneously model the transparency, shading, and illumination effects for polygons.

The CIG shall not display perceptible or distracting patterns or other visual anomalies when rendering a level of transparency or when rendering multiple layers of transparency.

3.3.1.2.5.7 Polygon Switch Groups

512 switch settings shall support separate groups of polygons. Each group shall be individually host controllable with five predetermined intensity levels. Each level shall be specified in a continuum of intensities (typically used for luminous polygons), or turned off. Polygons that are set to intensity 0 shall not display. Up to 32 local polygon switches shall support per moving model/motion system.

3.3.1.2.6 Light Points

The IG shall be capable of producing light points for the visual enhancement of the database. The light point capacity shall be sufficient to meet the training requirements specified herein in concert with satisfying the image update rate specification under all specified scene load conditions in each channel.

The minimum light point capacity shall satisfy the image update rate specification under all specified scene conditions in each view for all CDT and SE Core databases and model products accepted by CDT prior to contract award. The intensity and on/off status of each light point or group of light point shall be individually controlled by the host. The following light point features shall control by the host or CIG console:

a. On/Off status
b. Color
c. Brightness

d. Extinguishing range
e. Fading direction
f. Apparent rotation rate
g. Flashing rate

3.3.1.2.6.1 Light Switch Groups

Switch settings for global light switch groups shall define. Each group of lights shall be individually host controllable. Light switches shall support varying intensity settings, and turned on/off. Up to 32 local light switches shall support per moving model/motion system.

3.3.1.2.6.2 Light Point Colors

Each light string can assign one of 1,024 colors from the active color table. Each light point color defines with three 8-bit RGB values.

3.3.1.2.6.3 Light Types

The CIG shall support the following controllable light types:

a. Cultural lighting
b. Stars
c. Runway lights
d. Approach lights
e. Light strings
f. Directional lighting
g. Visual landing aids
h. Flashing lights
i. Rotating lights
j. Traffic lights
k. Strobe lights

3.3.1.2.6.4 Artificial Light Sources

The IG shall be capable of illuminating data base surfaces and objects in a defined pattern and intensity fall-off from own vehicle head lights, driving lights and spotlights as applicable. The illumination pattern shall emanate from an appropriate position affixed to own vehicle and be steerable if applicable. Own vehicle illumination shall be controlled from the driver's compartment or AS(s) as specified in the vehicle specific appendices.

The IG shall be capable of generating simulated infra-red (IR) and night vision images for use by night vision equipment (including the DVE) and weapon sights as specified in the variant Annexes and vehicle specific Appendices.

The IG shall be capable of generating illumination patterns and intensities for other light sources including but not limited to, Semi-Automated Forces (SAF) and scripted vehicle headlights, stationary and vehicle-mounted spotlights, airport runway and taxiway lamps, billboard and marquee lights and lights within building windows. During night scenarios,

SAF and scripted vehicle headlights shall not pop on or off as vehicles approach the ownship.

3.3.1.2.7 Texture

The IG shall be capable of mapping image and pattern data onto all polygons in the environmental database. The effect of transparency, shading, illumination, and all other simulated characteristics specified for polygons shall reflect in the texture-mapped polygons.

3.3.1.2.7.1 Static Texture Mapping

The image data shall spatially fix on the surfaces and display correct perspective and orientation as the viewpoint and mapped surface move in the displayed image. The texture shall remain fixed relative to the underlying polygons and shall be valid for all orientations of objects and polygons in the environment.

3.3.1.2.7.2 Dynamic Texture

Dynamic texture patterns shall provide which have the capability to move in any direction on the surface to which it is applied.

3.3.1.2.8 Color Fidelity

Each color component shall represent with a minimum of 24 bits allowing 16.7 million unique colors to represent.

Each CIG subsystem channel shall calculate, store and display the intensity of each pixel with a minimum of 24 bits of accuracy per displayed color component.

Luminance and chrominance information processing shall be accomplished with sufficient resolution and accuracy to ensure stable, continuous, color at the display with no discernible abrupt transitions or Mach banding except as demanded by the phenomena being simulated.

The CIG design shall preclude visible instantaneous changes in color and intensity due to changes in fading and shading as the eyepoint moves through the scene.

Color and intensity computations shall use algorithms, which correctly account for the physical phenomena in the simulation. The computed color and intensity shall be a function of reflectance, luminance, illumination magnitude and direction, range and atmospheric effects.

3.3.1.2.9 Anti-Aliasing

The CIG subsystem shall provide full scene anti-aliasing equivalent or better than eight subsamples/pixel for all scene elements and scene conditions in every image channel.

Each CIG view shall provide full scene anti-aliasing sufficient to meet the Image Quality requirement.

The CIG subsystem shall anti-alias all reticles and symbology. Undesirable artifacts of digital image processing shall eliminate or reduce to a negligible level for both surfaces and light points.

3.3.1.2.10 Displayed Image Sharpness

Image sharpness for each view shall be equal to or better than that of the corresponding view in the current CDT STSs and workstations. The ratio of vertical to horizontal resolution (in arc-minutes/OLP) shall vary no more than 0.8 to 1.2. Image motion of up to 15 degrees per second shall not degrade sharpness by more than 20 percent.

3.3.1.2.11 Vernier Resolution

Vernier resolution, measured as the minimum discernible apparent displacement of adjacent scene elements and as the minimum detectable relative motion of a scene element relative to the eye, shall not exceed 20 percent of the resolution (optical line pair (OLP) spacing) specified for each display.

3.3.1.2.12 Light Point Resolution

The light point resolution shall be the same as surface resolution.

3.3.1.2.13 Levels of Detail

Level of detail transitions shall extend out to the target detection ranges specified in "Range of Vision" section above. Beyond these specified target detection ranges, level of detail transitions shall not cause distraction to the trainees or non-correlation with correlated databases and simulation maps.

3.3.1.2.14 Load Management

The IG system shall control the scene content across all channels to accomplish the required image density and to manage the scene content around own vehicle and to prevent rapid changes in level of detail, color and transparency for individual objects close to own eye point. Fade in of three-dimensional objects close to own eye point shall accomplish smoothly in a manner that precludes the objects "popping" into the scene and prevents distraction. A high density of three-dimensional objects shall be maintained around own vehicle.

3.3.1.2.15 Scene and Overload Management

The visual system shall optimize and maximize the density, distribution, and information content of visual features in the scene(s) for all conditions of image generator operation. The CIG shall control the scene content across all channels to accomplish the required image density and to manage the scene content around own vehicle and to prevent rapid changes in level of detail, color, and transparency for individual objects close to own eye-point. Fade in of three-dimensional objects close to own eye-point shall accomplish smoothly in a manner that precludes the objects "popping" into the scene and prevents distraction. A high density of three-dimensional objects shall be maintained around own vehicle.

The visual system shall continuously optimize the selection of scene elements for display, for the training tasks related to each display, and for the exercise conditions. For all conditions of operation, commensurate with maximizing scene content, maximum instantaneous polygon and object processing capacity specified shall dedicate to the terrain, features, and static models specified herein. Instantaneous polygon and object processing shall be distributed between channels (viewports) (but not between channel processors) based on individual channel scene content with individual channel level-of-detail provided. Level-of-detail transition range and the width of transparency band used to fade levels-of detail shall be adjustable to accommodate varying levels of scene content and to minimize operation at reduced update rate. Processing capacity used for special effects and moving models that cause high concentrations of polygons excludes from the distribution requirement. The term feature denotes representations of separate physical entities (e.g. tree, storage tank, house, and field) with color distinct from the background and sized larger than 3 x 3 pixels.

3.3.1.2.15.1 Feature Selection

The following lists shall use as the criteria for the selection of features for display in each type of display channel. The relative priority of the features indicated by the order of the list but that does not imply that all features at the top of the list shall display at the expense of having no features from lower items in the list.

a. Driver's vision block, Auxiliary Station and DVE visual displays:

   (1) Foreground scene details which influence detail route selection, provide velocity and relative motion and position cues, indicate where and how fast the vehicle should be driven, indicate if an area is passable for the vehicle, indicate surface conditions such as mud, snow and sand
   (2) Items under (a) above at medium ranges based on their size, relevance to route planning and importance to scene continuity
   (3) Medium and far range scene details based on tactical significance and resolution of the display, and to maintain scene continuity
   (4) Items from the gun sight list as described in the driver's vision block and DVE visual displays but with reduced detail consistent with display field of view and resolution
   (5) Items from the driver's list sufficient for route planning and directing general vehicle motion
   (6) Medium and far range features to assess the general nature of the terrain and features of tactical significance and to support navigation

3.3.1.2.15.2 Scene Management

Scene content management shall optimize the training value of the system by ensuring a maximum of needed visual cueing information for current operating conditions, and ensuring a minimum of scene discontinuities and other distracting image processing artifacts which could inhibit user psychological acceptance of the scene. Scene content

filtering shall include the effects of visibility, elevation, viewing range, object angular sub-tense, and object color. Scene content shall control in real-time to accomplish the following:

a. Ensure that the image processing and storage capacity of the system utilizes, but not exceeded, for all the conditions, and that the requirements for continuous image density meets all conditions.
b. Ensure optimum selection of features for each display channel according to the function of that channel
c. Ensure continuity of the scene and prevent noticeable changes in scene elements
d. Prevent overload conditions
e. Minimize operation at reduced update rates
f. Eliminate scene details when they no longer contribute to the training problem
g. Ensure that visual features are distributed within the field of view according to crew needs for the applicable tasks

A continuous visual scene shall provide for movement throughout the visual environment. The following general capabilities shall provide:

a. Ability to see all other units, targets, and critically significant objects and effects within operator's line-of-sight
b. Ability to be seen by all other units which have line-of-sight
c. Ability to hide from the view of other units and use cover and concealment
d. Ability to modify the appearance (but not necessarily the geometry) of the environment as required to depict:

    1. Ability to use tactical excavations (defilade positions)
    2. Shell craters (created by engineering operations, artillery cratering missions, and aircraft cratering missions) that serve as obstructions to movement
    3. Breached minefields
    4. Destroyed bridges

The scene content management mechanisms shall include the following scene control features:

a. Eliminating scene elements from processing when they are hidden from view (behind obstructions)
b. Dynamic removal of scene elements (down to the polygon level) when their projected size precludes their effective use for visual cueing. This may be accomplished in non-real time by assigning transition range values, which effectively remove the object when its projected size is too small to contribute to training
c. Dynamic control of lights in a given area

d. Dynamic concentration of scene detail on terrain immediately surrounding own vehicle and on targets as viewed through a FOV
e. Dynamic modification of scene content control parameters, such as level of detail switching distance
f. Dynamic control of width of transparency band or similar alternative
g. Multiple levels-of-detail shall be used in all but the simplest models and sub-models to allow widely varying changes in model complexity
h. The ability to assign individual channel (viewport) load management
i. Programmable priority for the above measures and system resources to ensure that the most training critical aspects of scene quality and quantity are the last to be impacted when overload measures are implemented

3.3.1.2.15.2.1 Environment Integrity

Scene management shall maintain the integrity of the training environment to ensure that significant features (terrain, culture, and moving models) kept in the scene under all circumstances in which they are essential, e.g. concealment. Environment integrity shall maintain between visual assets within a STS/console (intra-STS) and STSs/consoles networked together in a common exercise (inter-STS). Environment integrity shall maintain to facilitate accurate weapon impact determination. A means to implement effective and realistic concealment simulation shall provide. Scene features which serve to conceal a unit shall be visible to all observers. The simulation shall include effects for varying degrees of concealment to provide for partially concealed vehicles.

3.3.1.2.15.2.2 Scene Management Dynamics

Scene management shall operate at a rate sufficient to ensure that the requirements for image continuity and continuous image density maintain for all conditions of motion of the vehicle simulated by the host. Scene content management shall occur in a gradual, continuous manner, masked from the viewer to the maximum extent practical. Deletion and insertion of scene elements made by the scene content manager shall accomplish gradually in a manner, which minimizes the objects "popping" into the scene and causing any distraction. This shall include dynamic control of visibility range, transparency, and contrast, for both individual scene elements and the entire scene, to mask scene content transitions. Changes in the displayed scene made by the scene content manager shall accomplish at the single object level and several polygon levels, except changes relative to perspective size which shall occur at the single polygon level.

3.3.1.2.15.2.3 Overload Prevention

The system shall detect impending overload conditions prior to the occurrence of any scene discontinuity and shall adjust system parameters to maintain scene continuity. All system resources which can limit scene processing shall monitor for overload conditions. Adjustments to scene content shall select to optimize relief of the exhausted resource. Overload conditions shall not result in the system locking up or timing out. The system shall automatically recover to full performance when the overload condition removes.

3.3.1.2.15.3 Terrain Level-of-Detail Management

Level of detail (LOD) reduction ranges shall be configurable and shall be defaulted not to begin closer than one km. Within the one km and 5.0 km ranges and consistent with the characteristics of target detection, recognition, identification and engagement, the CIG shall present proper line-of-sight, geometry, textures, colors and special effects. The transition in the detail portrayed from close in to the full five km range shall be subtle and non-distracting to the trainee. Where specific existing STSs/workstations have enhanced range capabilities relative to the ranges above, the CIG shall provide the enhanced range.

Environment integrity shall maintain between visual assets within a STS/console (intra-STS) and STSs/consoles networked together in a common exercise (inter-STS) to the extent necessary to avoid adverse impact on training. Scene features, which serve to conceal a unit, shall be visible to all observers.

3.3.1.2.15.4 Scene Content Update Rate

The position and attitude data for the viewpoint and all moving models and their articulated parts shall update and a complete scene shall compute at a rate not less than the CIG update rate. Temporary reductions shall not more than once exceed three seconds per minute.

3.3.1.2.16 Rates of Motion

Own vehicle motion and apparent target motion at up to the velocities and angular rates listed below (including their worst case combinations) shall not cause distracting visual effects, image breakup or distortion.

The displayed visual image and the driver compartment/motion platform movement shall synchronize to produce a realistic simulation of the vehicle in motion over roads or terrain. In addition, the driver compartment, its enclosure, and the motion platform shall allow for the reconfiguration/removal/replacement of the specific module for future updates/reuse. Performance of the aural cues and visual display scenes shall be coordinated with movement of the motion platform. The physical movement of the motion platform shall be determined by computations based upon the actual vehicle variant driver compartment motion (pitch, roll, yaw, heave, surge and sway), and shall correspond in real-time to driver actions and terrain/environment/vehicle interaction.

3.3.1.2.17 Field-of-View Culling

CIG shall support field-of-view (FOV) culling which removes objects not visible within a viewport's FOV. Objects too far to the left, to the right, or behind the observer shall not process.

3.3.1.2.18 Occulting

The CIG shall properly occult all objects in the simulated environment with respect to the viewpoint (including sensors). Each CIG subsystem channel shall provide partial or total

occulting, as appropriate, of surfaces and light points by surfaces nearer to the simulated viewpoint. Occultation shall compute and display with accuracy sufficient to prevent anomalies that affect training.

3.3.1.2.19 Mission Functions

3.3.1.2.19.1 Height Above Terrain and Height of Terrain

The CIG shall support height above terrain (HAT) and height of terrain (HOT) calculations.

3.3.1.2.19.2 Collision Detection

The CIG shall support collision detection with terrain, 3D features, moving models, clouds, and report to the host. Collision detection shall return the surface material code of the polygon in the collision as well as the model ID of the model.

3.3.1.2.19.3 Laser Range Finder

The system shall simulate the laser range finder for units which have that capability. Range finder information shall provide in the same manner as in the operational equipment for targets that are within the line of sight of the reticle center. When the laser range finder mode activates, proper fire control symbologies shall generate in the appropriate sights.

The Laser Range Finder (LRF) simulation shall provide range and material code information for targets or terrain up to 5,000 meters with an accuracy of +/- .01% of the actual range lased. The LRF shall compute a minimum of eight objects from an eye-point, or functional equivalent in each display frame while under full rendering load. The range finder shall support the simulation of false/doubled echoes and natural obscurants (i.e. haze and fog). The effectiveness of the LRF shall affect the use of tactical smoke. The CIG shall compute the range for the LRF simulation and return it to the host at least every other update period. The CIG shall report to the Host a unique model identifier and material type from the laser designation. The LRF computation shall depend on the look direction designated by the host and the intersection of the associated line of sight with visual environment polygons. The CIG shall provide Laser Range Finder Reports upon Host request. The latency shall not exceed 100 ms measured from the time the CIG receives the report request from the Host Computer until the time the CIG transmits the report to the Host Computer. The system shall compute and return the laser range with no effect on system throughput.

3.3.1.2.19.4 Line of Sight

It is desired that the CIG support returning a line-of-sight test between the eye-point and an object. The line segment shall be definable in any orientation.

3.3.1.2.19.5 Intervisibility

Line-of-sight test with two points other than the eye-point to return intervisibility results to the host is desirable. This shall use to determine if two objects in the database are

visible to each other. The surface material and model identification (ID) number shall return to the host.

3.3.1.2.20 Reticles & Symbology Requirements

A complete library set of CDT system DVE reticles and symbology shall deliver with the CIG as required for each simulator/workstation. The CIG shall be fully compatible with the existing interface for host control of the size and location of each element of reticles and symbology including location, size, color, and translucency. Reticles and symbology shall be free of any sensor processing effects. Aim-point accuracy of each reticle shall be identical to the current system. System update rate shall not adversely impact by any combination of reticles and symbology.

3.3.1.2.21 Real-Time Sensor Simulations

The CIG system shall compute and depict realistic, three-dimensional imagery of the simulated environment for out the window and sensor views of the surrounding environment in a manner that closely simulates the real world within the limits of the CDT training systems.

3.3.1.2.21.1 Real-Time Infrared Simulation

Thermal simulation shall utilize the visual database with descriptors and object data necessary to generate images with the fundamental characteristics of the sensor.

The effect of atmospheric attenuation shall compute in real time using a fading function appropriate to infrared.

The CIG thermal sensor simulation shall render realistic simulation in consideration of the following environmental conditions, as a minimum:

a. Meteorological effects: haze, fog, rain, snow, wind all with variable density
b. Sun or moon angle
c. Date - in one day increments
d. Time - in one second increments
e. Location - in one arc minute increments
f. Humidity - in one percent increments
g. Air Temperature - in one Celsius degree increments
h. Sun Angle - computed from Date, Time and Location
i. Infrared (IR) Support Temperature - in one Celsius degree increments

Displayed thermal intensity shall simulate real world thermal intensity by appropriate color and intensity of each feature in the scene throughout the entire diurnal cycle. The thermal signature shall be clear of sensor signature anomalies due to out the window (OTW) texture composition. The thermal scene shall be clear of distracting errors such as a thermally bright clear sky.

3.3.1.2.21.2 Real-Time Image Intensification Simulation

The effect of atmospheric attenuation shall compute in real time to provide fading of the simulated Image Intensification (I2) image. The following environmental effects shall provide:

a. Man-made lighting
b. Natural lighting
c. Moon angle
d. Starlight
e. Fog, haze, snow
f. Humidity
g. Air temperature
h. Rainfall level

The CIG shall provide simulated I2 sensor imagery of all objects in the displayed scene in a manner appropriate to simulate the DVE. The I2 imagery shall be free of distracting errors such as missing or dark lights.

At a minimum, the CIG shall simulate the illumination levels appropriate for the following conditions on night vision light I2 devices as selected by host or CIG console selection:

a. Overcast night
b. Starlight only
c. Half-moon
d. Full-moon

3.3.1.2.22 Sensor Effects Generation

Rendering of sensor imagery shall not result in degradation of visual simulation capacities.

3.3.1.2.22.1 IR Sensor Effects

a. The visual system shall provide a simplified but realistic representation of the actual thermal imagery. The thermal signatures shall provide the correct appearance for objects for a given region, temperature and atmospheric condition. The thermal imagery shall change appropriately in response to continuous time of day changes (diurnal cycle) and environmental factors specified herein.
b. The visual system shall provide appropriate thermal signatures for moving models and special effects throughout the diurnal cycle
c. The capability to modify and tune the thermal representation of database polygons without recompilation of the database shall be provided through modification of physical material properties and parameters contained in a file that is used by the database

d. Simulation of thermal signatures emitted through tactical smoke, dust, blowing sand, fog, haze and vegetation shall be provided
e. The thermal image shall simulate thermal noise appropriate to the type of thermal sensor being simulated
f. The thermal image simulation shall respond to host inputs based on operator sensitivity and contrast control in a manner that simulates the operational sensor A default setting for sensitivity and contrast, not requiring host control, shall be provided that allows viewing under most conditions
g. Both white-hot and black-hot modes shall be simulated
h. The color of tracers shall replicate that in the operational sensor
i. The sensor simulation system shall provide the capability to simulate optical blurring
j. The sensor simulation system shall provide the capability to simulate sensor mismatch
k. A test shall be provided to display proper FLIR signatures throughout the entire diurnal cycle

3.3.1.2.22.2 Thermal Image Color

The color of the simulated thermal image shall approximate that of the actual sensor.

3.3.1.2.22.3 Thermal Noise Simulation

The thermal image shall simulate a IOS host controlled level of thermal noise appropriate to the type of thermal sensor being simulated and a CIG controlled level of noise based on simulated environmental factors.

3.3.1.2.22.4 Thermal Simulation Tuning

The capability to modify and tune the IR representation shall provide at the CIG console. This shall include a physics based capability to modify and tune the IR representation of database polygons and textures by modification of image processing and database material properties and parameters.

3.3.1.2.22.5 I2 Sensor Effects

a. The Image Intensification (I^2) simulation provided by the CIG shall provide a simplified but realistic representation of the actual I^2 imagery including a simplified "saturation" function. The I^2 simulation shall provide the correct appearance for objects for a given lighting and atmospheric condition. The I^2 imagery shall change appropriately in response to lighting conditions that result from the continuous time of day changes (diurnal cycle) and environmental factors specified herein
b. The blooming effects of flares, muzzle flash, bright artificial lights, tracers, and fire shall simulate. A simplified, but realistic, model of blooming may be used. The capability to modify and tune the blooming effects shall be provided at the CIG console

c. The I^2 image shall simulate noise appropriate to the type of sensor being simulated
d. The CIG shall respond to brightness and contrast control changes from the host computer across a range that simulates the operational sensor
e. The I^2 image shall respond to host inputs based on operator brightness control in a manner that simulates the operational sensor. A default setting for sensitivity and contrast, not requiring host control, shall be provided that allows viewing under most conditions
f. The capability to modify and tune the I^2 representation shall be provided at the CIG console
g. Reticles and symbology shall not affect by sensor effects. Reticle color shall be controlled by the host independent of the sensor image color

3.3.1.2.22.6 I2 Image Color

The color of the simulated image intensification image shall be green.

3.3.1.2.22.7 I2 Noise Simulation

The I2 image shall respond to IOS host inputs of noise changes in a manner that simulates the vehicle.

3.3.1.2.22.8 I2 Sensitivity and Contrast Control

The I2 simulation shall respond to IOS host inputs to provide a full range of sensitivity and contrast changes. A default setting for sensitivity and contrast, not requiring IOS host control, shall be provided that allows viewing under most conditions.

3.3.1.2.22.9 I2 Simulation Tuning

The capability to modify and tune the I2 representation shall provide at the CIG console.

3.3.1.2.23 Airfield Alignment

The CIG shall have the ability to align airfields to accurately represent its placement relative to real-world and simulated navigational aids to ensure one to one correlation between the airfield and the simulated navigational aids.

3.3.1.2.24 Airfield Lighting Control

The CIG shall control runway lighting for up to 12 airfields. The intensity of the lights shall control in at least 5 discrete steps from "off" to maximum by the host computer.

3.3.1.2.25 Traffic Light Control

The CIG shall have the ability to control traffic lights. The intensity of the lights shall be controlled 3 stages: Red, Yellow, and Green to accurately represent the real-world traffic lights. The CIG shall control traffic lights for up to five traffic lights in the FOV or 100 per scenario

3.3.1.2.26 Runway Conditions

The CIG shall have the ability to control in real-time runway conditions. These include the ability to provide dry, wet, ice, snow, patchy snow and the ability to represent partially cleared snow.

3.3.1.2.27 Atmosphere

The CIG System shall depict all environmental effects that are in the existing system in a manner that meets or exceeds the performance of the current system and in a manner that shall not adversely affect trainee performance from the existing system. Environmental effects shall include:

a. Calendar date
b. Latitude and longitude location
c. Sun position
d. Moon position
e. Cloud cover

Atmospheric model shall include:

a. Clouds
b. Fog
c. Haze
d. Rain
e. Snow
f. Sky and directional horizon
g. Directional and diffuse illumination
h. Time of day (static selectable or continuous)
i. Seasonal effects

3.3.1.2.28 Environment Configuration and Tuning

The CIG shall have the ability to configure and tune the intensity and general environmental conditions off-line and in runtime. This would include snow, rain, ice, lightning, sandstorms, cloud cover, horizon, sun angle, moon angle, day/dusk/night intensities, and storms.

3.3.1.2.29 Horizon

The dawn/dusk horizons shall be simulated as a lower intensity gray with an orange glow on the east or west horizon respectively. The dawn/dusk horizons shall be selectable via the SGS option selection.

3.3.1.2.30 Sky Canopy

The unfaded sky color shall be blue. The sky brightness and color shall vary as a function of visibility effects and illumination from blue to shades of gray.

3.3.1.2.31 Visibility/Layered Fog and Haze

This CIG shall fade objects into the fog correctly as their distance from the eye-point increases. Visibility attenuation due to fog computed for all features and objects. Light-points may use their own fog function based on their modeled brightness, distance from the eye-point and directionality.

3.3.1.2.32 Haze

The haze layer shall extend from the ground to a specified height in real time via the SGS option selection(s).

3.3.1.2.33 Light Effects in Fog

It is desirable for the CIG shall generate halo effects on scene lights in real time.

3.3.1.2.34 Cloud Decks

The CIG shall have the ability to provide at least two cloud layers. Each cloud deck shall be independent of each other and provide a settable top and bottom to the layer. The layers shall provide control of cloud density and randomization for scud effects.

3.3.1.2.35 Scattered 3D Clouds

The CIG shall provide realistic 3D clouds with varying degrees of densities control by the host. The clouds shall be modeled to respond to atmospheric wind at different elevations providing dissipation and changes to opacity as in real-world conditions.

3.3.1.2.36 Fog and Cloud Texture

Fog and clouds shall have texture maps applied to provide a realistic effect while entering and existing cloud and fog layers.

3.3.1.2.37 Storm Clouds and Storm Effects

The CIG shall provide 3D modeled storm clouds with the ability to change size, shape, and color. Clouds shall also have the ability to generate lightning and storm effects within the cloud model.

3.3.1.2.38 Storm Control

The CIG shall have the ability to control via IOS host control all storm effects and have the ability to randomize storm conditions to control storm intensity, lightning frequency and intensity, visibility and illumination levels.

3.3.1.2.39 Wind Effects

The CIG shall have the ability to respond to wind controls send via the host. The wind direction and speed shall affect falling snow, falling rain, smoke, fog, windsocks, and clouds.

3.3.1.2.40 Falling Snow

The CIG shall provide falling snow effects and have the ability to provide at least three levels of intensities.

3.3.1.2.41 Time of Day

Two modes for time of day shall be selectable, static, and continuous.

3.3.1.2.41.1 Static Time of Day

When the static time of day mode selects the CIG, it shall provide a simulation of the following nine levels of natural illumination as selected by the IOS host:

a. Day (both noon and overcast)
b. Dawn
c. Dusk
d. Night with full moon (and starlight)
e. Night with ¾ moon (and starlight)
f. Night with ½ moon (and starlight)
g. Night with ¼ moon (and starlight)
h. Night with no moon, starlight only
i. Night with no moon, no illumination

3.3.1.2.41.2 Continuous Time of Day

When the continuous time of day mode is selected automatic, gradual adjustments in contrast, color and intensity of objects shall occur in the displayed image as appropriate to depict the time of day. The intensity and position of the illumination source shall represent consistent with the time of day, time of year and latitude.

3.3.1.2.42 Own Vehicle Lighting

The CIG shall provide own vehicle lighting to represent headlights, taillights, landing lights, spotlights, and other various source lights.

3.3.1.2.43 Landing Lights and Steerable Searchlights

The CIG shall provide lighting effects to represent fixed landing lights and steerable searchlights.

3.3.1.2.44 Beacon and Strobe

The CIG shall provide own vehicle beacon and strobe lights with the ability to control intensity and frequency of each individual own vehicle light.

3.3.1.2.45 Glare

The CIG shall provide glare effects resulting from own vehicle light sources. Light lobes, including steerable light lobes, cause the visible fog to brighten uniformly, while the own vehicle beacon and strobe cause periodic full-screen reddish and white flashes,

respectively. The glare intensities (and periods for the beacon and strobe) shall specify each type of glare effect.

3.3.1.2.46 Feature Models

3.3.1.2.46.1 Ultra-High Resolution Buildings

The CIG shall support the use of SE Core Ultra High Resolution Buildings (UHRB) within the training database. UHRB shall have the capability to provide at a minimum the following features:

a. Multiple elevations
b. Internal staircases/escalators
c. Windows
d. Doorways
e. Roof access
f. Basements
g. Furniture/Clutter

3.3.1.2.46.2 Subterranean Features

The CIG shall support the use of subterranean features such as tunnels within the training database.

3.3.1.2.47 Moving Models

The CIG shall be able to consume existing CDT and SE Core moving models. The CIG shall provide the capability to insert new moving models into the database without recompiling the database.

3.3.1.2.47.1 Simultaneous Model Management

The CIG Systems shall possess the capacity to address up to 512 simultaneous and independent, relocatable, switchable moving models and display at least 240 of these models at the specified update rate among the active views with models deployed evenly in range and breadth across the views. Each of these moving models shall include up to ten articulated parts. At least 200 models shall continuously update under host control in each update frame. Each view shall possess capacity to display up to 80 moving models, 70 of which shall update in each update frame. The specified number of moving models shall not limit any combination of reticles or symbology or the activation of any special effects such as dust trails or weapon effects that are part of the model. The specified number of moving models shall not limit environmental effects or viewing mode (e.g. thermal) or employment of up to two flares and ten smoke models in each view.

3.3.1.2.47.2 Model States

The CIG shall have the capability to display moving model and subordinate articulated parts for any of the available selectable states under control supported by SE Core model specification, including:

a. Invisible
b. Undamaged
c. Damaged

If equipped with turret and hull:

a. Damaged turret and hull
b. Damaged turret
c. Damaged hull
d. Destroyed

3.3.1.2.47.3 Model Controls

The CIG shall have the capability to display the full range of model attributes in the existing simulation under host control. These include:

a. Vehicle headlamps
b. Vehicle tail lights and blackout markers
c. Chemical lights
d. Launcher deployment and stowage
e. Placement of additional segments

3.3.1.2.48 Converging Traffic

Converging traffic that allows the host to initiate the simulation of an impending collision is desirable. Converging traffic shall simulate potential collisions by creating a route that approaches the eye.

3.3.1.2.49 Animation and Special Effects

3.3.1.2.49.1 Dust Trails

The CDT visual system shall display simulated dust trails on ground vehicles as modeled in the CDT terrain databases and controlled by the host computer. Activation of the dust trails shall not adversely affect other CDT requirements such as visibility ranges and number of moving models.

A minimum of six sizes of dust trail shall provide by the CIG under host control, three for forward motion, and three for reverse motion.

3.3.1.2.49.2 Propeller/Rotor Disc

A translucent disc for all aircraft with propellers (rotors) shall display in the scene.

3.3.1.2.49.3 Weapon Effects

All visible effects of weapons originating from friendly and hostile military units on targets, terrain and features, within the visual simulation range shall be visually depicted. These weapon effects shall include but are not limited to muzzle flash, rocket plume,

smoke, temporary vision obscuration, tracers, projectile flight (for guided, self-propelled weapons), weapon impact, and detonation.

The CDT system shall depicts both transient and permanent weapons impact effects. Transient weapons effects shall depict bursts on terrain or target vehicle hits. Permanent weapon impact effects shall result in the depiction of the computed result of the weapon damage to the general use models, buildings, and bridges. The weapon effect simulation shall be such that miss-registration between the effect and the associated point of origin, the coordinates for the weapon in flight and the impact point shall not be discernible by the observer.

3.3.1.2.49.3.1 Weapon Fire Effects

The CIG shall depict weapons fire effects (i.e. muzzle flash, tracer and missile launch) and simulation of enemy weapons effects employed against own ship/vehicle. There shall be weapons fire effects (e.g. muzzle flash, tracer, missile launch and laser designation of target) visually depicted for all weapons (enemy and friendly) in the CDT system.

3.3.1.2.49.3.2 Weapon Impact Effects

The CDT system shall depicts both transient and permanent weapons impact effects for all weapons (enemy and friendly).

3.3.1.2.49.3.3 Tracer Effects

The CDT visual system shall display simulated weapon system tracers consistent with the weapon being fired and shall realistically represent the rate of fire.

The CDT system shall depicts tracers from both own vehicle and enemy weapons. The tracer simulation shall be consistent with the weapon being fired and shall realistically represent the rate of fire. For tracers originating from weapons attached to a given simulator STS, the proper tracer trajectory, and occultation shall visually display the crew stations of that STS (i.e. Own Vehicle Tracers).

A simplified tracer simulation for tracers generated by weapons external to the simulator STS (i.e. Crossing Tracers) shall provide for up to four weapons per firing platform model. The simplified simulation for tracers shall have proper occultation but can have a predefined, simplified trajectory with no support for collision with other objects, i.e. tracer stream passes through other objects.

3.3.1.2.49.3.4 Smoke for Target Hits

The CDT system shall provide simulation of smoke associated with target hits/kills.

3.3.1.2.49.3.5 Flames for Target Hits

The CDT system shall provide animation effects associated with target hits/kills.

3.3.1.2.49.4 Flares

Falling flares shall simulate as an overhead illumination source at the appropriate location and elevation. Both the flare and the illumination it provides shall depict in the visual scene. Brightness, orientation, and area illuminated shall be controllable by the host. The lighting effect of flares shall be attenuated with range and cast a light lobe based on a gradual decrease of illumination on adjacent terrain polygons.

Two types of flares, the illumination round for the 120mm mortar, and the M485A2 illumination round for the 155mm Howitzer shall be selectable. The system shall support at least two simultaneous single or multiple flares.

3.3.1.2.50 Search Light

The CIG shall simulate searchlight illumination. The CIG shall simulate searchlights by increasing the ambient illumination within the searchlight illumination area when the respective light illumination area is within the FOV.

3.3.1.2.51 3D Sea States

3D sea states shall simulate dynamic elevation of the ocean surface to simulate different specified 3D wave motions. The 3D sea state effect shall center about the eye-point, and transitions to a flat 2D sea at an appropriate range where the 3D effect no longer requires in order reducing processing. The CDT system requires that 3D sea states interact properly with the terrain to provide breaking waves and surf zones as required.

3.3.1.2.52 Display Controls

3.3.1.2.52.1 Display Switching

Display and view switching shall be non-distracting. The switching of video sources to CDT displays shall appear instantaneous to the Soldier and shall provide seamless video displayed to the Soldier to allow for continuing operations of the display device.

3.3.1.2.52.2 Optical Performance

Image quality, apparent field of view, and viewing angle for each view shall meet the CDT STS and workstation requirements.

3.3.1.2.52.3 Image Burn Protection

The CIG shall support display screen saving capabilities for all video images to prevent display burn. The video sync signal shall suppress after a selectable period. The time lapsed prior to screen saver initialization shall be selectable in hours, minutes and seconds. Timing of sync drop during periods between real time operations shall be set to be identical to the current CIG.

3.3.1.2.52.4 Inactive Displays

Inactive displays and inactive portions of active displays shall be black.

3.3.1.2.52.5 Display Blanking

The CIG shall have the capability to individually blank each video channel or viewport on Host command.

3.3.1.2.52.6 Video Display Interface

The video display interface shall provide a user-friendly interface for analog and digital display devices. This interface shall support:

a. Adapt the CIG sync and timing to match a variety of COTS displays
b. Change the size and position of the displayed image

3.3.1.2.52.7 Video Output

The CIG output and video distribution system shall, at a minimum, meet the simulator performance requirements for luminance, geometric accuracy, edge matching, and contrast performance.

The CIG shall support auto-sync displays and operate with all display devices. The CIG shall provide a stable sync signal during system initialization to allow displays to initialize properly.

3.3.1.2.52.8 Gamma Correction

Each CIG view shall provide a programmable gamma correction capability to accommodate existing display types.

3.3.1.3 Interfaces to the CIG

The CIG System shall interface to the existing CDT systems as follows:

3.3.1.3.1 CIG to Host Physical Interface

The CIG shall interface to the host computer via a dedicated IEEE 802.3 Carrier Sense Multiple Access/Collision Detection (CSMA/CD) Ethernet with minimum capacity of 1 gigabit per second (Gbps). The point of interface shall be an RJ-45 connector at the PC host computer's Ethernet transceiver. Length shall be sufficient to allow for movement of the CIG at least 15 feet from the current location of the CIG.

3.3.1.3.2 CIG Software Interface

The CDT to image generator interface shall utilize the Common Image Generator Interface (CIGI) version 4.0 or later. Modification to the CIGI shall only be in work with Government approval.

The CIG to host computer interface shall support the full range of functionality required by the current simulation and as specified herein.

3.3.1.3.3 Interface of CIG to Other STS/IOS

The CIG interface shall cause no degradation of functionality, transport delay, or ease of alignment and set-up due to interfaces of the CIG to other STS systems.

3.3.1.3.4 CIG Maintenance Console

The CIG system Maintenance Console shall provide a user-friendly interface to allow the CIG operator/maintainer interface to perform CIG operation and maintenance functions independent of the Host Computer. The CIG Maintenance Console shall perform the following functions:

a. Boot-up the CIG
b. Complete CIG software cold start installation – including all operating systems, necessary CIG applications and up to 20 visual databases – from distribution storage media within three hours
c. Load any new or replacement visual database from distribution storage media within one hour
d. Revise CIG operating parameters
e. Display any CIG video output upon operator selection
f. Monitor CIG real time status with information for any computed output view (logical channel) with information at least equivalent to that provided by the baseline image generator, e.g. subsystem/process start times and completion times, system performance data for key parameters such as polygon throughput, update rate, and system overload management status
g. Perform CIG maintenance and diagnostics
h. Real time operation of all eye-points, control of moving models including all articulations and model switches, environmental conditions, and reticles and symbology
i. Select and display the required test patterns

3.3.1.3.5 CIG Maintainability

The CIG shall demonstrate a Mean Time To Repair (MTTR) of 1.0 hour or less. The CIG shall demonstrate a 90% probability that no more than 10% of each type of STS at a given site are simultaneously down for more than 30 minutes during a normal training day.

3.3.1.3.6 Maintenance and Diagnostic software

3.3.1.3.6.1 Daily Readiness Check

Upon command from the CIG console, the CIG subsystem shall execute its Daily Readiness Check (DRC) and display test images on all displays. Detailed results shall be available at the CIG console. The time required to perform the DRC shall not exceed six minutes.

3.3.1.3.6.2 Diagnostics

Upon command from the CIG console, the CIG perform diagnostics and provide the results at the CIG console. Upon command from the CIG console, the IG shall perform fault isolation, or enter the Database Initialization Mode or enter the Run Mode.

3.3.1.3.6.3 Fault Isolation

A fault isolation system shall be provided to support the Mean Time To Repair (MTTR) requirements of this document. The fault isolation system shall isolate to the line replaceable unit level, which defines as PCRS channel. The fault isolation system shall utilize any combination of the following to provide the fault isolation capability: built-in test programs and equipment and manual procedures and support equipment documented in the operations and maintenance manual.

3.3.1.3.6.4 Test Patterns

Test patterns shall provide in the CIG to verify display setup and alignment. These test patterns shall be available under CIG console control. All visual system test and maintenance databases required for all of the specified STSs and workstations, including:

a. one degree light points array for FOV measurements
b. United States Air Force (USAF) test pattern for resolution
c. All black curtain
d. All white curtain
    1. All white curtain100% modulated white test pattern for display color balance, measurement and testing
    2. 20% modulated white test pattern for display color balance, measurement and testing
e. Gradient gray test pattern for display color alignment
f. Color squares test pattern for display color alignment
g. Checkered black and white squares for display contrast and luminance alignment and testing
h. Test pattern used for convergence, geometric distortion, FOV, light point resolution, vernier resolution , polygon throughput, and surface resolution
i. Distortion test patterns

3.3.1.3.6.5 Technology Insertion & Expansion Requirements

The CIG shall utilize a modular architecture designed to easily accommodate additional CIG processors, increased texture memory, environment memory, and polygon and pixel processing capacity independent of other system changes. The CIG shall use commercial technology in a manner to allow cost-effective upgrades as the commercial market offers enhancements. The CIG shall provide growth expansion capabilities to include the following options:

a. Enhanced sensor simulation effects such as contrast tracking

b. Extension of Range of Vision (far clipping plane and first level of detail transitions) to accommodate increased weapon engagement and detection ranges
c. Dynamic shadows
d. Dynamic real time terrain and feature deformation

3.3.1.3.7 CIG System to Display Interface

3.3.1.3.7.1 Displayed Image Quality

The CIG system shall interface to the existing CDT display devices and unchanged portions of the video distribution system in a manner that preserves or improves visual system performance including image contrast, brightness, color, synchronization, image position and maintenance access and functionality.

3.3.1.3.7.2 Displayed Image Position

The size and position of each displayed image shall be matched to the image frustum in the host STS or workstation. Image position and sizing shall be adjustable from the Maintenance Console of the CIG.

3.3.1.3.7.3 Changes to Display & Optical Devices

No changes shall apply to existing display devices, optical devices, or light tightening without explicit approval of the government.

3.3.1.3.8 Installation Kit Requirements

3.3.1.3.8.1 Modifications to Video Distribution System

Modifications to the existing CDT STS/workstation video distribution system (e.g. video cables, splitters and amplifiers) shall incorporate as required to accommodate the CIG system. Removal of the replaced components and cabling from the existing system is desired but not required but unused cabling and components that are not remove shall be non-destructively marked or tagged as “unused” in a manner that is clear to maintenance technicians. All video distribution system modifications shall require approval from the government and documented to allow incorporation by others into the technical data package and affected system and maintenance documentation.

3.3.1.3.8.2 Other Installation Kit Items

The Installation Kit shall include all items required to install and interface the CIG to its target STS or workstation at the target installation (fixed or mobile application). Special consideration shall provide mobile applications relative to cooling, mechanical mounting, and maintenance access.

3.3.1.3.8.3 Installation Kit Interfaces

3.3.1.3.8.3.1 Installation Kit to Video Distribution System Interface

The Installation Kit shall interface to the existing CDT display devices and unchanged portions of the video distribution system in a manner approved by the government.

3.3.1.3.8.3.2 Installation Kit Power and Ground Interfaces

The contractor shall utilize existing CDT STS/workstation power and ground systems for installation kit components, including new video distribution system components.

3.3.1.3.8.3.3 Installation Kit Mechanical Interfaces

The Government will approve installation Kit mechanical interfaces to the facility or mobile shelter and host STS/workstation.

3.3.1.3.8.3.4 Installation Kit Software Interfaces

Changes to the existing video distribution system and/or other STS/workstation systems as a result of the Installation Kit that require changes to government software shall be approved by the government and shall be documented to allow development of the required software by others.

3.3.1.3.8.3.5 Technical Data Revisions

The contractor shall document changes to the host STS/workstation or CDT system designs, required to accommodate the CIG system, to allow formal incorporation.

3.3.1.3.9 Visual Database Interfaces

Depiction of the simulated environment shall not require changes to the correlated simulation databases, unless explicitly approved by the government.

3.3.1.3.10 Post Development Software Support Interfaces

The CIG system shall include a means to facilitate the cost effective and efficient installation of new visual databases and CIG software using high quality, industry-standard media. At a minimum, this would include CD and DVD media.

3.3.1.4 Environment Generation

3.3.1.4.1 Databases

The CIG shall be able to consume CDT and SE Core database and model products accepted by the CDT prior to contract award.

3.3.1.4.2 Database Size

Unless otherwise specified, the minimum size for all new CDT terrain databases shall be 20km x 20km.

3.3.1.4.3 Visual Database Performance

Visual databases shall enable the CIG to realistically portray the simulated environment, environmental effects, entities, objects, and special effects at the specified update rate in correlation with the existing simulation CDT software and supporting CDT databases.

3.3.1.4.4 Database Storage Capacity

Although only one database shall be in use (selected) at any given time on any given STS or console, each STS and console shall have enough mass storage capacity to simultaneously accommodate 20 complete databases. For the CDT system, the time to activate any one of the databases that are available shall be less than five minutes. At each STS and console, the CDT system shall provide a means to replace one of the available databases with a new one in less than one hour. For the CDT system, there shall be a means provided for replacing databases on STSs and consoles, by removable media (e.g. CD/DVD, at each STS and console). The databases used in the system shall be SE Core products.

3.3.1.4.5 Database Selection

The CIG shall have the ability to select up to at least 20 different databases by host control.

3.3.1.4.6 Scene Retrieval

The transition time to change between databases shall be less than five minutes from host execution. The retrieval of terrain, objects, and moving models shall process from the selected database about the eye-point position.

3.3.1.4.7 Changes to the Existing Simulation

No changes shall be required to the supporting simulation or correlated databases. Changes may be required to the existing host in accordance with the government-approved CIG to host computer interface.

3.3.1.4.8 Developed/Converted/Reformatted Visual Database Requirements

Visual databases for the CIG shall include existing CDT and SE Core visual databases as specified by the Government.

3.3.1.4.8.1 Visual Databases Source

All developed/converted/reformatted databases for the CIG shall derive from data provided by the Government.

3.3.1.4.8.2 Correlation to Existing Simulation

Converted/reformatted visual databases shall correlate to the existing simulation databases used for semi-automated forces, environmental data, plan view displays, radios and tactical maps in a manner so that no changes are required to those databases without explicit approval of the Government. Converted/reformatted visual databases shall

correlate with the existing simulation software so that no changes are required without explicit approval of the Government.

3.3.1.4.8.2.1 Terrain Geometry Correlation

The converted/reformatted terrain surface shall have the same elevation, to within 0.1 meters for every location and for all rendered levels of detail as the source database.

3.3.1.4.8.2.2 Two-Dimensional Feature/Object Model Geometry Correlation

Two-dimensional (2-D) features/objects in the converted/reformatted database (after conformance) shall be located to within 0.1 meters, have the same size, and have the same orientation to within 0.1 degree, for every location and for all rendered levels of detail as the corresponding feature/object in the source database. All object functionality and distinctive features such apparent water depth and trafficability appearance shall convert intact to assure no loss of functionality in the simulation.

3.3.1.4.8.2.3 Three-Dimensional Feature/Object Model Geometry Correlation

Three-dimensional (3-D) features/objects in the converted/reformatted database shall be located at the same location and occupy the same volume as the source feature (after conformance), to within 0.01 meters relative to the terrain, and 0.001 meters relative to internal dimensions of that feature/object. All object functionality such as lights, vehicle marking, thermal signature, damage states, levels of detail, and animations shall convert/reformat intact to assure no loss of functionality in the simulation.

3.3.1.4.8.2.4 Correlation to Correlated Databases

Conversions/reformatting shall not require any changes to the existing support databases used for semi-automated forces, plan view displays, radios, and tactical maps.

3.3.1.4.8.3 Control of Visual Anomalies

Visual anomalies in the visual database shall control to the extent specified under Sec. 3.2.1.6 - Image Quality.

3.3.1.4.9 State and Control Switches

The developed/converted/reformatted database shall include all model and feature state and control in the source database. Host changes required to use these features shall document in the Government-approved CIG to host computer interface control document (ICD).

3.3.1.4.10 Dynamic Objects

The CIG shall be capable of adding, moving, re-orienting, removing and operating the state and controls of placeable terrain features in the converted visual database under control from the SGS application.

3.3.1.4.11 Static Objects

Under Host Computer control, the CIG shall be capable of changing the state (including invisible, undamaged, damaged and destroyed) of at least 65,000 static objects. Static objects include buildings, bridges, and the like.

3.3.1.4.12 Seasonal Changes

The CDT system shall simulate all four seasons.

3.3.1.4.13 Model Library Content

The complete CDT and SE Core model libraries shall be developed/converted/reformatted to the extent required by the CIG.

3.3.1.4.14 Sensor Effects (DVE only)

Sensor attributes in the existing database such as hot spot models, thermal or image intensified textures, blooming models, and the like shall develop/convert/reformat or replace in the developed/converted/reformatted visual database. At least all sensor attributes of the source database shall be developed/converted/reformatted.

3.3.1.4.15 Special Effects

Special effects attributes such as size, duration and opacity that affect the simulation (interoperability with semi-automated and computer generated forces) shall be maintained in the developed/converted/reformatted visual databases.

The CIG System shall depict all special effects that are in the existing system in a manner that meets or exceeds the performance of the current system and in a manner that shall not adversely affect trainee performance from the existing system. Special effects at a minimum shall include:

a. Tactical smoke
b. Dust trails
c. Propeller/rotor disc
d. Weapon effects, including:
    1. Ground to air weaponry
    2. Air to ground weaponry
    3. Missile plumes
    4. Weapon fire effects appropriate to the type weapon
    5. Weapon impact effects appropriate to the type weapon and impact material
    6. Tracers
e. Smoke for target hits
f. Flames for target hits
g. Flares and flare illumination

3.3.2 Image Display Subsystem

The CDT image display subsystems shall convert the signals from the image generator into visual images representing the simulated environment for each of the STS/console displays as specified. For each STS, light-tight shrouds or similar means shall provide so that extraneous dust and light from outside the STS does not degrade visual display system performance.

All optics used in the sights and optical paths shall be readily accessible to facilitate cleaning and adjustments. The image display subsystem shall include the following display types as applicable to each individual STS/console:

a. Thermal imagery systems (DVE)
b. Light intensification devices (DVE)
c. IOS visual displays
d. Driver displays

3.3.2.1 Display Configurations

The following provides requirements for each general type of display, which is common to more than one STS or console.

All vision path obstructions and restrictions encountered on the real vehicle (includes limitations resulting from head motion and parts of own vehicle which obstruct) shall be duplicated in the STSs.

The displayed image center shall be within 30 arc minutes of static head pointing direction. With all head rotation less than 60 degrees per second, the displayed image center shall not lag the head pointing direction by more than 6 degrees. The IFOV shall be slewed in a way that maintains the correct position of the associated imagery while preventing artificialities or anomalies (e.g. perceptible jumps, latencies, and imagery quality degradations). Additionally, the imagery shall remain stable (free from image swim or oscillation and other abnormal movement) with all head rotation less than 60 degrees per second and all head oscillations of less than 1 Hz.

Driver displays shall be as follows:

a. For the driver, all display vision blocks shall be active at all times. A larger total FOV shall provide through the optical design using a larger active displayed area than the smaller instantaneous FOV area. A means to satisfy both the instantaneous and total FOV requirements shall be provided

b. Drivers Viewer Enhancer will be active when vehicle master and DVE power switch is on

3.3.2.2 Design Constraints

Each STS shall not exceed five graphics computers. Each IOS shall not exceed three graphics computers. Each After Action Review (AAR) shall not exceed one graphics computer. Exception to this shall require prior approval by the government.

SYSTEM REQUIREMENTS DOCUMENT (SRD)

FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX B – SAFETY CHECKLIST

VERSION 1.1

14 SEPTEMBER 2017

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

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Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

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1. **SCOPE**

This checklist is a mandatory part of the specification. The information contained herein intends to be compliance.

2. **APPLICABLE DOCUMENTS**

(This section is not applicable to this appendix.)

3. **REQUIREMENTS**

3.1 Electrical

1. Are operating personnel require protection from accidental contact with voltages in excess of 30 volts?
2. Does each contact, terminal or like device, having voltages between 70 and 500 volts, rms. or DC, with respect to ground, have barriers or guards to minimize accidental contact by operating or maintenance personnel?
3. Are barriers or guards that protect terminals or like devices exhibiting 70-500 volts clearly marked to indicate highest voltage encountered upon its removal?
4. Are portions of assemblies operating at potentials above 500 volts root mean square (RMS) or DC, completely enclosed from the remainder of the assembly, and is the enclosure provided with non-bypassable interlocks?
5. Are enclosures for potentials, which exceed 500 volts, marked "DANGER, HIGH VOLTAGE, XXX VOLTS" in white on a red background?
6. Do all circuits and capacitors discharge 30 volts or less within no more than two seconds after power is require removing?
7. If the answer to question 6 is NO, do high-voltage capacitors of circuits automatically discharge when the case or rack opens?
8. Do test points provide in equipment where measurement of potentials in excess of 300 volts is required?
9. Are tests points designed to require plug-in, not clamp-on, and test instruments?
10. Are green or red indicators lamps provide, "Power on"?
11. Is sufficient space provided between shield endings and exposed conductors to prevent shorting or arcing?
12. Are electrical conductors' designs prevent insertion of the wrong plug into a receptacle or other mating unit?
13. Are plugs and receptacles codes and markings clearly indicate mating connectors, where those of similar configuration are in close proximity?
14. Are plugs and receptacles designs preclude electrical shock and burns while disconnected?
15. Are male plugs require de-energize when disconnected?
16. Is dissimilar plug/receptacle pairs used in units containing explosives?
17. When designed equipment to operate on more than one type of input power exists, does the connector design prevent connection or use of improper power?

18. Are single-phase power cables properly color coded black, hot white, neutral green, or ground?
19. Are three-phase power cables coded as in question 18, above, with the second and third phases in red and blue, respectively?
20. Are meter terminals require protection from voltages of 70 volts or more?
21. Do probes that are part of or accessories to the equipment contain safety guards that prevent contact with the tip and is the length of the exposed portion of the tip not more than 0.75 inches? (This question does not apply if the voltages measured are less than (a) 30 volts rms, (b) 60 volts DC, or (c) 24.8 volts DC interrupted at a rate of 10 Hz to 200 Hz.)
22. Are current and voltage overload protection devices provided?
23. Except for antennas and transmission line terminals, are all external parts, surfaces, and shields at ground potential at all times?
24. Is the path from the equipment to ground continuous and permanent?
25. Is the ground wire color coded green or green with yellow stripes?
26. Does the ground have capacity to safely conduct any currents that imposed thereon?
27. Is the ground wire separate from electrical circuits, i.e., not tied to neutral?
28. Are tests require implementation to determine the amount of leakage current on the grounding conductor? If YES, indicate the amount of current, in milliamperes, measured.
29. Is the impedance of the path from the equipment tie point to ground sufficiently low to limit the potential drop and to allow the operation of overcurrent devices in the circuits?
30. Does the path from the equipment tie point to ground have sufficient mechanical strength to minimize accidental ground disconnection?
31. Is the ground connection to the chassis or frame secured by one of the following: Spot welded terminal lug, soldering lug, screw, nut, and lockwasher?
32. On transmitting equipment, is a grounding stud provided that permits attachment of a portable shorting rod?
33. Except for RF voltages, are antenna and transmission at ground potential?
34. Do convenience outlets automatically ground the mated plugs of metal-cased portable tools and equipment?
35. Are both the phase and neutral supply voltage lines require connection to the chassis?
36. Are wires and cables require support and terminates to prevent shock and fire?
37. Are DC powers connections color coded and marked for polarity?
38. Does the main power switch cut off all the complete equipment?
39. Is the identification of the main power switch clear?
40. Is the main power switch located on the panel?
41. Is physical protection require to provide from accidental contact with the power input side of the main power switch and the incoming power line connections?
42. Are power switches located such that they cannot operate by accidental contact?
43. Are provisions require to provide to deactivate mechanical drive units (switch, circuit breakers, etc) without disconnecting other parts of the equipment?
44. Are means require to provide to cut off power while installing or replacing an item of equipment or an assembly or part thereof?

45. Are emergency controls readily accessible and clearly identified?
46. Does the equipment use batteries? If YES, indicate whether batteries are the primary or backup power source.
47. Is the battery in the Government inventory? If YES, indicate the battery's nomenclature, e.g., BA-XXX, BB-XXX, etc.
48. Can the battery enclosure or box prevent injury or damage in the event of a violent gas venting or rupture of the battery cells?
49. Are batteries compartments require to vent?

3.2 Mechanical

1. Are safety covers require to provide for exposed gears, cams, levers, fans, and belts?
2. Are self-lock or other fail-safe devices require to incorporate into expandable and collapsible structures, such as shelters, jacks, masts, and tripods, to prevent accidental or inadvertent collapsing or falling?
3. Are positive means preventing miss-mating of fittings; couplings; fuel, oil, hydraulic, and pneumatic lines; and mechanical linkages?
4. Are doors; drawers; associated catches, hinges, supports, fasteners, and stops designed to prevent accidental injury?
5. Is the installed equipment free of overhanging edges and corners that may cause injuries?
6. Is the equipment likely to remain upright under normal use and in strong wind, considering its means of support and center of gravity?
7. Does the weight of the design equipment carried by a single soldier not exceed the following limits?

Handling Function	M&F	M
Equipment designed to be lifted from the floor to five feet or less above the floor.	37	56
Equipment designed to be lifted from the floor to three feet or less above the floor.	44	87
Equipment designed to be carried 33 feet or less.	42	82

M&F: Male and Female Population
M: Male Population Only
Weight (lbs)

8. Does the weight distribution allow easy handling, moving, and positioning?

9. Are suitable carrying handles require to provide?
10. Are lifting requirements require labels on equipment weighing over 37 lbs?
11. Are safeties of relief valves require to provide for pressurized systems or components?

3.3 Environmental

1. Is the temperature of all exposed parts less than 60^{o}C, when the ambient temperature is 25^{o}C, regardless of the condition of operation?
2. Is the temperature of front panels and operating controls less than 49^{o}C, when the ambient temperature is 25^{o}C, regardless of the condition of operation?
3. Is the release of toxic, corrosive, explosive fumes or vapors require prevention?
4. Are the outer coverings of cables, wires, and other components free of glass fiber materials?

3.4 Radiation

1. Are warning labels require providing that indicate the hazardous range of microwave emissions for components that produce a power density in excess of the following limits?

Frequency (f)	Power Density (MHz) mW/cm2
0.01-3	100
3-30	900/f2
30-100	1
100-1,000	100
1,000-300,000	10

2. Have all devices that exceed 10,000 volts been evaluated for X radiation?
3. Are x-ray producing devices require shielding to reduce personnel exposure to 2.0 mr/hour or less?
4. Is x-ray producing device and component in which they are located require labeling with an X-radiation hazard warning symbol?
5. Have tests verified no radium or other radioactive materials are present?
6. Are all tubes, knobs, meters, dials, scales, markings, etc., free of radioactive material? If NO, indicate isotope and quantity.
7. Are radiation markings and labels require affixing to all parts or components containing radioactive material?
8. Are filters, goggles, or other protective devices require to provide, and are warning signs posted, for all sources of radio frequency, ultraviolet, infrared, high-energy visible, laser, and any other type of hazardous radiant energy?
9. Is either an FDA classification label or a DA Label 168 require affixing to each laser device?

3.5 Other Safety, Including Software Safety

1. Are there provisions to prevent injury from implosion of cathode ray tubes?
2. Is design equipment preventing accidental ignition of hazardous atmospheres (i.e. equipment that intends for use in atmospheres of explosive gas of vapors, combustible dusts, or ignitable fibers and flying.)?
3. Is a shut-down device or an alarm require to provide to prevent injury or equipment damage?
4. Is there adequate separation between critical warning lights and other lights?
5. Are audible warning signals distinguishable from other sounds under normal operating conditions?
6. Are warning circuits separate from control circuits?
7. Is the display lighting of aircraft electronics (avionics) compatible to the use of night vision goggles
8. Is the system or equipment free of software that (a) could create a hazard; (b) control hazardous processes or outputs; or (c) controls information upon which the operator must rely in order to make safe decisions? If YES, then skip questions 9 through 16.
9. Does the software adequately control all hazardous routines and outputs?
10. Does the software allow the operator to take control over the hardware at any time? If the answer is YES, then skip question 11.
11. Does the software allow the operator to take control over the hardware when hazardous routines or outputs are involved?
12. Will operator have information needed in order to make safe decisions without reliance upon information generated by the software? If YES, skip 13.
13. Is the probability that the software will fail to provide information needed by the operator in order to make safe decisions at an acceptably low level?
14. Is the probability that the software will induce a critical hazard at an acceptably low level?
15. Can the failures of any inputs or output devices cause a critical hazard?
16. Does the system assume or revert to a safe state upon a power failure or upon the failure of any hardware component, such as the primary computer?

3.6 Antennas

1. Are antennas terminals require to insulate to prevent RF burns?
2. Are antennas tips require to design to prevent puncture wounds?
3. Are labels require to provide to warn against contact with overhead electrical lines?
4. Are lock-out device require providing for remotely-operated antennas?
5. Is safety latches provided that prevent unintended release of the guy cable?
6. Lightning Protection Adequacy: IF mast is electrically continuous, treat it as the down conductor.
   a. If antenna acts as an aerial terminal, conductivity must equal or better that of #8 AWG solid copper. If YES, skip b.

b. If antenna does not act as an aerial terminal, (e.g. dish antenna) does rod extend at least 6 inches above the antenna and meet criteria in a?

c. Is the down conductor equivalent to #8 AWG solid copper, with a minimum strand size of #17 AWG?

d. Are joints mechanically strong and corrosion resistant?

e. Is resistance of joint less than that of 2 ft. (.6m) of down conductor? [R=.002 ohms or less - negligible resistance]

f. Will the down conductor remain free of bends or kinks after repeated use?

g. Is the down conductor straight as possible, without any turns less than 90 degrees and 8 inches in radius?

h. Is ground rod at least 1/2 inch in diameter, 8 ft. long, copper clad steel, or equivalent?

i. Is ground rod free of paint?

j. Does antenna mast configuration during erection, storage, take-down or operation prevent any component of the lightning protection system from mechanical damage or wear?

k. If mast is electrically continuous and acts as the down conductor, is the ground stud adequate?

3.7 Vehicles, Shelters, Trailers, and Vans

1. Is the vehicle weight properly distributed and is the vehicle laterally stable?
2. Has the vehicle road-worthiness testing? (e.g. Munson road test)
3. Are entries and exits free of obstructions?
4. Is an emergency exit require providing and marking?
5. Are ladders, non-slip surfaces, and guardrails or chains require providing for the shelter roof?
6. Do the entryway ladders or steps allow safe entrance and exit?
7. Are adequate instructions providing placement of detached semi-trailers?
8. Are safety-chains require providing to prevent the trailer from detaching from the towing vehicle?
9. Are accessories secure or stow to prevent damage when the vehicle is moving?
10. Will the lifting rings support the total weight of the shelter and the installed equipment?
11. Are ground rod and straps require providing?
12. Is a ground stud require providing at the power entry box?
13. Is the ground stud require identification by a label or other marking?
14. Are the ground pins of the convenience outlets hard-wired to the ground stud?
15. Are all outdoor receptacles require connection to ground-fault circuit interrupters (GFCI's)? If YES, skip question 16.
16. Is the socket configuration of each outdoor receptacle that is not connected to a GFCI unique to its special application and unusable for other applications or as a convenience outlet?

17. Is all ground wire color-coated green?
18. Has a test conducted to determine the amount of leakage current on the grounding conductor? If YES, indicate the amount of current, in milli-amperes measured.
19. Except for generators, are all grounds, including GFE, isolated from neutral?
20. Is the power ground wire require connection to the ground stud?
21. Are proper color coding on indicators required? (White: Information; Amber: Caution; Red: Danger; Green: Power On.)
22. Are terminals, plugs, and other exposed parts that may exhibit over 70 volts (convenience outlets excluded), guarded against accidental contact during maintenance?
23. Are safety switches require providing to disconnect remotely- located assemblies?
24. Does the floor surface prevent slipping?
25. Are floor surfaces require adequate insulation?
26. Are there fire hazards present?
27. Are fire extinguisher's accessible and located near exits? Are they of the proper rating for the application?
28. Are open hatches, covers, lids, and doors positively require locking?
29. Are hinged or sliding components (except for the equipment rack shelf) require latching or otherwise secured to prevent unintended movement?
30. Do the racks or cabinets contain stops to prevent drawers from extending beyond their intended limits?
31. Are fuel lines that are inside the shelter made as short as possible?
32. Is there a heater fuel shut-off valve inside the shelter?
33. Is a fuel line or adapter require providing for connection to the external fuel tank or container?
34. Is the heater exhaust pipe located as far as possible from the fuel intake valve?
35. Does the heater exhaust pipe routing prevent the concentration of carbon monoxide in the shelter?
36. Are fuel cans located outside the shelter and at a safe distance from the heater?
37. Are battery compartments forced-air ventilated to the outside?
38. Is a warning device require providing to indicate when either the battery vent lid or door is closed or when the ventilation fan is inoperable?
39. Are warning labels require providing to indicate possible explosive gas accumulations?
40. Is the vehicle exhaust sufficiently require separation from shelter openings to avoid an accumulation of carbon monoxide in the shelter?
41. Is there adequate overhead clearance?
42. Are walls fastenings sufficient to prevent equipment from breaking away, falling, or accidentally dislodging?
43. Are ceilings, walls, and other surfaces adjacent to aisles free of electrical switches that are vulnerable to breakage by accidental collision? If the answer is YES, then skip question 44.
44. Do such switches contain metal shafts that pose a hazard when exposed?

3.8 Health Hazards

1. A. Are noise levels less than 85 dBA for steady state or 140 dBP for impulse? If your response is NO, answer question B.
   B. Are appropriate warnings and/or safeguards provided on the equipment and in the technical manuals?
2. Are hazardous or potentially hazardous materials (e.g., toxics, flammables, ignitables, corrosives, reactives, explosives, oxidizers, carcinogens, etc.) used or required (operation, maintenance and storage
3 Do non-hazardous materials require substitution?
5. Are potential exposures to hazardous materials during use, maintenance, and disposal controlled to levels below the Occupational Safety and Health Administration, (OSHA) Permissible Exposure Limit (PEL), American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values (TLV), and/or National Institute of Occupational Safety and Health (NIOSH), Recommended Exposure Limits (REL), (use the most stringent standard)?
6. Is personal protective equipment (PPE) required for use of hazardous materials?
7. Is the shelter require occupation during normal operations?
8. Is the vehicle require occupation during normal operations of the shelter?
9. Is the shelter air conditioned and heated to prevent heat and cold stress to occupants?. If your response is YES, answer question 9.
10. Is the system's ECU sufficient to maintain temperatures within the shelter between 60-86ºF?
11. Is lighting required within the shelter? If YES, answer question 11.
12. Are light levels within the shelter sufficient to conduct normal operations?
13. Is the shelter require power by a generator, vehicle, etc.? If your response is YES, answer question 13.
14. Are personnel required to be in or near vehicles with generators operating and/or the vehicle engine idling during normal operating conditions? If your response is YES, answer question 14.
15. Do the diesel exhaust levels within the shelter or vehicle exceed permissible limits of the following substances:

Substances	Permissible Limits (parts per million (PPM))	
	8 Hr TWA	STEL
Carbon Monoxide	35	200
Formaldehyde	0.75	2
Sulfur Dioxide	2	5
Acrolein	0.1	0.3
Nitric Oxide	25	N/A
Nitrogen Dioxide	N/A	1

16. Is insulating material (e.g., asbestos, fibrous glass, mineral wool, polystyrene foam, and polyurethane foam) add or incorporate into the shelter, vehicle, or equipment? If you response is YES, answer question 16.
17. Are appropriate warnings and safeguards require providing on the equipment and in the technical manuals?
18. Are ozone-depleting substances (e.g., Chlorofluorocarbons (CFC) CFC-11, CFC-12, CFC-113, CFC-114, CFC-115, HCFC-123, Halon 1211, Halon 1301, Halon 2402, Methyl Chloroform, and Carbon Tetrachloride) required? (Clean Air Act). If your response is YES, answer questions 18 and 19.
19. Are appropriate warnings and safeguards require providing on the equipment and in the technical manuals?
20. Can substitute with an ozone depletion potential (OPD) of 0.05 or less be used?

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX C – TANK VARIANT (TV) AND TANK ENGINEER VARIANT (TEV)

VERSION 2.1

14 SEPTEMBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

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1.0 Scope

This System Requirements Document (SRD) describes the requirements for the Tank variants (TV) and Tank Engineering Variants (TEV) kit. When the driver's compartment installs on a Common Driver Trainer (CDT) platform, the collective system becomes a Common Driver Trainer Tank Variant (CDT TV) that will provide training for M1A1 SA and M1A2 System Enhancement Package version 2 (SEPV2) Abrams tracked vehicle drivers. The CDT TV will provide initial entry training at the armor school as well as sustainment and advanced training at the fielded sites. The trainer will enable training in the critical driver tasks that repetitively train in a simulator. It will also allow training of driver tasks that are dangerous and/or infrequently trained in the "real world" (e.g. driving on ice, fording streams, driving under blackout conditions and driving down a steep embankment when coming off an improved road).

The TEV kit includes Assault Breacher Vehicle (ABV) and Joint Assault Bridge driver's compartment hardware and software and vehicle commander's station hardware and software. When this kit installs on a CDT TV platform, the collective system becomes a Common Driver Trainer Tank Engineering Variant (CDT TEV) that provides training for the Assault Breacher Vehicle (ABV) and Joint Assault Bridge (JAB) tracked vehicle drivers and vehicle commanders. It will provide initial entry training at the engineer school. The trainer will enable training in the critical driver and crew interaction tasks that repetitively train in a simulator. It will also allow training of driver and crew interaction tasks that are dangerous and/or infrequently trained in the "real world", e.g.:

a. Driving on ice
b. Fording streams
c. Driving under blackout conditions
d. Driving down a steep embankment when coming off an improved road
e. Deployment and recovery of assault bridges
f. Operation of the Linear Detonation Charge System (LDCS)
g. Plowing
h. Breaching operations

2.0 Applicable Documents

TM 9-2350-264-10-1	M1A1 Operator's Manual
TM 9 2350-264-10-1 Change 2	M1A1 Operator's Manual
TM 9-2350-388-10-1 Change 6	M1A2 SEP Operator's Manual
TM 9-2350-388-10-2 Change 6	M1A2 SEP V2 Operator's Manual
TM 11374A-OR/1-1	Joint Assault Bridge Operator's Manual
TM 11374A-OR/1-2	Joint Assault Bridge Operator's Manual
TM 10984A-OR/3	Front End Equipment Operator's Manual
TM 10984A-OI/7	Linear Demolition Charge System

In the event of a conflict between the requirements of this document and those contained in the documents above, the requirements contained in this document, take precedence.

3.0 Requirements

3.1 System Level Requirements

The CDT TV and TEV shall consist of the CDT Common Modules and the reconfigurable Abrams specific module as specified herein. The CDT common modules are the IOS, computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem and After Action Review (AAR) subsystem as described in the Common SRD and Appendix A. The reconfigurable TV specific module shall interface to the CDT by the defined interfaces for the CDT modules listed above and shall not degrade the performance of existing CDT variants. The reconfigurable TV specific module shall integrate with the CDT common modules for the CDT TV configuration. The CDT TV specific modules shall consist of the simulated reconfigurable driver's compartments, the instruments and controls for the driver and the software required to operate the driver's compartment, and the software to provide the specific vehicle performance in response to driver inputs and interaction with the Common Modules. When a delivery order configures to include a TEV kit, (JAB and ABV), additional functionality of a Commander's station (hardware and software) at the AAR station shall provide. Unless specifically modified in this appendix, the requirements specified for the CDT TV shall apply to the CDT TEV.

3.2 Common Module Requirements

3.2.1 Instructor Operator Station (IOS) Requirements

The IOS shall control the operation of the CDT TV and TEV, select/modify training scenarios, monitor simulated vehicle status (e.g., instruments, switches, etc.) monitor driver trainee performance, and manage student records in accordance with the requirements as described in the CDT Common SRD.

The IOS shall have pages tailored to the operations of the M1 tank as follows:

a. The IOS shall display on the Gauges page a graphical representation that actively shows the position or state of the following common controls in the reconfigurable Abrams specific module:

(1) Steering, Throttle, and Transmission Control Assembly
(2) Service Brake Pedal
(3) Parking Brake Pedal and bracket
(4) Parking Brake Release Handle
(5) Hydraulic System Pressure Gauge
(6) Crew Fire "T" Handle
(7) Engine Fire "T" Handle
(8) Battle Override Handle
(9) Drain Valve Handle
(10) Turret Traverse Lock

b. When configured for M1A1 SA operation, the IOS Gauges page shall display a graphical representation of the Driver's Master Panel (Figure 3, Table 3), Driver's Instrument Panel (Figure 1, Table1), and the Driver's Alert Indicator Panel (Figure 2, Table 2). This actively shows the gauges and their values and the state of all the switches (including 2nd SHOT switch & guard) and indicator lights.

c. When configured for M1A2 SEPV2/V3/V4 operation, the IOS Gauges page shall display a graphical representation of the driver's Improved Driver's Integrated Display (iDID) that actively shows the information presented on the iDID display (Figure 4, Table 4) and the status of the iDID pushbutton switches (including 4-way pushbutton switch) and the 2nd SHOT switch and guard.

d. When configured for M1A2 SEPV3 operation, the IOS Gauges page shall display a graphical representation and controlled by the driver's Driver's Control Display Panel (DCDP) that actively shows the information presented on the DCDP (Figure 5, Table 5) with the status of the DCDP pushbutton switches (including 4-way pushbutton switch) and the 2nd SHOT switch and guard.

e. The IOS shall display on the Malfunctions page the status of CDT TEV JAB malfunctions. When executing pre-programmed scenarios, the instructor shall only be able to view the status (whether the malfunction is executed or not) of the malfunction programmed into the scenario. The indicator status shall be displayed for the Slope and Status Indicator Panel (SSIP) (Figure 6, Table 6), the Hydraulic Power Control Panel (HPCP) (Figure 7, Table 7), the Warning Emergency Control Panel (WECP) (Figure 8, Table 8), and the Launch Hand Controller (LHC) (Figure 9, Table 9). When executing free play scenarios, the instructor shall be able to initiate and clear malfunctions using the Malfunctions page.

f. The IOS shall display on the Malfunctions page the status of CDT TV malfunctions. When executing pre-programmed scenarios, the instructor shall only be able to view the status (whether the malfunction is executed or not) of the malfunction programmed into the scenario. When executing free play scenarios, the instructor shall be able to initiate and clear malfunctions using the Malfunctions page.

g. The IOS shall display on the Scoring page a list of scoring deduction events along with a time tag for when the scoring deduction occurred. When executing pre-programmed scenarios, the scoring deduction(s) shall use to compute the trainee's final score, produce the student scorecard, and retain the data in the student record.

h. The IOS shall have the capability to select main gun, M2 .50 cal machine gun, M240 7.62mm machine gun or smoke grenade. When selected, the instructor shall then have the capability of controlling the direction of weapon fire and firing the weapon. Firing the weapon shall trigger the appropriate aural cue and visual effect (if applicable).

i. The IOS shall display on the Malfunctions page the status of any unique TV/TEV malfunctions. When executing pre-programmed scenarios, the instructor shall only be able to view the status (whether the malfunction is executed or not) of the malfunction programmed into the scenario. When executing free play scenarios, the instructor shall be able to initiate and clear malfunctions using the Malfunctions page.

j. The IOS shall display on the Scoring page a list of any unique TV/TEV unique scoring deduction events along with a time tag for when the scoring deduction occurred. When executing pre-programmed scenarios, the scoring deduction(s) shall use to compute the trainee's final score, produce the student scorecard, and retain the data in the student record. When executing free play scenarios, the instructor shall use scoring deduction events for AAR.

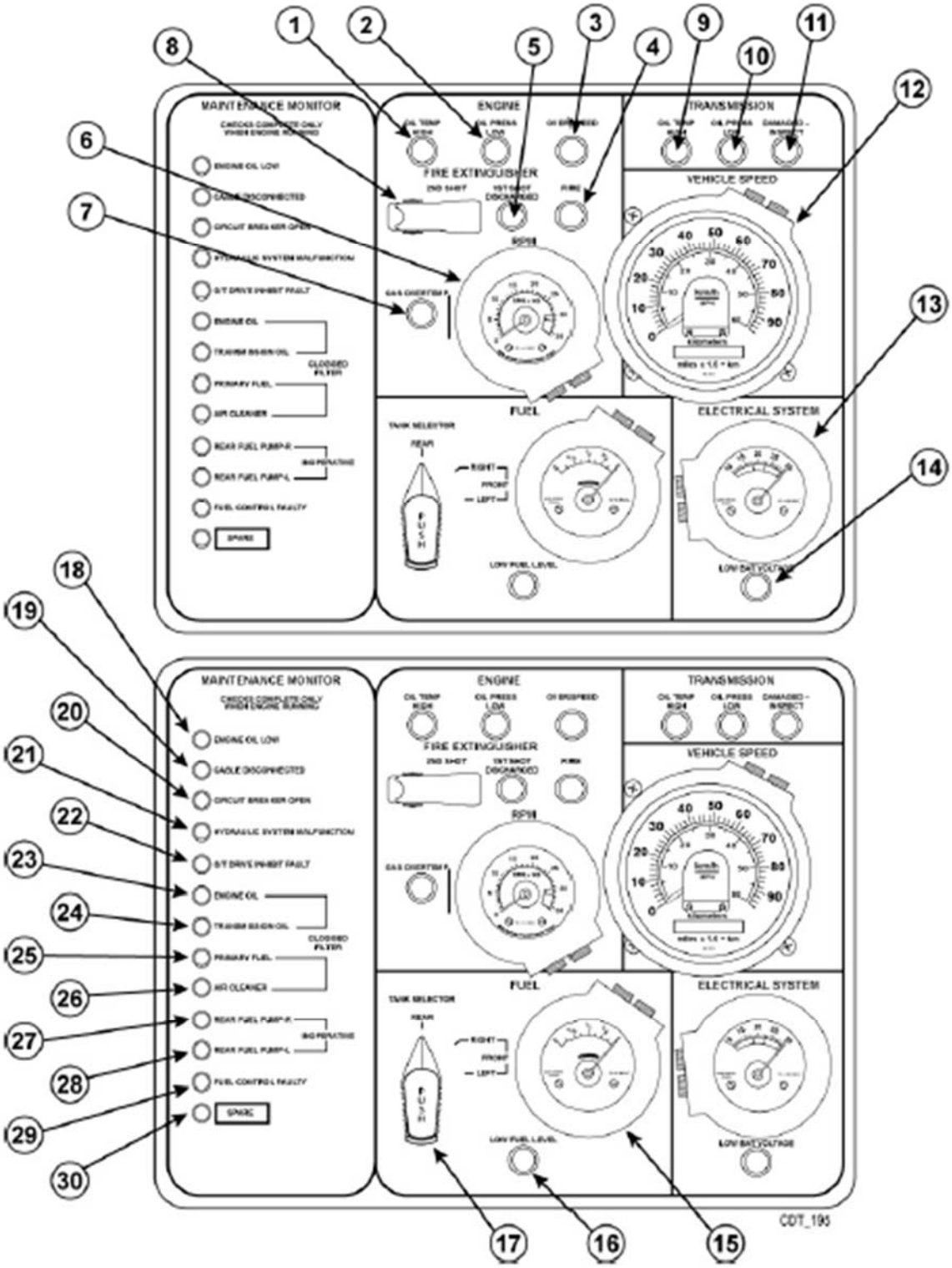

Figure 1. M1A1 Driver's Instrument Panel (DIP)

Table 1. M1A1 Driver's Instrument Panel

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	Engine Oil Temp High Light	Light red if engine oil is too hot.
2	Engine Oil Pressure Low Light	Light red if engine oil pressure is too low.
3	Engine Overspeed Light	Light red if engine RPM is too high.
4	Engine Fire Light	Flashes red to warn that a fire is in the engine compartment.
5	First Shot Discharged Light	Light Yellow when the first shot engine fire extinguisher bottle circuit is energized.
6	RPM Gauge	Show engine speed in hundreds of revolutions per minute.
7	Gas Overtemp Light	Light red when engine power turbine input gas is too hot.
8	Second Shot Switch	Starts engine shutdown, then discharges second shot fire extinguisher bottle after 18 - second delay.
9	Transmission Oil Temp High Light	Light red if the transmission oil is too hot.
10	Transmission Oil Pressure Low Light	Lights red if the Transmission Oil Pressure is too Low.
11	Transmission Damaged Inspect Light	Not simulated.
12	Vehicle Speed Gauge	Shows tank speed in kilometers per hour (km/h) and miles per hour (mph) for forward or reverse tank movement. Distance traveled shown in kilometers.
13	Electrical System Voltmeter	Shows electrical system voltage. With the engine shutdown and Vehicle Master Power Switch ON, the voltmeter shows battery voltage. Wither the engine running, the voltmeter shows the alternator output voltage.
14	Low Batt Charge Light	Not simulated.
15	Fuel Gauge	Shows fuel level in tank selected on the Tank Selector Switch.
16	Low Fuel Level Light	Lights Yellow when the fuel level in the rear tank drops below 1/8 full.
17	Tanks Select Switch	Selects tanks for fuel level check on the fuel gauge. Turns on the front fuel pump when the Low Fuel Level light is lit.
18	Engine Oil Low Light	Light Yellow if engine oil level is low.
19	Cable Disconnected Light	Not simulated.
20	Circuit Breaker Open Light	Not simulated.

ITEM	CONTROL OR INDICATOR	DESCRIPTION
21	Hydraulic System Malfunction Light	Light Yellow if hydraulic system malfunctions.
22	G/T Drive Inhibit Fault Light	Not simulated.
23	Engine Oil Clogged Filter Light	Not simulated.
24	Transmission Oil Clogged Filter Light	Not simulated.
25	Primary Fuel Clogged Filter Light	Not simulated.
26	Air Filter Clogged Filter Light	Not simulated.
27	Rear Fuel Pump-R Inoperative Light	Not simulated.
28	Rear Fuel Pump-L Inoperative Light	Not simulated.
29	Fuel Control Faulty	Light Yellow if fuel control malfunctions. If light is flashing and if vehicle has digital electronic control unit (DECU), this indicates that vehicle power to DECU is malfunctioning.
30	SPARE	Not simulated.

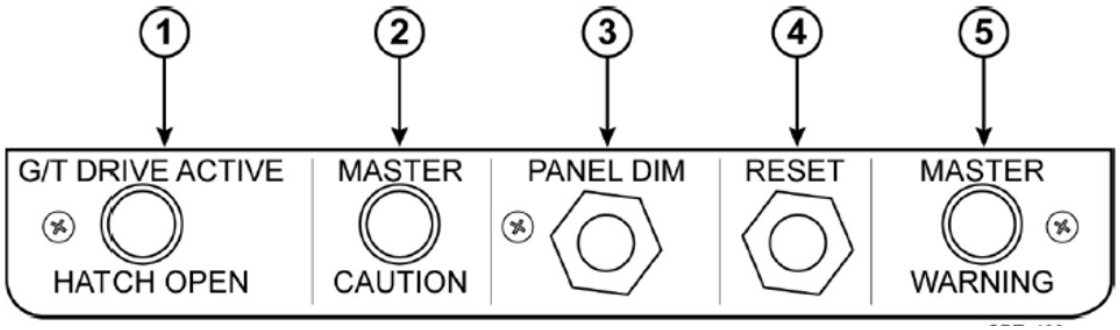

Figure 2. Driver's Alert Indicator Panel

Table 2. Driver's Alert Indicator Panel

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	G/T Drive Active / Hatch Open Light	Not simulated
2	Master Caution Light	Lights yellow to alert driver to look for vehicle fault indication on the instrument panel.
3	Panel Dim Pushbutton	Permits PANEL LIGHTS knob on driver's master panel to control brightness of alert panel lights when pressed after VEHICLE MASTER POWER switch is set to ON.
4	Reset Pushbutton	Turns off MASTER CAUTION light when pressed.
5	Master Warning Light	Lights red to warn driver to look at the instrument panel for warning of critical condition in engine or transmission.

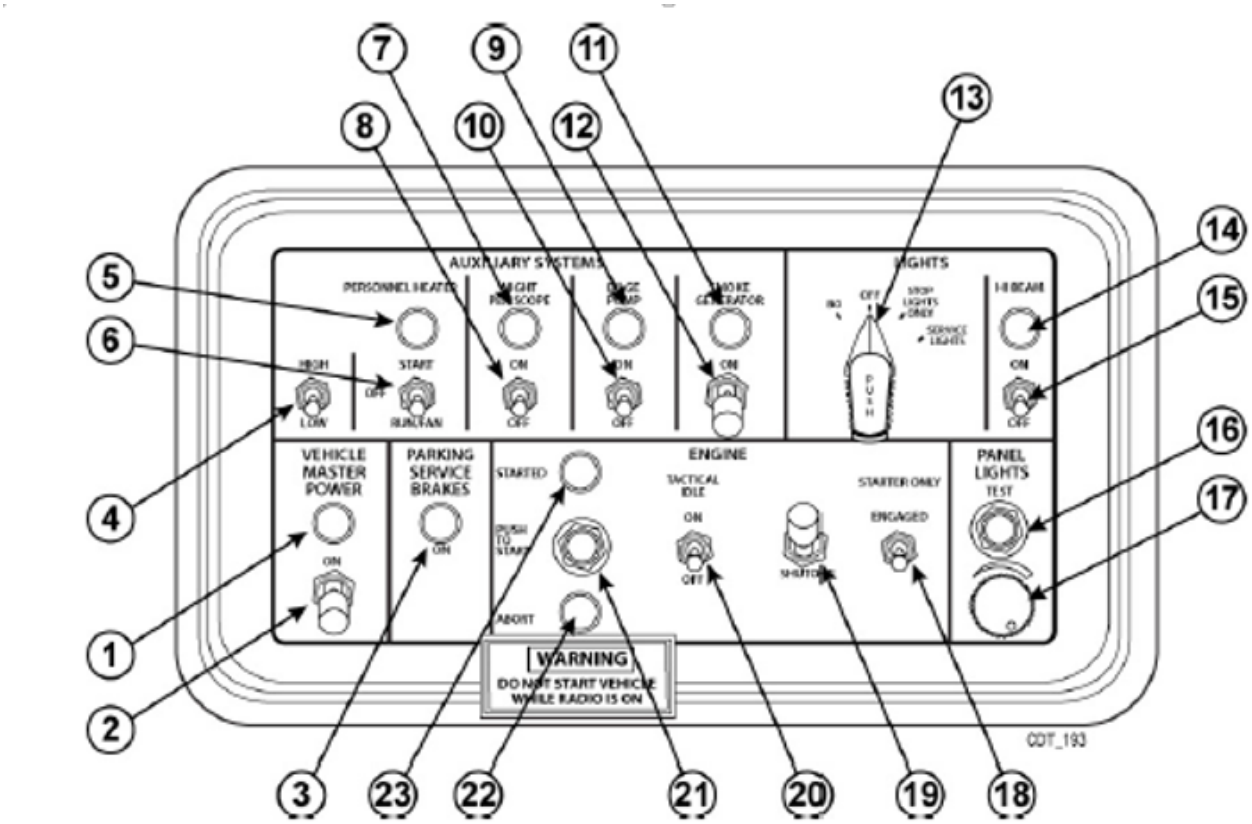

Figure 3. M1A1 Master Driver Panel

Table 3. M1A1 Master Driver Panel

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	Vehicle Master Power Light	Lights green when power is on inside the tank.
2	Vehicle Master Power Switch	Turns on the tank cab.
3	Parking/Services Brake Light	Light red when parking brake is set, or service brake is engaged.
4	Personnel Heater Temp Switch	Not simulated.
5	Personnel Heater Light	Lights green when personnel heater temp switch is engaged.
6	Personnel Heater Run Fan Switch	Starts, stops, and runs the personnel heater and permits use of the fan for ventilation.
7	Night Periscope Light	Lights green when power applies to the DVE.
8	Night Periscope Switch	Turns power on/off to the DVE.
9	Bilge Pump Light	Lights green when power applies to the bilge pump.
10	Bilge Pump Switch	Turns power on/off to the bilge pump.
11	Smoke Generator Light	Lights green when power applies to the smoke generator.
12	Smoke Generator Switch	Not simulated.
13	Lights Switch	Turns power on/off to outside blackout markers, stoplight, and service drive.
14	HI Beam Light	Lights green when the service lights high beam lamps lit.
15	HI Beam Switch	Turns power on/off to the service light high beam lamps.
16	Panel Lights Test Pushbutton	Turns on all panel lights and internal gauge lights to full brightness when pressed.
17	Panel Lights Knob	Controls brightness of driver's panel lights and internal gauge lights, except the engine fire light.
18	Starter Only Engaged Switch	Provides power to turn engine starter without ignition. Engine will not start using this switch.
19	Shutoff Switch	Shuts off fuel to the engine.
20	Tactile Idle Switch	Selects engine tactical idle speed of 1200-1400 rpm.
21	Push to Start Pushbutton	Provides automatic engine start.
22	Abort Light	Lights yellow to show the engine has aborted start.
23	Started Light	Lights green when engine has started successfully.

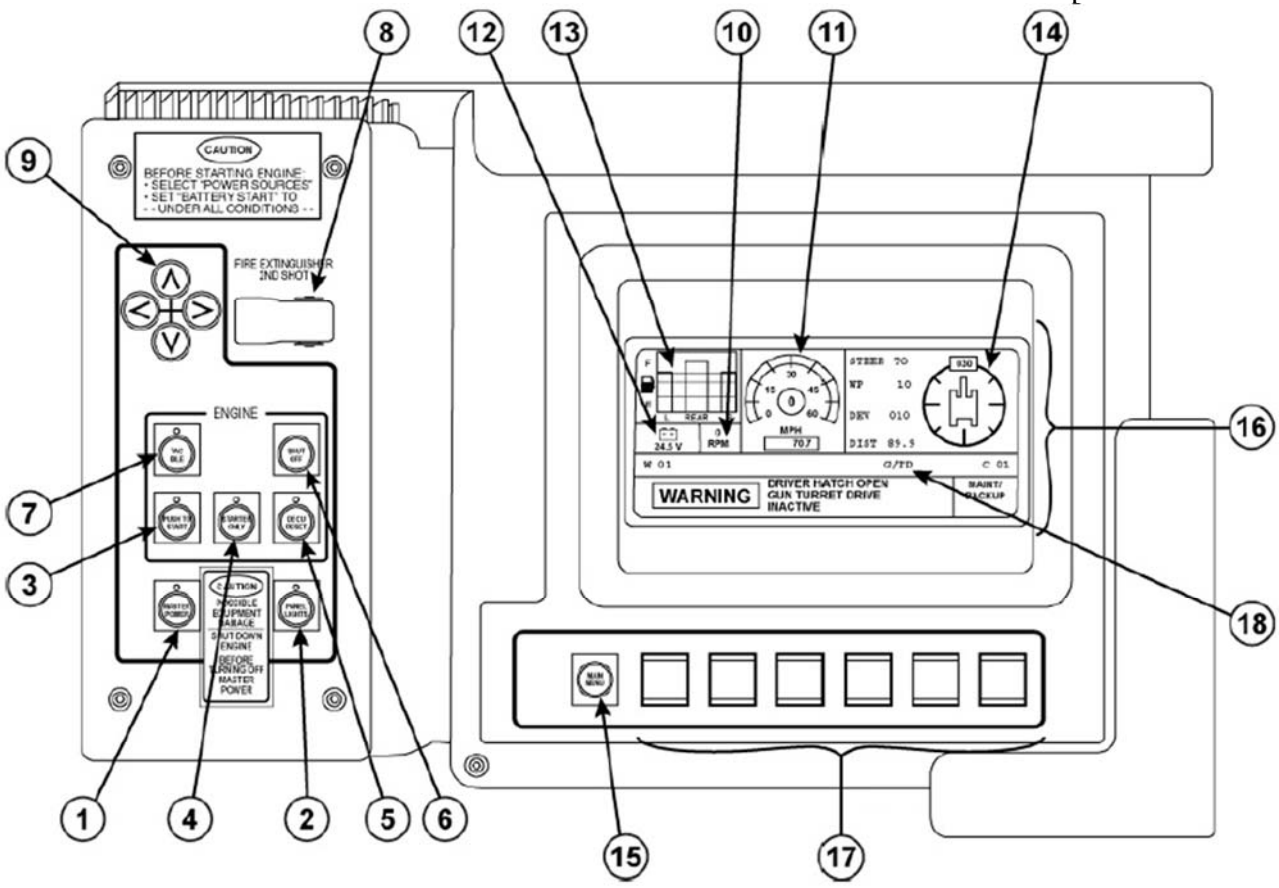

Figure 4. Improved Driver's Integrated Display (iDID)

Table 4. Improved Driver's Integrated Display (iDID) Description

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	Master Power Pushbutton	Connects batteries/generator to the tank electrical system. Light Indicates power is on to the Center Control Panel.
2	Panel Lights Pushbutton	Select to adjust iDID brightness.
3	Push to Start Button	Allows driver to initiate engine start sequence.
4	Starter Only Pushbutton	Provides Power to turn engine starter without ignition. Engine will not start using this pushbutton.
5	DECU Reset Pushbutton	Allows driver to initiate reset command to the DECU which resets the DECU fault functions.
6	Shutoff Pushbutton	Sends signal to the DECU to initiate engine shutoff sequence.
7	Tactile Idle Pushbutton	Selects engine tactile idle speed of 1200-1400 rpm.
8	Fire Extinguisher 2nd Shot Switch	Starts engine shutdown, then discharges 2nd shot fire extinguisher bottle after 18 second delay.
9	4-Way Pushbutton	Used to adjust panel lights and various input functions
10	RPM Indicator	Shows engine speed in hundreds of revolutions per minute.
11	Vehicle Speed Indicator	Shows tanks speed in miles per hour or kilometers per hour.
12	Electrical System Indicator	Shows electrical system voltage.
13	Fuel Indicator	Shows fuel level in tanks, using 1/8 increments.
14	Steer-to-Indicator Compass	Used to guide the driver by providing information about relative position to distance.
15	Main Menu Pushbutton	Push to return to main menu when in any other lower menu.
16	Main Menu Pushbutton	Allows driver to initiate the iDID menu.
17	Pushbuttons	Allows driver to initiate functions on the iDID main menu.
18	Gun/Turret Drive Active Icon	Shows the driver's hatch interface overrides: GTD is active.

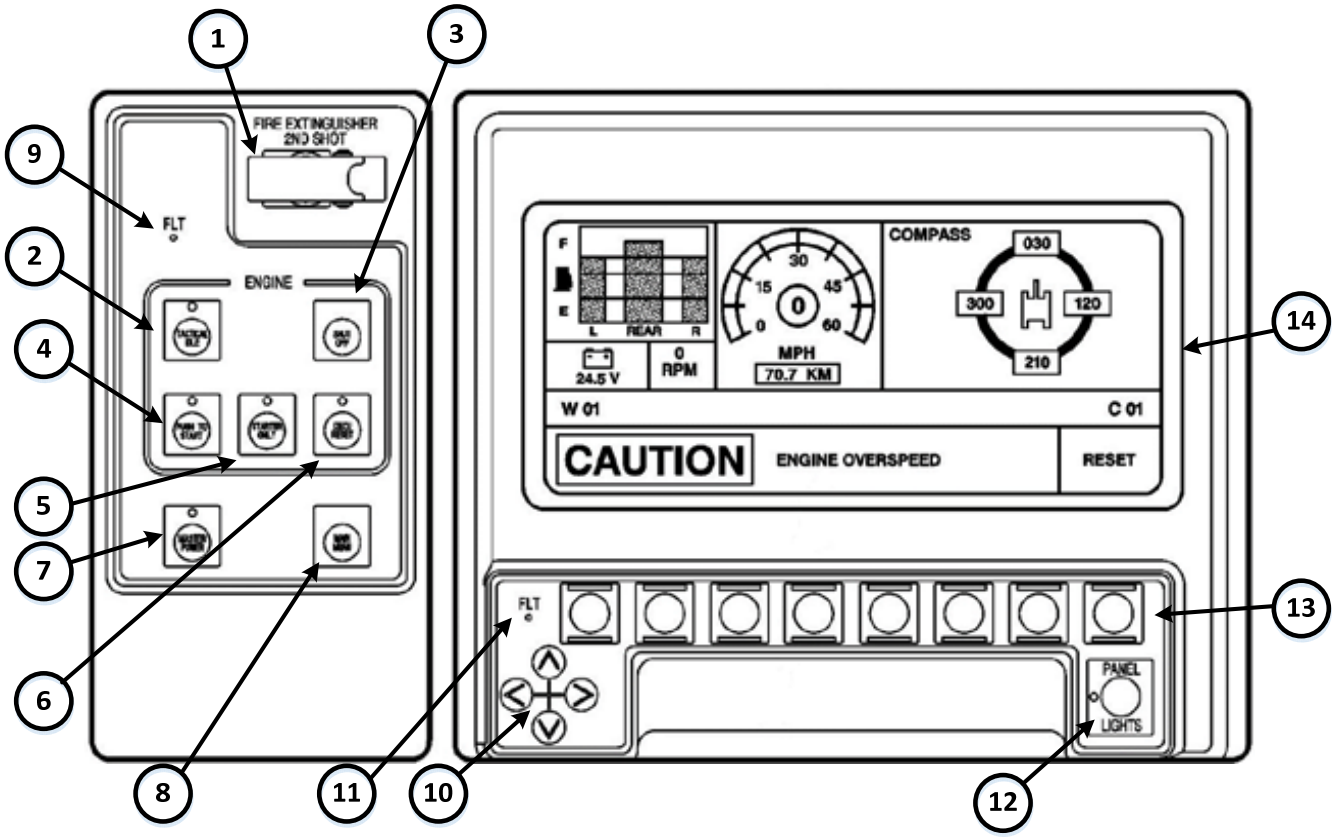

Figure 5. Driver's Control and Display Panel (DCDP)

Table 5. Driver's Control and Display Panel (DCDP)

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	DCDP Fire Extinguisher 2nd Shot Switch	Starts engine shutdown, then discharges 2nd shot fire extinguisher bottle after 18 second delay.
2	DCDP Tactile Idle Pushbutton	Selects engine tactile idle speed of 1200-1400 rpm.
3	DCDP Shutoff Pushbutton	Sends signal to the DECU to initiate engine shutoff sequence.
4	DCDP Push to Start Button	Allows driver to initiate engine start sequence.
5	DCDP Starter Only Pushbutton	Provides Power to turn engine starter without ignition. Engine will not start using this pushbutton.
6	DCDP DECU Reset Pushbutton	Allows driver to initiate reset command to the DECU which resets the DECU fault functions.
7	DCDP Master Power Pushbutton	Connects batteries/generator to the tank electrical system. Light Indicates power is on to the Center Control Panel.
8	DCDP Main Menu Pushbutton	Return DCDP Display to Main Menu
9	DCDP FLT Indicator	Fault Indictor Status
10	DCDP 4-Way Pushbutton	Used to adjust panel lights and various input functions
11	DCDP FLT Indicator	Fault Indictor Status
12	DCDP Panel Lights	DCDP Brightness Adjust Activation Function
13	DCDP Function Pushbuttons (8)	DCDP Operation Multifunction Control Pushbuttons
14	DCDP Display Area	DCDP Operation and Status screen

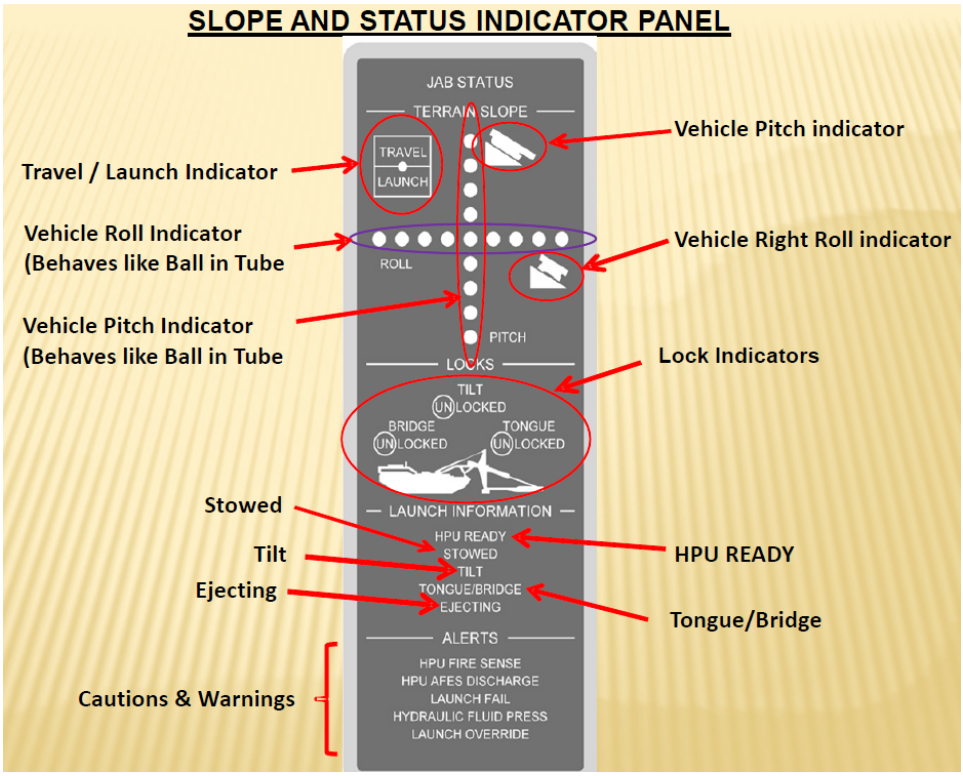

Figure 6. Driver's Slope and Status Indicator Panel (SSIP)

Table 6. Driver's Slope and Status Indicator Panel (SSIP) Description

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	Travel/Launch Indicator	Illuminates to Indicate Bridge or Travel Operation Status
2	Vehicle Pitch Indicator	Illuminates to Indicate Pitch Detected
3	Vehicle Roll Indicator	Illuminates to Indicate Roll Position
4	Vehicle Right Roll Indicator	Illuminates to Indicate Right Roll Detected
5	Vehicle Pitch Indicator	Illuminates to Indicate Pitch Position
6	Lock Indicator Bridge	Illuminates to Indicate Lock Status - Bridge
7	Lock Indicator Tilt	Illuminates to Indicate Lock Status -Tilt
8	Lock Indicator Tongue	Illuminates to Indicate Lock Status -Tongue
9	Stowed Indicator	Illuminates to Indicate Stow Status
10	Tilt Indicator	Illuminates to Indicate Tilt Status
11	Ejecting Indicator	Illuminates to Indicate Eject Status
12	HPU READY Indicator	Illuminates to Indicate HPU ready Status
13	Tongue Bridge Indicator	Illuminates to Indicate Tongue Bridge Status
14	HPU Fire Sense Alert Indicator	Illuminates to Indicate Fire Sense Status
15	HPU AFES Discharge Alert Indicator	Illuminates to Indicate HPU AFES Status
16	Launch Fail Alert Indicator	Illuminates to Indicate Launch Fail Status
17	Hydraulic Fluid Pressure Alert Indicator	Illuminates to Indicate Hydraulic Fluid Pressure Status
18	Launch Override Alert Indicator	Illuminates to Indicate Launch override Status

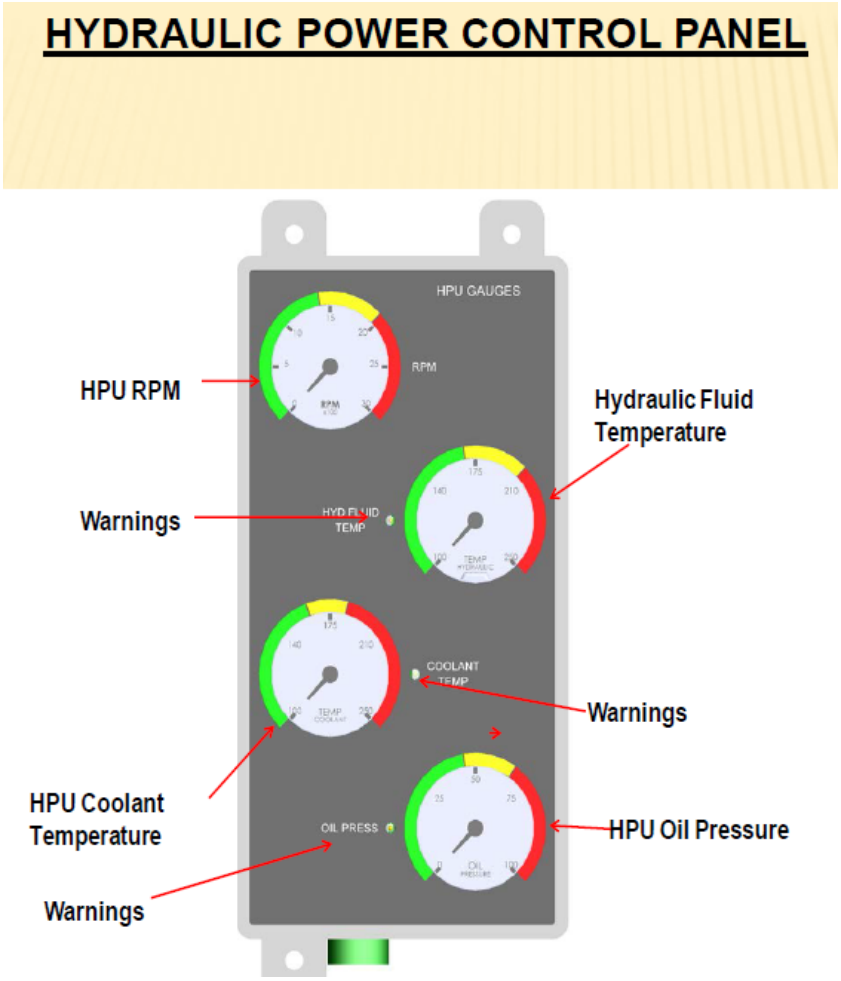

Figure 7. Hydraulic Power Control Panel (HPCP)

Table 7. Hydraulic Power Control Panel (HPCP) Description

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	HPU RPM Gauge	Show HPU engine speed in hundreds of revolutions per minute.
2	Hydraulic Fluid Temperature Gauge	Shows HPU hydraulic fluid temperature in degrees.
3	Hydraulic Fluid Temperature Warning	Illuminates to Indicate Hydraulic Fluid Over Temperature
4	Coolant Fluid Temperature Gauge	Shows HPU Coolant fluid temperature in degrees.
5	Coolant Fluid Temperature Warning	Illuminates to Indicate Coolant Fluid Over Temperature
6	HPU Oil Pressure Gauge	Shows HPU Oil Pressure in degrees.
7	HPU Oil Pressure Warning	Illuminates to Indicate HPU Oil Over Pressure

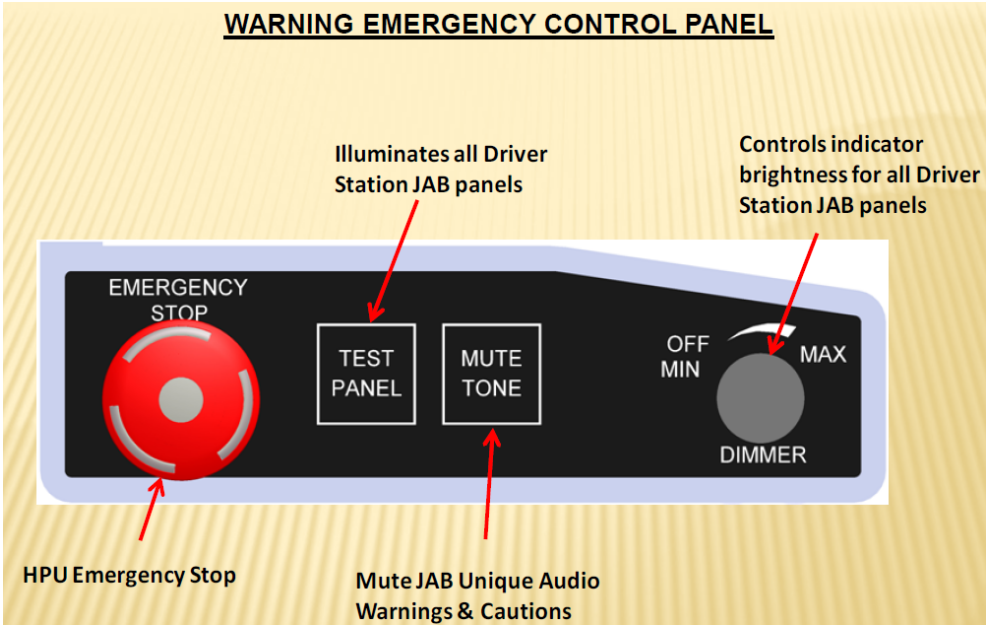

Figure 8. Warning Emergency Control Panel (WECP)

Table 8. Warning Emergency Control Panel (WECP) Description

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	HPU Emergency Stop	Switch to halt HPU operation
2	Test Panel Pushbutton	Illuminates all Driver Station JAB panels
3	Mute Tone Pushbutton	Mute JAB unique Audio Warnings and Cautions
4	Dimmer / Off control Switch	Controls indicator brightness for all Driver Station JAB panels

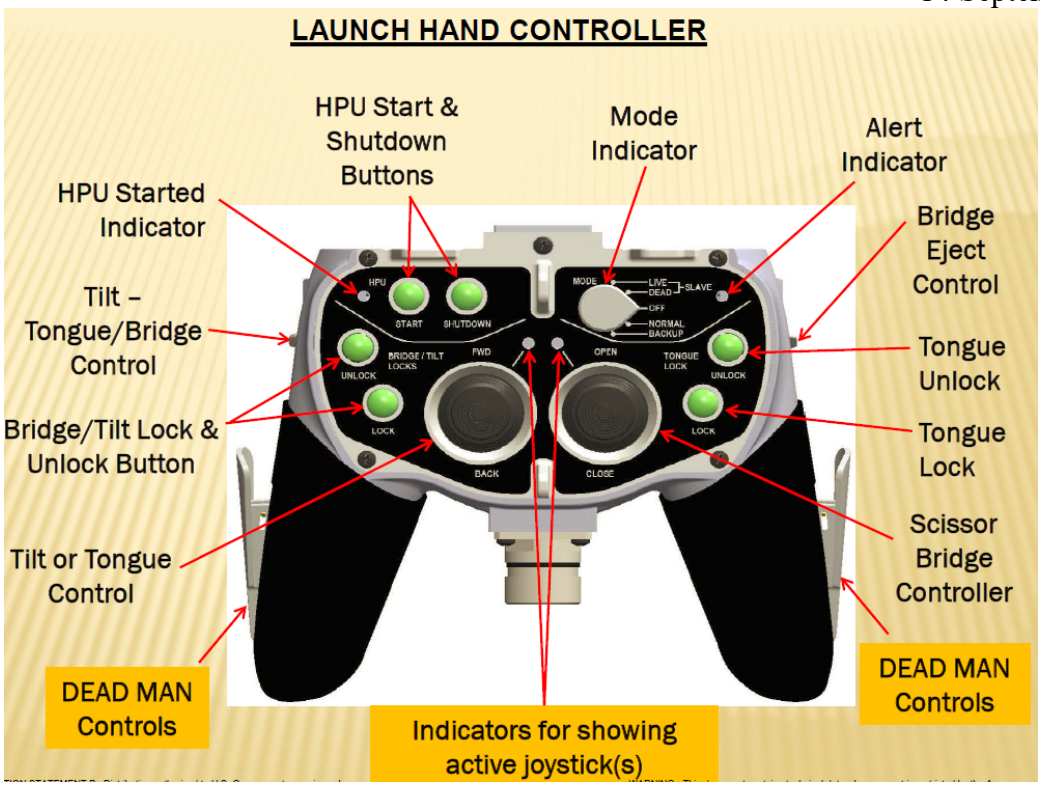

Figure 9. Launch Hand Controller (LHC)

Table 9. Launch Hand Controller (LHC) Description

ITEM	CONTROL OR INDICATOR	DESCRIPTION
1	HPU Started Indicator	Illuminates when HPU engine has started.
2	HPU Start Button	Starts HPU engine.
3	HPU Shutdown Button	Stops HPU engine.
4	Mode Switch	Sets the mode for LHC controller
5	Alert Indicator	Illuminates when HPU has status to report.
6	Bridge Eject Control Button	Bridge Eject Control Button
7	Tongue Unlock Button	Tongue Unlock Button
8	Tongue lock Button	Tongue lock Button
9	Scissor Bridge Controller	Scissor Bridge Control position switch
10	Tilt- Tongue /Bridge Control	Tilt- Tongue Bridge Eject Control Button
11	Bridge /Tilt- Lock Button	Bridge /Tilt- Lock Button
12	Bridge /Tilt- Unlock Button	Bridge /Tilt- Unlock Button
13	Tilt or Tongue Control	Tilt or Tongue Control position switch
14	Indicators for showing active joystick	Illuminated when LHC is active
15	DEAD MAN Controls	Launch Hand Controller Panel Enable switches

3.2.2 Visual / Display System

The visual system shall produce visual imagery for the CDT TV in accordance with the Appendix A.

The visual database(s) used to produce the imagery for the CDT TV shall be in accordance with the requirements as described in the Appendix A.

The display system used to display the visual imagery for the CDT TV shall be in accordance with the display system requirements as described in the CDT Common SRD.

The TEV kit vehicle commander's station shall have a one channel visual system. The single channel visual system shall display the vehicle commander's center periscope imagery. The periscope imagery shall display on a flat screen, color monitor with a minimum diagonal measurement of 19 inches located at the vehicle commander's station. The vehicle commander shall have the ability to control the look point (turret azimuth) of the periscope imagery displayed on the visual system monitor relative to the vehicle. The vehicle commander's visual system shall display the same environmental effects/conditions specified in scripted and unscripted scenarios for the driver's compartment visual system. The vehicle commander's visual system shall display the visual effects specified in Appendix A.

3.2.3 Aural/Communication Subsystem

The aural/communications system used in the CDT TV shall be in accordance with the requirements as described in the CDT Common SRD.

3.2.4 After Action Review (AAR)

The AAR system for the CDT TV shall be in accordance with the requirements as described in the CDT Common SRD. When equipped, the vehicle commander's station shall allow the vehicle commander to fire the own vehicle weapons. When activated at the vehicle commander's station, own vehicle weapons firing aural cues and visual effects for LDCS and smoke grenade firing shall trigger.

3.3 Operational Requirements

The CDT TV requirements for physical space, power requirements, safety limitations/considerations, system start times, setup times, and reconfiguration times shall be in accordance with the requirements as described in the CDT Common SRD. When a TEV kit is required, the vehicle commander's station shall consist of:

a. A Commercial Of The Shelf (COTS) workstation with touch screen display(s) for:
    1) interactive commander control inputs
    2) visual system display for the vehicle commander's front periscope view
    3) visual system display for the vehicle commander's sensor Integrated Vision System (IVS) or Vision Enhancement System (VES) view
b. A communication system
c. A chair

The CDT TEV requirements for power requirements, safety limitations/considerations, system start times, setup times, and reconfiguration times shall be in accordance with the requirements as described in the CDT Common SRD.

3.4 Variant Requirements

The CDT TV shall include a reconfigurable driver's compartment and simulation software that provides the physical configuration, controls, instruments, vehicle operation, and vehicle dynamics of the M1A1 SA and the M1A2 SEPV2/V3/V4 version of the Abrams tank. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M1 Abrams Tank version necessary to accomplish the required training tasks.

When configured as a M1A1 SA tank driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks.

When configured as a M1A1 TEV, the simulation, hardware and software that provides the physical configuration, controls, instruments, vehicle operation and vehicle dynamics of the ABV and the JAB and a vehicle commander's station shall have software that simulates the physical controls, instruments and vehicle operations available to the vehicle commander of the ABV or the JAB. When the physical components of the CDT TEV kit removes from the driver's compartment and the vehicle commander's station powers off, the CDT TEV shall become a CDT TV and retain all of the capabilities.

The main components of the vehicle commander's station shall be a front periscope view visual display, a sensor visual display (IVS or VES), an intra-vehicle communication system and the vehicle commander's control panel(s) touchscreen display(s) used to simulate the controls, instruments, switches and panels of the variant vehicle necessary to accomplish the required training tasks. The vehicle commander's station out the window view shall displays as an instructor-selectable page at the IOS. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M1 Abrams Tank Engineering vehicle version necessary to accomplish the required training tasks.

When configured as a JAB driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks.

When configured as an ABV driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks.

When configured as a M1A2 SEPV2/V3/V4 tank driver's compartment, the simulation software shall use the Abrams Common Software Library (ACSL) software to provide the driver's compartment control and switch interaction for all switches, controls, and indicators supported by the ACSL. The training system shall provide IOS controls or trainer initializations that allow the trainer to utilize both ACSL versions v4.1 and v4.2 based on the user's training requirements.

The simulation software shall provide all non-ACSL supported driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks. The simulation software shall also provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The M1 Abrams tank driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests.

During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator the specific M1 Abrams configuration installed (M1A1 SA or M1A2 SEPV2/V3/V4, ABV, JAB) and provide an error message if there are any reconfigurable component-mismatches or components not installed.

The CDT TV and TEV shall train the driver training tasks listed in the following paragraphs performed by the student. The performance shall assess by the system and monitored by the instructor. The training tasks generally reflect the numerous and varied skills that comprise of the task of driving an Ml Abrams Tank (either the M1A1 SA, M1A2 SEPV2/V3/V4 or both) or configured as a TEV. Table 10 includes the TV and TEV variant training tasks.

Table 10. Variant Training Tasks						
	Training Tasks:	**TV-M1A2 SEPv3**	**TV-M1A2 SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
1	Enter driver's compartment (normal seat)	x	x	x	x	x
2	Enter driver's compartment (AutoFlug Variant)	x	x	x	x	x
4	Power up the hull system	x	x	x	x	x
5	Adjust driver's seat	x	x	x	x	x
6	Adjust driver's periscopes	x	x	x	x	x
7	Adjust steering/throttle control	x	x	x	x	x
8	Operate engine compartment fire extinguisher -auto	x	x	x	x	x
9	Operate engine compartment fire extinguisher -manual	x	x	x	x	x
10	Operate driver compartment fire extinguisher -manual	x	x	x	x	x
11	Transfer fuel	x	x	x	x	x
12	Start engine (normal)	x	x	x	x	x
13	Start engine (after aborted start)	x	x	x	x	x
14	Check warning and caution lights	x	x	x	x	x
15	Check hydraulics	x	x	x	x	x
16	Operate bilge pump	x	x	x	x	x
17	Operate gas particulate system	x	x	x	x	x
18	Check master warning light (M1A1 SA only)	x	x	x	x	x
19	Check master caution light (M1A1 SA only)	x	x	x	x	x
20	Operate Driver's Instrument Panel (M1A1 SA only)			x	x	x
21	Operate the iDID (M1A2 SEPV2/V3/V4 only).		x			
	Operate the DCDP (M1A2 SEPV3 only).	x				
22	Operate driving control		x			
23	Operate transmission	x	x	x	x	x
24	Operate steering	x	x	x	x	x
25	Operate brakes	x	x	x	x	x
26	Operate outside lights	x	x	x	x	x
27	Slow/fast forward driving	x	x	x	x	x
28	Reverse driving	x	x	x	x	x
29	Neutral steering	x	x	x	x	x

	Training Tasks:	TV-M1A2 SEPv3	TV-M1A2 SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
30	Pivot steer	x	x	x	x	x
31	Motor pool parking	x	x	x	x	x
32	Decelerate smoothly to a halt	x	x	x	x	x
33	Navigate through training environment using instrumentation (M1A2 SEPV2/V3/V4 only)	x	x	x	x	x
34	Install the Driver's Vision Enhancement (DVE) night vision device	x	x			
35	Operate all DVE functions on tank power	x	x	x	x	x
36	Remove the DVE night vision device	x	x	x	x	x
37	Operate the Rear View Sensor System (RVSS)	x	x	x	x	x
38	Shut down engine/vehicle	x	x	x		
39	Power down the hull system	x	x	x	x	x
40	Secure the station	x	x	x	x	x
41	Adjust the driver's seat (adjust for ingress/egress or operation)	x	x	x	x	x
42	Adjust the Driver's Mine Safety Seat (DMMS)(adjust for ingress/egress or operation-Autoflug Variant)	x	x	x	x	x
43	Operate intercom/communications system	x	x	x		
44	Familiarity with location of all fire detection sensors	x	x	x	x	x
45	Operate the vehicle in extreme cold	x	x	x	x	x
46	Respond to malfunctions	x	x	x	x	x
47	Check hatch status	x	x	x	x	x
48	Connect Chemical, Biological, Radiological, Nuclear (CBRN) M25 protective mask, verify air flow, and don the mask	x	x	x	x	x
49	Vehicle starting	x	x	x	x	x
50	Vehicle shutdown	x	x	x	x	x
51	Exit the driver's station from the DMMS (Autoflug Variant)	x	x	x	x	x

	Training Tasks:	**TV-M1A2 SEPv3**	**TV-M1A2 SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
52	Drive on narrow roads	x	x	x		
53	Drive on urban roads	x	x	x	x	x
54	Drive on highway	x	x	x	x	x
55	Drive in towns	x	x	x	x	x
56	Overhead obstacles	x	x	x	x	x
57	Drive in a convoy	x	x	x	x	x
58	Fording	x	x	x	x	x
59	Drive in mountains	x	x	x	x	x
60	Drive on slopes under 22 degrees	x	x	x	x	x
61	Drive on steep hills	x	x	x	x	x
62	Drive on plains terrain	x	x	x	x	x
63	Drive in rolling hills	x	x	x	x	x
64	Drive on forest trails	x	x	x	x	x
65	Tactical road march	x	x	x	x	x
66	Drive over logs	x	x	x	x	x
67	Drive over ditches (maximum 108 inch width	x	x	x	x	x
68	Drive on inclines under 31 degrees	x	x	x	x	x
69	Drive over walls (maximum 42 inch height)	x	x	x	x	x
70	Drive onto railroad car	x	x	x	x	x
71	Cross bridges	x	x	x	x	x
72	Crossing assault bridge	x	x	x	x	x
73	Loading tank on Heavy Equipment Transport	x	x	x	x	x
74	Traveling	x	x	x	x	x
75	Traveling overwatch	x	x	x	x	x
76	Action right	x	x	x	x	x
77	Action left	x	x	x	x	x
78	Turn glacis toward greatest threat	x	x	x	x	x
79	Minimize exposure time	x	x	x	x	x
80	Coil formation	x	x	x	x	x
81	Herringbone formation	x	x	x	x	x
82	Vee formation	x	x	x	x	x
83	Wedge formation	x	x	x	x	x
84	Line formation	x	x	x	x	x
85	Minefield crossing	x	x	x	x	x
86	Perform missile evasive maneuvers	x	x	x	x	x

	Training Tasks:	TV-M1A2 SEPv3	TV-M1A2 SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
87	Bounding (alternate)	x	x	x	x	x
88	Bounding (successive)	x	x	x	x	x
89	Maintain steady firing platform	x	x	x	x	x
90	Occupy hull down	x	x	x	x	x
91	Enter firing position	x	x	x	x	x
92	Exit firing position	x	x	x	x	x
93	Occupy hull down at high speed	x	x	x	x	x
94	Occupy turret down at high speed	x	x	x	x	x
95	High speed firing platform	x	x	x	x	x
96	Extreme cant platform	x	x	x	x	x
97	Operate JAB				x	
98	Operate JAB (Start Engine)				x	
99	Operate JAB (Make After-Start Checks)				x	
100	Operate JAB (Drive JAB)				x	
101	Operate JAB in Extreme Cold				x	
102	Operate JAB in Extreme Cold (Start Engine)				x	
103	Operate JAB in Extreme Cold (Make After-Start Checks)				x	
104	Operate JAB in Extreme Cold (Drive JAB)				x	
105	Operate JAB in Extreme Heat				x	
106	Operate JAB in Extreme Heat (Operate Engine)				x	
107	Operate JAB in Extreme Rain/Wind				x	
108	Operate JAB in Extreme Dust, Sand, or Mud (Drive JAB)				x	
109	Check Percent Power or Mission Capability Power				x	
110	Start/Stop Hydraulic Power Unit (HPU)				x	
111	Power Up/Power Down Bridge Control Panel (BCP)				x	
112	Launch/Recover Scissor MLC 70 Bridge				x	
113	Launch/Recover BLS (No Bridge)				x	
114	Launch MLC 70 Bridge				x	
115	Recover Launched MLC 70				x	

	Training Tasks:	TV-M1A2 SEPv3	TV-M1A2 SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
116	Recover Impacted Bridge				x	
117	Launch/Recover MLC 70 Bridge on Slope				x	
118	Launch/Recover MLC 70 Bridge in Wetlands or Marsh				x	
119	Operate JAB in Desert Environment				x	
120	Operate JAB in Extreme Heat				x	
121	Drive JAB in Extreme Dust, Sand, or Mud				x	
122	Operate JAB in Extreme Rain/Wind				x	
123	Operate Front End Equipment (FEE)				x	
124	Operate Lane Marking System (LMS)				x	
125	Operate Remote Control System (RCS)				x	
126	Operate Jettison System in Extreme Cold				x	
127	Operate Linear Demolition Charge System (LDCS)				x	
128	Operate Thermal Camera and Laser Rangefinder (TCALRF)				x	
129	Operate ABV				x	
130	Operate ABV (Start Engine)					x
131	Operate ABV (Make After-Start Checks)					x
132	Operate ABV (Drive ABV)					x
133	Operate Front End Equipment (FEE) in Extreme Cold					x
134	Operate Lane Marking System (LMS) in Extreme Cold					x
135	Operate Remote Control System (RCS) in Extreme Cold					x
136	Operate Jettison System in Extreme Cold					x
137	Operate Linear Demolition Charge System (LDCS) in Extreme Cold					x

	Training Tasks:	TV-M1A2 SEPv3	TV-M1A2 SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
138	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Cold					x
139	Operate ABV in Extreme Cold					x
140	Operate ABV in Extreme Cold (Start Engine)					x
141	Operate ABV in Extreme Cold (Make After-Start Checks)					x
142	Operate ABV in Extreme Cold (Drive ABV)					x
143	Operate ABV in Desert Environment					x
144	Operate ABV in Extreme Heat					x
145	Operate Front End Equipment (FEE) in Extreme Heat					x
146	Operate Lane Marking System (LMS) in Extreme Heat					x
147	Operate Remote Control System (RCS) in Extreme Heat					x
148	Operate Jettison System in Extreme Heat					x
149	Operate Linear Demolition Charge System (LDCS) in Extreme Heat					x
150	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Heat					x
151	Operate ABV in Extreme Heat (Operate Engine)					x
152	Operate Front End Equipment (FEE) in Extreme Dust, Sand, or Mud					x
153	Operate Lane Marking System (LMS) in Extreme Dust, Sand, or Mud					x
154	Operate Remote Control System (RCS) in Extreme Dust, Sand, or Mud					x
155	Operate Jettison System in Extreme Dust, Sand, or Mud					x

	Training Tasks:	TV-M1A2 SEPv3	TV-M1A2 SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
156	Operate Linear Demolition Charge System (LDCS) in Extreme Dust, Sand, or Mud					x
157	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Dust, Sand, or Mud					x
158	Operate ABV in Extreme Dust, Sand, or Mud (Drive ABV)					x
159	Operate ABV in Extreme Rain/Wind					x
160	Operate Front End Equipment (FEE) in Extreme Rain/Wind					x
161	Operate Lane Marking System (LMS) in Extreme Rain/Wind					x
162	Operate Remote Control System (RCS) in Extreme Rain/Wind					x
163	Operate Jettison System in Extreme Rain/Wind					x
164	Operate Linear Demolition Charge System (LDCS) in Extreme Rain/Wind					x
165	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Rain/Wind					x
166	Monitor HPCP panel Temperature, Pressure, RPM Gauges				x	
167	Monitor SSIP JAB Status Panel				x	
168	Operate WECP panel, STOP, TEST, MUTE, Dimmer controls				x	
169	Operate the LHC Controller device				x	

In addition to the specific TEV driver training tasks listed above, the CDT TEV shall train the specific crew coordination training tasks listed in the following paragraphs performed by the students, the performance assessed by the system and monitored by the instructor. The training tasks generally reflect the numerous and varied skills that comprise the task of operating a TEV (either the ABV, JAB or both). Table 11 includes the TV and TEV variant crew training tasks.

Table 11. Variant Crew Training Tasks						
	Crew Training Tasks:	**TV-M1A2 SEPv3**	**TV-M1A2 SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
1	Check Percent Power or Mission Capability Power				x	
2	Start/Stop Shutdown Launch Override Hydraulic Power Unit (HPU)				x	
3	Power Up/Power Down Bridge Control Panel (BCP)				x	
4	Launch/Recover Scissored MLC 70 Bridge				x	
5	Launch/Recover BLS (No Bridge)				x	
6	Launch MLC 70 Bridge				x	
7	Recover Launched MLC 70				x	
8	Recover Impacted Bridge				x	
9	Launch/Recover MLC 70 Bridge on Slope				x	
10	Launch/Recover MLC 70 Bridge in Wetlands or Marsh				x	
11	Operate JAB in Desert Environment				x	
12	Operate JAB in Extreme Heat				x	
13	Drive JAB in Extreme Dust, Sand, or Mud				x	
14	Operate JAB in Extreme Rain/Wind				x	
15	Respond to Indicators on CCIP JAB Status Panel				x	
16	Operate Front End Equipment (FEE)					x
17	Operate Lane Marking System (LMS)					x
18	Operate Remote Control System (RCS)					x
19	Operate Jettison System in Extreme Cold					x
20	Operate Linear Demolition Charge System (LDCS)					x
21	Operate Thermal Camera and Laser Rangefinder (TCALRF)					x
22	Operate ABV					x
23	Operate ABV (Start Engine)					x
24	Operate ABV (Make After-Start Checks)					x
25	Operate ABV (Drive ABV)					x
26	Operate Front End Equipment (FEE) in Extreme Cold					x

Table 11. Variant Crew Training Tasks						
	Crew Training Tasks:	**TV-M1A2 SEPv3**	**TV-M1A2 SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
27	Operate Lane Marking System (LMS) in Extreme Cold					x
28	Operate Remote Control System (RCS) in Extreme Cold					x
29	Operate Jettison System in Extreme Cold					x
30	Operate Linear Demolition Charge System (LDCS) in Extreme Cold					x
31	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Cold					x
32	Operate ABV in Extreme Cold					x
33	Operate ABV in Extreme Cold (Start Engine)					x
34	Operate ABV in Extreme Cold (Make After-Start Checks)					x
35	Operate ABV in Extreme Cold (Drive ABV)					x
36	Operate ABV in Desert Environment					x
37	Operate ABV in Extreme Heat					x
38	Operate Front End Equipment (FEE) in Extreme Heat					x
39	Operate Lane Marking System (LMS) in Extreme Heat					x
40	Operate Remote Control System (RCS) in Extreme Heat					x
41	Operate Jettison System in Extreme Heat					x
42	Operate Linear Demolition Charge System (LDCS) in Extreme Heat					x
43	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Heat					x
44	Operate ABV in Extreme Heat (Operate Engine)					x
45	Operate Front End Equipment (FEE) in Extreme Dust, Sand, or Mud					x
46	Operate Lane Marking System (LMS) in Extreme Dust, Sand, or Mud					x
47	Operate Remote Control System (RCS) in Extreme Dust, Sand, or Mud					x

Table 11. Variant Crew Training Tasks						
	Crew Training Tasks:	**TV-M1A2 SEPv3**	**TV-M1A2 SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
48	Operate Jettison System in Extreme Dust, Sand, or Mud					x
49	Operate Linear Demolition Charge System (LDCS) in Extreme Dust, Sand, or Mud					x
50	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Dust, Sand, or Mud					x
51	Operate ABV in Extreme Dust, Sand, or Mud (Drive ABV)					x
52	Operate ABV in Extreme Rain/Wind					x
53	Operate Front End Equipment (FEE) in Extreme Rain/Wind					x
54	Operate Lane Marking System (LMS) in Extreme Rain/Wind					x
55	Operate Remote Control System (RCS) in Extreme Rain/Wind					x
56	Operate Jettison System in Extreme Rain/Wind					x
57	Operate Linear Demolition Charge System (LDCS) in Extreme Rain/Wind					x
58	Operate Thermal Camera and Laser Rangefinder (TCALRF) in Extreme Rain/Wind					x

3.5 Specific Reconfigurable M1 Abrams Module Requirements

3.5.1 Simulated Driver Compartment

The CDT TV driver's compartment shall be reconfigurable between either the M1A1 SA or the M1A2 SEPV2/V3/V4 configuration of the M1 tank. In addition, the CDT TEV driver's compartment shall be reconfigurable between either the ABV or the JAB configuration.

The driver's compartment shall be composed of common components listed in this document and specific components listed in the following paragraphs depending on the configuration selected. The specific components shall be, to the maximum extent possible, easily installed and removed to configure the driver's compartment properly for the specific tank configuration. The specific hardware configuration along with the specific simulation software shall define the system (comprised of the driver's compartment and vehicle commander's station) as a M1A1 SA, a M1A2 SEPV2/V3/V4, an ABV, or a JAB simulator. The specific vehicle commander's

station displays and the specific driver's compartment configuration shall simulate the physical and functional characteristics of a M1A1 SA, a M1A2 SEPV2/V3/V4, an ABV, or a JAB with sufficient fidelity to adequately train the students in the training tasks listed in this document.

a. Storage of unused specific alternate configuration components shall provide with the M1 Abrams tank driver's compartment. The specific driver's compartment configuration shall replicate all instruments, indicators, gauges, controls, lights, circuit breakers, switches, displays, driver's hatch, and the components listed in the following paragraphs required to support the training tasks defined in this document.
b. All instruments, indicators, gauges, controls, lights, circuit breakers, switches, displays, driver's hatch, and components of the driver's compartment that are non-tactile (i.e. viewed but not touched) and not used for training shall be dimensionally accurate to within +/- 20%.
c. All tactile instruments, indicators, gauges, controls, lights, circuit breakers, switches, displays, driver's hatch, and components of the driver's compartment used for training shall be dimensionally accurate within a tolerance of +/- 0.25 inches.
d. The location within the tank driver's compartment of tactile and non-tactile components that are not use for training shall be located within 3.0 inches of their actual position.
e. All measurements shall make from a single reference point.
f. The CDT TV driver's compartment shall include mounting locations with all necessary hardware and electrical interfaces with all necessary cabling to support installation and use of the CDT TEV kit.

Items normally present in the driver compartment of the vehicle but not critical for training the required driver tasks shall present in mock-up form with the same size, shape, and location as the M1A2 components. Detachable devices (i.e. DVE night vision device) on the vehicles used to drive the tank shall also simulate. The driver's seat and headrest shall replicate to include all adjustments and range of motion available in the actual vehicle. The vehicle body, periscopes and, if appropriate, external frame assemblies shall functionally replicate to provide appropriate visual and human factor obstructions. The driver's compartment shall include a fresh air circulation and exchange system with sufficient airflow to maintain the internal temperature within ±5 degrees˚F of the temperature outside the driver's compartment. The simulated driver compartments shall be equipped with the decals and instructional plates visible in the driver's compartment of the vehicle with limitations of placing labels per M1A2. The simulated driver compartments shall be equipped with rear ingress/egress with a simulated turret traverse lock.

The CDT TV cab shall design such that reconfiguration by instructor/operator personnel between M1A1 SA configuration and the M1A2 SEPV2/V3/V4 configuration or vice versa can accomplish in less than 30 minutes, with a desired objective time of 15 minutes. Installation of either the ABV or JAB hardware specified in paragraph 3.5.1.1.31.7 and 3.5.1.1.31.8 into an M1A1 SA or M1A2 SEP configured driver's compartment shall accomplish in less than 30 minutes with an objective time of 15 minutes by instructor/operator personnel. The CDT TEV cab shall design such that reconfiguration by instructor/operator personnel between ABV configuration and the JAB configuration or vice versa can accomplish in less than 30 minutes, with a desired objective time of 15 minutes.

3.5.1.1 Driver's Compartment Subsystem Common Components

The driver's compartment subsystem shall simulate the common components of the Abrams driver's compartment listed in Table 12 and the following paragraphs.

Table 12. Driver Common Components

	Driver Common Components:	TV-M1A2	TV-M1A1	TEV-JAB	TEV-ABV
1	Hatch Assembly	x	x	x	x
2	Hatch Control Assembly	x	x	x	x
3	Center periscope with quick release handles	x	x	x	x
4	Two side periscopes	x	x	x	x
5	Steering, Throttle, and Transmission Control Assembly	x	x	x	x
6	Service Brake Pedal	x	x	x	x
7	Parking Brake Pedal and bracket	x	x	x	x
8	Parking Brake Release Handle	x	x	x	x
9	Periscope Washer Pump	x	x	x	x
10	Driver's seat	x	x	x	x
11	Driver's Head Rest	x	x	x	x
12	Hydraulic System Pressure Gauge	x	x	x	x
13	Intercommunication Control Set	x	x	x	x
14	Driver's Dome Light	x	x	x	x
15	Crew Fire Handle	x	x	x	x
16	Engine Fire Handle	x	x	x	x
17	Battle Override and Drain Valve Handles	x	x	x	x
18	Personnel Heater Diffuser Assembly	x	x	x	x
19	Personnel Heater Air Circulation Ventilator and Hose	x	x	x	x
20	Halon Tank	x	x	x	x
21	DVE Night Vision Device	x	x	x	x
22	Rear View Sensor System (RVSS)	x	x	x	x
23	Gas Particulate Filter (NBC System)	x	x	x	x
24	NBC System Hose & WYE Quick Disconnect	x	x	x	x
25	Turret Traverse Lock	x	x	x	x
26	Combat Vehicle Crew (CVC) Helmet	x	x	x	x

3.5.1.1.1 Hatch Assembly

The driver's hatch assembly shall physically and functionally replicate (i.e. location, dimensions, and movement) the driver's compartment hatch of the M1 tank. The hatch shall provide both open and closed hatch training. The hatch shall allow proper mounting, adjustment, and maintenance of the three periscopes. The center periscope shall employ the quick disconnect mounting for installation of the DVE device. The hatch shall open and close by the hatch control assembly. A latch mechanism shall provide to lock the hatch in the fully open position. The hatch shall be safety interlocked to the motion subsystem to allow motion only when the hatch is in a locked position (either fully closed and locked or fully open and locked).

3.5.1.1.2 Hatch Control Assembly

The hatch control assembly shall physically and functionally replicate (i.e. location, dimensions, and operation) the driver's compartment hatch control assembly in the M1 tank to allow opening and closing of the hatch assembly. The hatch-lifting handle with detent release button, and hatch crank handle with palm lever detent shall provide. The crank shall not rotate when the hatch-lifting handle is in the lowered position.

3.5.1.1.3 Center Periscope with Quick Release Handles

The center periscope shall be located in the same position and provide the same instantaneous (center and fixed head position) field of view as that provided by the center periscope in the M1 tank. The total field of view (with head motion) shall be 148 degrees (+/- 10%) horizontal and 49 degrees (+/- 10%) vertical. The mirror of the periscope (inside the compartment) shall be adjustable as in the operational unit. The center periscope shall attach to the hatch via a quick release mount that replicates the quick release mount on the M1 tank hatch.

3.5.1.1.4 Side Periscopes

The two-sided periscopes shall be located in the same position and provide the same instantaneous (center, fixed head position) field of view as that provided by the side periscopes in the M1 tank. The total field of view (with head motion) shall be 130 degrees (+/- 10%) horizontal and 49 degrees (+/- 10%) vertical. The mirror of the periscope (inside the compartment) shall be adjustable as in the operational unit. The two-sided periscopes shall be permanently mounted as in the M1 tank and only removable for maintenance.

3.5.1.1.5 Steering, Throttle, and Transmission Control Assembly

The Steering, Throttle, and Transmission Control Assembly from the M1 tank shall replicate both physically and functionally in the M1 driver's compartment. The steering and throttle control shall have the same dimensions, controls, range of motion and adjustments as the operational equipment. The simulation shall represent the appropriate force feel cues and deflection required for braking, stopping, and turning the vehicle. During turns, the steering angle shall alter the transfer of engine power to deliver greater force to the track on the outside of the turn. The turns shall represent by additional power applied to the outside track during these turns.

The steering control mechanical dead band shall be 4 degrees (+/- 2 degrees) located within +/- 7 degrees of true center. Breakaway force of the steering mechanism shall be 16 lbs. (+/- 2.5 lbs.) applied 7.5 inches for the centerline of the steering assembly. Ending force shall be 37.5 lbs. (+/- 4 lbs.) applied 7.5 inches from the steering assembly pivot axis. Specified breakaway and ending forces shall apply to deflection in either direction.

The throttle control shall have a dead band of 0 degrees. Maximum deflection shall be 62 degrees (+/- 6 degrees). Breakaway torque of the throttle control shall be 4 in-lbs. (+/- 2 in-lbs.). Ending torque shall be 10 in-lbs. (+/- 5 in-lbs.).

The transmission control assembly of the M1 tank shall replicate both physically and functionally in the CDT TV TEV driver's compartment. The transmission control shall have the same dimensions, controls, range of motion, and adjustments as the operational equipment. The transmission control shall provide 5 gear selections: N (Neutral); PVT (Pivot); R (Reverse); D (Drive); and L (Low). Transmission control selection shall modify the engine output and vehicle dynamics the same as it would in the actual vehicle. The two intercom press to talk buttons located on either side of the transmission control shall enable the student to talk over the communication subsystem, without removing his hands from the steering/throttle control, using the same functionality of the M1 tank.

3.5.1.1.6 Service Brake

The service brake pedal assembly shall replicate physically (location, dimensions and movement) and functionally the service brake pedal in the M1 tank. The amount of deflection on the brake pedal shall directly correlate to the additional resistance applied to the rotation of the vehicle tracks. Maximum deflection of the service brake pedal shall be 15 degrees (+/- 2 degrees). Breakaway force shall be 12.5 (+/- lbs) and the ending force shall be 54 lbs (+/- 8 lbs), both measured 10 inches from the pivot point.

3.5.1.1.7 Parking Brake Pedal and Bracket

The parking brake pedal assembly shall replicate physically and functionally the service brake pedal in the M1 tank. Pressing the parking brake pedal when it is not engage and the parking brake release handle is not pulled shall activate the parking brake aural cue and inhibit rotation of the tracks. The parking brake shall be functional at all times. Maximum deflection of the parking brake pedal shall be 9 degrees (+/- 2 degrees). Ending force shall be 51 lbs. (+/- 7.5 lbs.) measured on the pedal 7.25 inches from the parking brake pivot point. The parking brake shall be functional at all times and will not incur a software induced malfunction.

3.5.1.1.8 Parking Brake Release Handle

The parking brake release handle shall replicate physically and functionally the parking brake release handles in the M1 tank. Pulling the release handle shall disengage the parking brake, allowing the tracks to rotate and activating the parking brake release handle aural cue. Parking brake release handle shall be functional at all times. The force required to disengage the parking brake shall be 53 lbs. (+/- 8 lbs.). Total travel of the parking brake release handle shall be 5.75 in (+/- 0.8 in). The parking brake shall disengage at 5.5 in (+/- 0.8 in).

3.5.1.1.9 Periscope Washer Pump

The periscope washer foot pump shall replicate only in size and position as a space constraint. The periscope washer foot pump shall not be functional.

3.5.1.1.10 Driver's Seat

The CDT TV driver's compartment shall provide mounting points and hardware to accept installation of either the M1A2 SEPV2/V3/V4 driver's seat or the Drivers Mine Safety Seat/Autoflug (DMSS) driver's seat. When installed, the M1A2 SEPV2/V3/V4 driver's seat shall replicate the physical and functional characteristics of the driver's seat in the M1A2 SEPV2/V3/V4 tank with the exception of the handle and arm on the left side of the seat. The shorter handle and arm from the M1A2 SEPV2/V3/V4 shall install. When the M1A2 SEPV2/V3/V4 driver's seat installs, all adjustments and range of motion of the M1A2 SEPV2/V3/V4 driver's seat shall provide. When the Autoflug seat installs, all adjustments and range of motion of the Autoflug seat shall provide.

3.5.1.1.11 Driver's Headrest

The driver's headrest shall replicate the physical and functional characteristics of the driver's headrest in the M1A2 SEPV2/V3/V4 tank. All adjustments and range of motion of the M1 driver's headrest shall provide.

3.5.1.1.12 Hydraulic System Pressure Gauge

The hydraulic system pressure gauge shall replicate the hydraulic system pressure gauge in the M1 tank. The gauge shall be functional at all times. Normal operation shall indicate a pressure that varies between 1200 and 1800 pounds per square inch (psi) during normal operation. If either the loss of brakes malfunction or the loss of engine power malfunction activates, the pressure shall register less than 1000 PSI.

3.5.1.1.13 Intercommunication Control Set

The intercommunication control set shall replicate the physical and functional characteristics of the intercommunication control set C-12357/VRC. The volume, live and Voice Extension (VOX) controls shall be active.

3.5.1.1.14 Drivers Dome Light

The driver's dome light shall replicate the physical and functional characteristics of the M1 driver's dome light. The location in the M1A2 SEPV2/V3/V4 is over the driver's left shoulder.

3.5.1.1.15 Crew Fire Handle

The crew fire handle shall replicate physically and functionally. Pulling the crew fire handle shall simulate the activation of the crew fire extinguisher manual mode. Pulling the crew fire handle shall simulate the activation of the crew fire extinguisher shot aural cue. The crew fire extinguisher handle shall be active only once per training scenario.

3.5.1.1.16 Engine Fire Handle

The engine fire handle shall replicate physically and functionally. Pulling the engine fire handle shall simulate the activation of the engine fire extinguisher manual mode. The engine fire extinguisher handle shall be functional only once unless the instructor cancels the engine fire malfunction. Canceling of the engine fire malfunction shall simulate the "recharging" of the engine fire extinguisher and allow the engine fire extinguisher handle to be functional in the simulation one more time.

3.5.1.1.17 Battle Override and Drain Valve Handles

The battle overrides and drain valve levers shall replicate both physically and functionally in the driver's compartment. The drain valve lever operates the drain valve for the crew compartment. The battle override lever provides manual throttle control in combat emergency when normal electrical control is lost.

3.5.1.1.18 Personnel Heater Diffuser and Air Direction Controls

The personal heater diffuser and air direction controls on the left side of the driver's compartment shall replicate for size and location for space constraints but shall be non-functional.

3.5.1.1.19 Personal Heater Duct and Associated Components

The personal heater duct, air feed hose, louver mount and baffle control shall be replicated physically and functionally on the left side of the driver's compartment below the iDID.

3.5.1.1.20 Halon Tank

The halon tank and discharge valve on the right side of the driver's compartment shall be a graphical representation of the same size and colors that depicts the location in the driver's compartment.

3.5.1.1.21 DVE Night Vision Device

The DVE shall mount in a fixture that is interchangeable with the center hatch periscope and utilizes the quick release mounting. The DVE support shall replicate the size, shape, and adjustability of the operational system. A power and signal connector shall be provided on the right driver's compartment wall. The DVE shall replicate the image (field of view and image characteristics) of an M1 tank DVE. The gain, level, brightness, and white hot/black hot controls shall be operational and modify the displayed image as in the operational system. The M1A1 SA driver's compartment shall provide an area between the back driver's compartment wall and the mocked-up gas particulate filter for storage instead of storage in the loader's area of the turret. (Note: Artificial shortening of the gas particulate filter assembly is acceptable to accommodate storage.) DVE storage in the M1A2 SEPV2/V3/V4 is a shelf to the right of the driver's seat.

3.5.1.1.22 Rear View Sensor System (RVSS)

The RVSS display, mounting bracket and control box shall mount in the driver's compartment replicating the installation in M1 tank. The RVSS display, bracket and control box shall replicate the size, shape, and functionality of the operational system components. Power and/or

signal connectors shall provide to connect to the display unit and the control box. The RVSS display shall replicate the display image of an M1 tank (i.e. field of view, camera location and display information/overlays). The RVSS shall utilize the CDT image generation system to provide a real time, simulated infrared and computer generated image of the training data base(s). All controls on the display unit and control box shall replicate the functions on the operational units except for the "Reset/Config" button. Reset/Config button shall be non-functional (i.e. system always in Abrams configuration and not resettable).

3.5.1.1.23 Gas Particulate Filter (NBC System)

The gas particulate filter, part of the Nuclear, Biological, and Chemical (NBC) filter assembly, located in the left rear of the driver's compartment shall be a graphical representation of the same size and colors that depicts the location in the driver's compartment.

3.5.1.1.24 NBC System Hose and WYE Quick Disconnect

The NBC hose with WYE connector quick disconnect (including the assembly holder) shall replicate on the left side of the driver's seat. The hose shall supply an adequate supply of air to support operations using the NBC mask when proper NBC switch settings activate.

3.5.1.1.25 Turret Traverse Lock

The turret lock shall replicate the M1 turret lock. The turret lock shall be located outside the driver's compartment above the rear hatch. Start of training scenarios shall inhibit unless the turret lock is in the locked position.

3.5.1.1.26 Combat Vehicle Crew (CVC) Helmet

The tank driver's compartment shall include a (1) CVC helmet (P/N-A3206101-3, NSN-5965-01-397-7544) with communications system plug hook-up. Each head size of the CVC shall provide by the Government.

3.5.1.1.27 M1A1 SA Specific Driver's Compartment Components

The M1A1 SA driver's compartment configuration shall have the following components in addition of the common components of all variants:

a. Driver's Master Panel
b. Driver's Instrument Panel
c. Driver's Alert Indicator Panel

3.5.1.1.27.1 Driver's Master Panel

The driver's master panel shall replicate physically and functionally the driver's master panel in the M1A1 SA tank. All switches and indicators shall operate in accordance with TM 9-2350-264-10-1 (including Change 2) operators manual.

3.5.1.1.27.2 Driver's Instrument Panel

The driver's instrument panel shall replicate physically and functionally the driver's instrument panel in the M1A1 SA tank. All switches, gauges and indicators, alarms and alerts shall operate

in accordance with TM 9-2350-264-10-1 (including Change 2) operators manual with the exception of the following:

a. Transmission Damaged Inspect light - Illuminates red only when the panel light test pushbutton on the driver's master panel presses.
b. Low Battery Charge light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
c. Cable Disconnected light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
d. Circuit Breaker Open light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
e. G/T Drive Inhibit Fault light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
f. Engine Oil Clogged Filter light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
g. Transmission Oil Clogged Filter light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
h. Primary Fuel Clogged Filter light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
i. Air Cleaner Clogged Filter light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
j. Rear Fuel Pump-R Inoperative light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.
k. Rear Fuel Pump-L Inoperative light - Illuminates yellow only when the panel light test pushbutton on the driver's master panel is pressed.

3.5.1.1.27.3 Driver's Alert Indicator Panel

The Driver's Alert Indicator Panel shall replicate physically and functionally the Driver's Alert Indicator Panel in the M1A1 SA tank. All switches and indicators shall operate in accordance with TM 9-2350-264-10-1 (including Change 2) operator's manual with the exception of the G/T DRIVE ACTIVE HATCH OPEN light which shall only illuminate red when the Panel Light Test pushbutton on the Driver's Master Panel is pressed.

3.5.1.1.28 M1A2 SEP Specific Driver's Compartment Components

The M1A2 SEP Driver's Compartment configuration shall contain upgraded driver's displays.

3.5.1.1.29 M1A2 SEP V2 Specific Driver's Compartment Components

The M1A2 SEPV2/V3/V4 driver's compartment configuration shall contain the Improved Driver's Integrated Display (iDID) in addition to the common components of paragraph 3.5.1.1 – Driver's Compartment Subsystem Common Components. The iDID is a component in the M1A2 SEPV2/V3/V4 tank that provides the driver with tank operation and driving information through a programmable display and allows the driver to select menus and specific functions though a set of pushbuttons. The iDID shall replicate in a housing on the left side of the driver's compartment. The housing shall replicate the overall dimensions and position of the operational system housing. The iDID is composed of two separate panels with pushbuttons, a display, and

a guarded switch. The dimensions of the panels and the size and spacing of all of the components on the panels shall replicate the iDID in the M1A2 SEPV2/V3/V4 tank. The action and tactile feel of the pushbuttons shall replicate. The display resolution and color shall replicate. The guarded switch size and action shall replicate. The pushbuttons, switch, display and menus of the iDID shall operate in accordance with TM 9-2350-388-10-1 change 6 and TM 9-2350-388-10-2 change 6 Appendix L with the exception of the APU, NATO UTL Power, APU Emergency and AC menus which shall be non-functional.

3.5.1.1.30 M1A2 SEP V3 Specific Driver's Compartment Components

The M1A2 SEPV3 driver's compartment configuration shall contain the Drivers Control and Display Panel (DCDP) in addition to the common components of paragraph 3.5.1.1 – Driver's Compartment Subsystem Common Components. The DCDP is a component in the M1A2 SEPV3 tank that provides the driver with tank operation and driving information through a programmable display and allows the driver to select menus and specific functions though a set of pushbuttons. The DCDP shall replicate in the left side of the driver's compartment. The DCDP housings shall replicate the overall dimensions and position of the operational system housing. The DCDP are composed of two separate panels with pushbuttons, a display, and a guarded switch. The dimensions of the panels and the size and spacing of all of the components on the panels shall replicate those in the M1A2 SEPV3 tank. The action and tactile feel of the pushbuttons shall replicate. The display resolution and color shall replicate. The guarded switch size and action shall replicate. The pushbuttons, switch, display and menus of the DCDP shall operate in accordance with TM 9-2350-388-10-1 change 6 and TM 9-2350-388-10-2 change 6 Appendix L with the exception of the APU, NATO UTL Power, APU Emergency and AC menus which shall be non-functional.

3.5.1.1.31 Additional Driver's Compartment Components

In addition, the following components not found in the M1 tank but required to provide adequate training and safety shall provide:

3.5.1.1.31.1 Emergency lighting

The CDT TV driver's compartment shall have an emergency, battery operated light that provides sufficient lighting for rapid and safe exit during emergency conditions.

3.5.1.1.31.2 Fresh Air Circulation Exchange

The driver's compartment shall have constant, fresh, and forced air circulation to minimize driver stress.

3.5.1.1.31.3 Fire Detection/Warning System

A smoke detector shall be located inside the driver's compartment. The smoke detector shall interface with the CDT smoke and fire detection system to initiate proper simulator action if smoke or fire detects. The driver's compartment shall have an audio and visual alarm (prominently visible to the driver) that interfaces with the CDT smoke and fire detection system to alert the driver to an emergency condition.

3.5.1.1.31.4 Emergency Stop and Shutdown

There shall be an emergency shutdown switch and it is accessible by the driver. The emergency shutdown switch shall interface with the CDT emergency shutdown system.

3.5.1.1.31.5 Hatch Interlock

There shall be a tank driver's compartment hatch interlock. The hatch interlock shall inhibit any motion system response to simulation control inputs and settle the motion system to the fully lowered position in a controlled manner when either the fully open or fully closed hatch locks are disengaged.

3.5.1.1.31.6 Optional Tank Equipment

The CDT TV shall provide for the tank to optionally configure with a Mine Clearing Blade or a Mine Roller Kit.

When the blade simulates, the tank driver shall have the capability to raise or lower the mine clearing blade from within the driver's compartment utilizing the Mine Clearing Controls and Indicators Box (MCCIB). The MCCIB shall be located in the proper location in the M1A1 SA and the M1A2 SEPV2/V3/V4 driver's compartment configuration. The top of the blade support frame that is visible above the front hull in the driver's field of view shall be visible in the CDT TV and shall react visually to the use of the raise and lower switches on the MCCIB from maximum height to fully lower. The Mine Clearing Blade and its' visible support frames shall react appropriately (dynamically and visually) when a simulated mine is set off by the blade. The vehicle dynamics shall react appropriately to the additional weight and the resistance to driving and steering according to whether the blade is in the raised or lowered position. When the mine clearing blade raises or lowers by actuation of the MCCIB, the proper aural cue shall provide. When mine clearing blade is digging into the ground, the proper aural cue shall present to the driver's compartment.

When the roller is simulates, the tank driver shall have the capability to disconnect the mine roller kit from within the driver's compartment using the Mine Roller Control Box (MRCB). The MRCB shall be located in the proper location in the M1A1 SA and the M1A2 SEPV2/V3/V4 driver's compartment configuration. The top of the roller support frame that is visible above the front hull in the driver's field of view shall be visible in the CDT TV and shall react visually to the use of the MRCB. The Mine Roller and its' visible support frames shall react appropriately (dynamically and visually) when a simulated mine is set off by the roller. The vehicle dynamics shall react appropriately to the additional weight and the resistance to driving and steering when the roller is connected. When the mine roller disconnects by actuation of the MRCB, the proper aural cue shall provide. When the roller is rolling on the ground, the proper aural cue shall present to the driver's compartment.

3.5.1.1.31.7 ABV Specific Driver's Compartment Components

The CDT TEV kit shall include the following ABV specific components:

a. Multipurpose Control Unit (MCU)
b. Remote Multipurpose Control Unit (RMCU)

3.5.1.1.31.7.1 Multipurpose Control Unit (MCU)

The Multipurpose Control Unit (MCU) shall replicate physically and functionally the Multipurpose Control Unit in the ABV. All switches and indicators shall operate in accordance with TM 10984AOR/3 Front End Equipment operator's manual.

3.5.1.1.31.7.2 Remote Multipurpose Control Unit (RMCU)

The Remote Multipurpose Control Unit (RMCU) shall replicate physically and functionally the Remote Multipurpose Control Unit in the ABV. All switches and indicators shall operate in accordance with TM 10984AOR/3 Front End Equipment operator's manual.

3.5.1.1.31.8 JAB Specific Driver's Compartment Components

The CDT TEV kit shall include the following JAB specific components:

a. Launcher Panel
b. Launcher Indicator Panel
c. Hydraulic Power Unit Control Panel

3.5.1.1.31.8.1 Launcher Indicator Panel (LIP)

The Launcher Indicator Panel shall replicate physically and functionally the LIP in the JAB. All switches and indicators shall operate in accordance with TM 11374AOR/1 operator's manual dated March 31, 2008.

3.5.1.1.31.8.2 Launcher Panel (LP)

The Launcher Panel shall replicate physically and functionally the LP in the JAB. All switches and indicators shall operate in accordance with TM 11374AOR/1 operator's manual dated 31 March 2008.

3.5.1.1.31.8.3 Hydraulic Power Unit Control Panel (HPUCP)

The Hydraulic Power Unit Control Panel shall replicate physically and functionally the HPUCP in the JAB. All switches and indicators shall operate in accordance with TM 11374AOR/1 operator's manual dated March 31, 2008.

3.5.1.1.31.9 Vehicle Commanders Station

The CDT TEV shall include a vehicle commander's station capable of training crew coordination tasks by using a crew intra-vehicular communication system, a front periscope view visual display, a sensor (IVS or VES) visual display and a touchscreen displays capable of simulating various vehicle commander's controls and indicators. The vehicle commander's station shall consist of a workstation with the periscope and sensor display mounted in the center

front of the commander. The touchscreen displays shall be mounted either side of the sensor display. The crew intra-vehicular communication system shall replicate the intercom system in the ABV and the JAB. The touchscreen displays shall include graphical, interactive simulations for the following vehicle commander's controls and indicators:

ABV:

a. Lane Marking System (LMS) Control Unit
b. Commander's Control Unit (CCU)
c. Upgraded Tank Commander's Panel (UTCP)
d. Linear Charge Demolition System (LCDS) Control Box
e. Integrated Vision System (IVS) Control Panel
f. IVS Display Controls
g. Communications Control Box

JAB:

a. Upgraded Tank Commander's Panel (UTCP)
b. Vision Enhancement System (VES) Control Panel
c. VES Display Controls
d. Communications Control Box

3.5.2 Vehicle Simulation

3.5.2.1 Vehicle Dynamics Performance TV and TEV

The CDT TV shall simulate the M1 Abrams tank vehicle dynamics to the level of detail required to support the training tasks in paragraph 3.4 – Variant Requirements. Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g. engine and transmission), suspension (e.g. springing, damping and range of travel), and the rigid hull of the M1A1 tank. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

The vehicle dynamics of the CDT TV shall meet the performance requirements for the critical maneuvers within +/- 10%. The critical maneuvers and the performance requirements define in the following tables.

1) The definitions for the critical maneuvers for vehicle dynamics are as listed in Table 13.

Table 13. Vehicle Variant Performance Parameters

Vehicle Parameter	Test No.	Time (secs)	Trans Range	Throttle	Brake	Steering	Terrain Slope	Test Parameter		Comments
Performance Description										
OV speed at idle in surface drive on flat surface	T2	35.0	Drive	Idle	Off	0.0	0.0	Vehicle speed		The duration of the test is 35 seconds, for the first 2 seconds the vehicle is at rest (in neutral at idle). At t = 2 seconds set the transmission to drive. Determine the vehicle speed after accelerating for 33 seconds
OV speed at idle in low on flat surface	T3-1	35.0	Low	Idle	Off	0.0	0.0	Vehicle speed		The duration of the test is 35 seconds, for the first 2 seconds the vehicle is at rest (in neutral at idle). At t = 2 seconds set the transmission to drive. Determine the vehicle speed after accelerating for 33 seconds
OV speed at ½ throttle in low on flat surface	T3-2	33.0	Low	0.5	Off	0.0	0.0	Vehicle speed		The duration of the test is 33 seconds, for the first 2 seconds the vehicle is at rest (in neutral at idle). At t = 2 seconds set the transmission to low and throttle to 50%. Determine the vehicle speed after accelerating for 31 seconds
OV speed at full throttle in low on flat surface	T3-3	33.0	Low	1.0	Off	0.0	0.0	Vehicle speed		The duration of the test is 33 seconds, for the first 2 seconds the vehicle is at rest (in neutral at idle). At t = 2 seconds set the transmission to low and throttle to 100%. Determine the vehicle speed after accelerating for 31 seconds
OV braking distance from 25 MPH	T5	-	Low	1.0	Off	0.0	0.0	Vehicle speed		Vehicle accelerates until it reaches 25 MPH
		-	Low	Idle	On	0.0	0.0	Braking distance		After reaching 25 MPH full brake is applied and throttle returned to idle. Braking distance is determined from vehicle position when it reaches 25 MPH until it comes to rest.
OV climbing and stopping on hill	T7	30.0	Low	1.0	Off	0.0	(1)	Track speed	Vehicle speed	Climbing speed of vehicle after 20 seconds on a hill of slope specified in Table III.2 for the terrain type under test.
		35.0	Low	Idle	On	0.0	(1)	Vehicle speed		At 35.0 seconds, the brake is fully applied, does the vehicle come to rest on the

NOTE:

1. The slope of the hill depends on the terrain type (see Table 14)
2. The steering angle is not constant with time. It chooses to match the test driver input steering angle.

b. The vehicle dynamics performance for the critical maneuvers is as follows:

Table 14. Vehicle Dynamics Performance for the Critical Maneuvers

Performance Description	Idle Speed in Drive	Idle Speed in Low	Half-Throttle Speed at 31 sec.	Full-Throttle Speed at 31 sec.	Brake Distance	Hill Climbing Maximum Slope				Turn Radius	Lateral Velocity	Initial Speed	Delta Speed	Pivot Radius
	(MPH)	(MPH)	(MPH)	(MPH)	(Feet)	Max. Speed	Track Speed (MPH)	Grnd Speed (MPH)	Stop on Hill	(Feet)	(Ft/Sec)	(MPH)	(MPH)	(Feet)
Terrain Type														
Pavement	2.69	2.47	21.84	36.20	40.15	0.540	4.89	4.09	Yes	24.61	-0.1496	13.89	-11.21	2.11
Dirt	1.17	1.34	19.42	33.24	44.89	0.400	7.80	5.72	Yes	19.50	-0.2177	11.99	-8.70	3.92
Sand	0.59	0.96	18.59	32.35	45.62	0.110	19.90	18.78	Yes	18.84	-0.2219	11.41	-8.14	4.24
Mud	0.00	0.51	17.80	31.14	51.58	0.350	8.92	4.76	Yes	23.81	-0.128	7.21	-3.77	19.88
Rock	0.61	0.93	18.56	32.06	56.55	0.280	10.89	6.79	Yes	26.44	-0.1361	11.39	-7.84	2.73
Grass	0.77	1.10	18.85	32.74	40.21	0.450	5.66	4.6	Yes	20.08	-0.1601	11.62	-8.7	2.54
Wet Pavement	2.65	2.43	21.80	35.99	44.87	0.430	7.65	4.47	Yes	5.68	-0.3686	13.83	-10.35	3.00
Wet Dirt	0.69	1.02	18.69	32.37	45.25	0.340	9.38	7.30	Yes	22.02	-0.1549	11.51	-8.22	3.46
Wet Sand	0.00	0.14	17.22	30.79	40.58	0.420	5.91	4.37	Yes	10.36	-0.2130	7.04	-4.07	2.22
Wet Mud	0.00	0.00	2.79	10.65	13.58(1)	0.025	14.59	8.44	Yes	4.01	0.00	0.42	-0.39	4.52
Wet Rock	0.00	0.00	16.49	29.60	61.40	0.230	11.9	7.09	Yes	28.13	-0.1069	6.76	-3.36	6.40
Wet Grass	0.00	0.30	17.42	31.02	43.25	0.230	11.90	10.45	Yes	11.09	-0.2265	7.13	-3.93	2.72
Ice	2.62	2.12	20.15	28.84	172.33	0.072	31.48	5.66	Yes	21.45	-0.9630	14.69	-9.26	3.38
Snow	0.08	0.49	17.55	30.07	72.48	0.140	17.50	11.85	Yes	9.99	-0.3875	10.71	-6.50	2.43

NOTE:

1. Braking distance on this surface is from maximum vehicle speed attainable on this surface.

c. The vehicle dynamics performance for critical maneuvers in various desert sand types are as shown in Table 15:

Table 15. Variant Terrain Types

Terrain Type	Dry Pavement	Packed Sand	Wet Sand	Loose Sand	Soft Sand
Idle Speed in Drive (MPH)	2.48	1.53	0.44	0.0	0.0
Idle Speed in Low (MPH)	2.55	2.21	1.89	1.20	0.27
Half Throttle Speed in Low (MPH)	22.83	20.70	18.77	14.13	11.09
Full Throttle Speed in Low (MPH)	38.42	35.66	33.59	29.70	24.66
Brake Distance (Feet)	38.77	44.49	42.11	45.02	33.26
Hill Climb: Max Slope	0.54	0.400	0.42	0.37	0.16
Hill Climb: Vehicle Speed (MPH)	4.55	4.99	4.19	4.15	9.08
Hill Climb: Track Velocity (MPH)	5.38	7.59	6.66	7.64	12.20
Hill Climb: Stop on Hill (Yes/No)	Yes	Yes	Yes	Yes	Yes
Turn Radius (Feet)	27.70	27.18	28.39	37.80	46.61
Lateral Velocity (ft/sec)	-0.53	-1.03	-0.42	-0.20	-0.09
Initial Speed (MPH)	14.02	12.67	11.35	9.14	7.48
Delta Speed (MPH)	-5.29	-2.63	-2.17	-1.03	-0.56
Pivot Radius (Feet)	2.10	19.44	20.91	0.00	0.00

The CDT TEV shall simulate the ABV and JAB vehicle dynamics to the level of detail required to support the training tasks in paragraph 3.4 – Variant Requirements. Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The threshold vehicle dynamics simulation for the CDT TEV shall provide models of the power train (e.g. engine and transmission), suspension (e.g. springing, damping and range of travel), and the rigid hull of the M1 tank. The parameters for these models shall evaluate at 60 Hertz (Hz) to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment and the out the window display at the vehicle commander's station. The CDT TEV shall utilize the vehicle dynamics model used in the CDT TV with pertinent parameter changes for vehicle configuration, weight, weight location, and moments of inertia.

The vehicle dynamics of the CDT TEV shall meet the performance requirements for the critical maneuvers for this SRD appendix, with variations for the differences in pertinent vehicle parameters.

3.5.2.2 Engine Model

The following operational parameters of the engine shall simulates:

a. Engine torque - The engine output torque shall be derived as a function of engine speed and load due to terrain topography, tractability, and throttle angle.

b. Engine speed - The rotational speed of the engine shall be determined as a function of throttle position, load torque and engine/transmission inertia. The RPM gauge and the ENGINE OVERSPEED indicator in the driver's compartment and the engine speed aural cue shall drive by this output.

c. Fuel consumption - The fuel consumption shall be determined as a function of throttle position. The fuel level in the rear fuel tank shall be determined by subtracting the fuel used from the amount of fuel remaining in the tank. The fuel gauge in the driver compartment shall drive by the amount of fuel remaining in the tank specified by the position of the tank selector switch (right front, left front, or rear). The fuel system model shall include the following fuel tank capacities:

    1. Left Front - 105 gallons
    2. Right Front - 150 gallons
    3. Rear - 248 gallons

All fuel tanks shall be full at the start of each training scenario. Activation of the low fuel malfunction shall reduce the fuel level in the rear tank as described in paragraph 3.5.3.a.7 – Low Fuel. Fuel transfers from the front tanks to the rear tank shall occur at a rate of 12 gallons per minute (+/- 10%).

3.5.2.3 Transmission Model

The following output parameters of the transmission shall simulate:

a. Gear selections - The gear selections shall determine by the position of the transmission SHIFT CONTROL on the steering/throttle control, the vehicle speed and the throttle angle. The gear selection shall limit the range of output of the transmission dynamics model as appropriate for the selected gear.

b. Shaft RPM - The shaft RPM at the output of the transmission shall be determined from the engine speed and gear selection. The vehicle speed gauge in the driver compartment shall drive from this output.

3.5.2.4 Steering and Brake Model

The steering and brake model shall modify the outputs of the transmission model to determine the applied force on each track. The steering angle shall alter the transfer of engine power to deliver greater force to the track on the outside of the turn. Additional power shall apply to the outside track during turns to simulate the regeneration of power from the inside track.

The position of the service brake pedal and the engaged/disengaged status of the parking brake shall be input to the brake model. Appropriate brake force shall be determined and applied to inhibit the rotation of the transmission drive shaft.

3.5.2.5 Steering and Brake Model- TEV

The Steering and Brake Model specified in paragraph 3.5.2.4 – Steering and Brake Model shall modify to account for any differences between the M1 steering and braking forces and the ABV or JAB steering and braking forces.

3.5.2.6 Suspension Model

The model of the suspension system shall include computation of the forces acting on the suspension components. The effects of the terrain, including slope and height shall combine with the forces due to the mass and momentum of the hull to determine the suspension force acting on the rigid hull. Pitch torque and roll torque shall compute as inputs to the hull model by transferring the combined forces on the own vehicle through the damping and spring characteristics of the suspension.

3.5.2.7 Suspension Model-TEV

The Suspension Model specified in paragraph 3.5.2.6 – Suspension Model shall modifies to account for any differences between the M1 suspension and the modified suspension systems used on the ABV and JAB.

3.5.2.8 Hull Model

The position, velocity, and acceleration of the own vehicle center of gravity shall be determined in six degrees of freedom by the hull model. Inputs from the power train, suspension, and terrain

models shall combine to resolve the updated vehicle position and derive the velocities and accelerations.

3.5.2.8.1 Hull Model- TEV

The Hull Model specified in paragraph 3.5.2.8 – Hull Model shall modifies to account for any differences between the M1 hull and the ABV or JAB hulls.

3.5.2.8.2 Physics-Based Ownship Models (priced option) - TEV

In addition to the models specified in paragraphs 3.5.2.2 – Engine Model through 3.5.2.8 – Hull Model, the CDT TEV shall have an objective to develop physics-based ownship models for the ABV and JAB. The physics-based models shall be capable of altering CDT TEV hardware and software responses to real-time changes in terrain types, loading on vehicle components such as tracks, suspension and front end equipment, and environmental conditions. Hardware and software responses shall include, but not be limited to, changes in aural cue pitch and volume, changes in steering and braking feel and response, and changes in motion platform response.

3.5.2.9 Tank Collision Model

The simulated tank collision model shall include the tank hull, turret and gun tube. The tank collision model shall react with the following exceptions:

a. Turret – The turret shall detect a major collision if the turret encounters a major collision object at any vehicle speed including 0 mph (tank stopped and rotating the turret).

b. Gun Tube -

1) The gun tube shall detect a major collision if the gun tube contacts a major collision object at any vehicle speed including 0 mph (tank stopped and rotating the turret).

2) The gun tube shall detect a minor collision if the gun tube contacts a minor collision object at any vehicle speed including 0 mph (tank stopped and rotating the turret).

3) The gun tube shall detect a major collision if the gun tube contacts the ground at any vehicle speed including 0 mph (tank stopped and rotating the turret).

3.5.3 Malfunctions and Emergency Conditions

The CDT TV shall meet the requirements listed in the following list of malfunctions and emergency conditions for the M1 tank. All the malfunctions and emergency conditions listed herein shall present the appropriate feedback (e.g. abnormal vehicle dynamics, instrument readings, and aural cues) to the driver trainee consistent with the operation and performance of the M1 tank. For the M1A1 SA Malfunction and Emergency Conditions, all relevant driver's compartment indicator's and warnings shall operate in accordance with (IAW) TM 9-2350-264-10-1 (M1A1 Operator's Manual) and TM 9 2350-264-10-1 Change 2 (M1A1 Operator's Manual Change 2). For the M1A2 SEPV2/V3/V4, all relevant warning verbal messages, caution alert tones and iDID indications shall operate IAW TM 9-2350-388-10-1 Change 6 (M1A2 SEP Operator's Manual, Change 6). All malfunctions and emergency conditions listed below shall program to activate at specified points in pre-programmed scenarios or initiated and cleared by

the instructor in free play scenarios unless otherwise specified herein. The CDT TV shall include the following malfunctions and emergency conditions:

a. Malfunction and Emergency Condition Indications:

1) Engine Fire - Activation of the engine fire malfunction shall only be possible when the engine is running. There shall be three engine fire scenarios, each having an equal probability of occurrence when the engine fire malfunction is active.

a) Fire activation with successful automatic 1st Shot activation - M1A1 SA - MASTER CAUTION light and 1st SHOT DISCHARGED light are ON and MASTER WARNING light and ENGINE FIRE light are OFF. M1A2 SEP V2 – An alert tone will be heard, the FIRST SHOT DISCHARGED caution message and engine fire icon appear on the iDID or DCDP)

b) Fire activation with ineffective automatic 1st Shot activation - M1A1 SA - MASTER CAUTION light and 1st SHOT DISCHARGED light are ON and MASTER WARNING light is ON and ENGINE FIRE light is flashing. M1A2 SEP V2 – An alert tone will be heard, the FIRST SHOT DISCHARGED caution message and icon appear on the iDID or DCDP then MAIN ENGINE FIRE warning message and icon is displayed on iDID or DCDP).

c) Fire activation without automatic 1st Shot activation - M1A1 SA - MASTER WARNING light is ON, ENGINE FIRE light is flashing and 1st SHOT DISCHARGED light did not light. M1A2 SEP V2 – MAIN ENGINE FIRE warning message and engine fire icon appear on the iDID and the FIRST SHOT DISCHARGED caution message and icon did not appear on the iDID OR DCDP.)

The engine shutdown sequence shall automatically initiates 30 seconds after the start of the engine fire malfunction if not initiated by the trainee. Attempts to restart the engine while the malfunction is active shall result in an abort. The engine fire malfunction shall cancel by instructor command.

2) Loss of Engine Power – Activation of the loss of engine power malfunction shall result in a lack of engine response to the throttle control and reduction of the maximum engine speed to idle speed with appropriate power output to the tracks. In addition, response to steering and service brake inputs shall reduce by 50% and the hydraulic pressure gauge shall have a low pressure reading (less than 1000 psi) to simulate the loss of hydraulic pressure. If the engine is shut-off, attempts to restart while the malfunction is active shall result in an abort. The loss of engine power malfunction shall cancel by instructor command.

3) Loss of Steering – Activation of the loss of steering malfunction shall result in a loss of response to steering inputs. The loss of steering malfunction shall cancel by instructor command.

4) Loss of Brakes – Activation of the loss of brakes malfunction shall result in a lack of response to the service brake pedal and the illumination of the HYDRAULIC SYSTEM MALFUNCTION indicator (indicating less than 1000 psi hydraulic pressure) whenever master power is on. The loss of brakes malfunction shall cancel by the instructor.

5) Loose Track – The loose track malfunction is not selectable in either preprogrammed or free run scenarios. A loose track shall indicate by a series of jolts with corresponding stiffening in the steering while moving and activation of the throwing track aural cue. The jolts, steering stiffness, and aural cue shall continue until the condition that caused the loose track indication no longer exists. The loose track indication shall initiate when the following conditions exist:

a) Vehicle on mud or sand, and vehicle pivoting continuously for at least 60 degrees
b) Vehicle on mud or sand; transmission selection of Reverse (R), Low (L) or Drive (D); speed less than 10 miles per hour (MPH); steering angle exceeding 50%; and the vehicle turning continuously for at least 80 degrees
c) Vehicle moving and the roll angle exceed 22 degrees.

6) Thrown Track – Activation of the thrown track malfunction shall result in the thrown track aural cue activating for three seconds followed by the loss of drive to one set of tracks and the loss of steering control. After activation, the thrown track malfunction shall cancel by the instructor.

7) Low Fuel – Activation of the low fuel malfunction shall result in the rear tank reduce to 1/8 of capacity over a period of ten minutes. When the fuel level in the rear tank reaches 1/8 of capacity, the LOW FUEL LEVEL light shall illuminate. The low fuel malfunction shall be cancelled either by the driver transferring enough fuel from either front tank to fill the rear tank to at least 3/8 full or by instructor command. Cancellation by instructor command shall cause the fuel level in the rear tank to reset to full.

8) Engine Over Speed - Activation of the engine over speed malfunction shall only be possible when the engine is running and the throttle is applied. When activated, the engine speed shall be forced above 3100 revolutions per minute (RPM) and the ENGINE OVERSPEED light shall illuminate (M1A1 SA) or an alert tone is heard and the ENGINE OVERSPEED caution message is displayed on the iDID or DCDP (M1A2 SEPV2/V3/V4). 30 seconds after activation, the engine shutdown sequence shall initiate unless the student completes the response to the malfunction. Attempts to restart the engine while the malfunction is active

shall result in an abort. The engine over speed malfunction shall cancel by completing the response to the malfunction or by instructor command.

9) Gas Over Temperature - Activation of the gas over temperature malfunction shall only be possible when the engine is running. When activated, the GAS OVERTEMP indicator shall illuminate. The engine shutdown sequence shall begin 30 seconds after activation unless the student completes the response to the malfunction. Attempts to restart the engine while the malfunction is active shall result in an abort. The malfunction shall cancel by completing the response to the malfunction or by instructor command.

10) Low Engine Oil Pressure - Activation of the low engine oil pressure malfunction shall only be possible when the engine is running. When activated, the ENGINE OIL PRESSURE LOW indicator shall illuminate in the M1A1 SA or an alert tone will sound, a verbal warning message shall transmit over the intercom and the ENGINE OIL PRESSURE LOW warning message shall display on the iDID or DCDP display for the M1A2 SEPV2/V3/V4. The engine shutdown sequence shall automatically begin 30 seconds after activation unless the student completes the response to the malfunction. Attempts to restart the engine while the malfunction is active shall result in an abort. The malfunction shall cancel by instructor command.

11) High Engine Oil Temperature - Activation of the high engine oil temperature malfunction shall only be possible when the engine is running. When activated, the ENGINE OIL TEMPERATURE HIGH indicator shall illuminate in the M1A1 SA or an alert tone will sound, a verbal warning message will transmit over the intercom and the ENGINE OIL TEMPERATURE HIGH warning message shall display on the iDID or DCDP display for the M1A2 SEPV2/V3/V4. The engine shutdown sequence shall automatically begin 30 seconds after activation unless the student completes the response to the malfunction. Attempts to restart the engine shall result in an abort. The malfunction shall cancel by completion of the response to the malfunction or by instructor command.

12) High Transmission Oil Temperature - Activation of the high transmission oil temperature malfunction shall only be possible when the engine is running. When activated, the TRANSMISSION OIL TEMPERATURE HIGH indicator shall illuminate in the M1A1 SA or an alert tone will sound, a verbal warning message shall transmit over the intercom and the TRANSMISSION OIL TEMPERATURE HIGH warning message shall display on the iDID or DCDP display for the M1A2 SEPV2/V3/V4. The engine shutdown sequence shall automatically begin 30 seconds after activation unless the student completes the response to the malfunction. Attempts to restart the engine shall result in an abort. The malfunction shall cancel by completion of the response to the malfunction or by instructor command.

13) Low Transmission Oil Pressure - Activation of the low transmission oil pressure malfunction shall only be possible when the engine is running. When activated, the TRANSMISSION OIL PRESSURE LOW indicator shall illuminate in the M1A1 SA or an alert tone will sound, a verbal warning message shall transmit over the intercom and the TRANSMISSION OIL PRESSURE LOW warning message shall display on the iDID or DCDP display for the M1A2 SEPV2/V3/V4. The engine shutdown sequence shall automatically begin 30 seconds after activation unless the student completes the response to the malfunction. Attempts to restart the engine while the malfunction is active shall result in an abort. The malfunction shall cancel by instructor command.

b. Malfunction and Emergency Condition Responses

1) Engine Fire

a) Fire activation with successful automatic 1st shot activation – When this emergency condition executes during a scripted or free play scenario, the trainee shall execute the following sequences of responses, in the correct order and within 30 seconds for a satisfactory score:

(1) Set THROTTLE to idle
(2) Halt tank with service brake
(3) Set SHIFT CONTROL to Neutral (N)
(4) Set PARKING BRAKE

b) Fire activation with ineffective 1st shot activation - When this emergency condition executes during a scripted or free play scenario, the trainee shall execute the following sequences of responses, in the correct order and within 30 seconds for a satisfactory score:

(1) Set THROTTLE to idle
(2) Halt tank with service brake
(3) Set SHIFT CONTROL to Neutral (N)
(4) Set PARKING BRAKE
(5) Open cover over 2nd SHOT switch and move 2nd SHOT switch to rear
(6) The 2nd SHOT switch must remain in the rear position for at least 18 seconds for the 2nd SHOT bottle activates.

c) Fire activation without automatic 1st shot activation - When this emergency condition executes during a scripted or free play scenario, the trainee shall execute the following sequences of responses, in the correct order and within 30 seconds for a satisfactory score:

(1) Notify Tank Commander of engine fire
(2) Pull ENGINE FIRE T-handle

(3) Set THROTTLE to idle
(4) Halt tank with service brake
(5) Set SHIFT CONTROL to Neutral (N)
(6) Set PARKING BRAKE
(7) If ENGINE FIRE light remains ON
(8) Open cover and move 2nd SHOT switch to rear

2) Loss of Engine Power – When the loss of engine power malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)

3) Loss of Steering - When the loss of steering malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)

4) Loss of Brakes - When the loss of brakes malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Steer tank and coast to a stop
d) Set PARKING BRAKE when speed less than 3 mph
e) Set SHIFT CONTROL to Neutral (N)

5) Loose Track - When the conditions for a loose track malfunction are in effect during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds of the start of the throwing track aural cue for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Center Steering Control

d) Halt tank

6) Thrown Track - When a thrown track malfunction executes (indicated by loss of drive to one track) during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Center Steering Control
d) Halt tank

7) Low Fuel - When the Low Fuel indication illuminates (approximately ten minutes after executing the low fuel malfunction) during a scripted or free play scenario, the trainee shall execute the following sequence of responses for a satisfactory score:

a) Move TANK SELECTOR switch to RIGHT FRONT or LEFT FRONT
b) Press RESET button
c) Halt tank
d) Transfer fuel from right front or left tank until rear tank is greater than 3/8 full

8) Engine Over speed - When the Engine Over speed malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Press the RESET button
c) Apply brakes to reduce tank speed to a halt
d) Set TACTICAL IDLE switch to OFF
e) Set SHIFT CONTROL to Neutral (N)
f) Set PARKING BRAKE
g) Press the RESET button

9) Gas Over temperature - When the Gas Over temperature malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Press the RESET button
c) Set TACTICAL IDLE switch to OFF
d) Halt tank
e) Set PARKING BRAKE

f) Set SHIFT CONTROL to Neutral (N)
g) Press the RESET button

10) Low Oil Pressure - When the Low Oil Pressure malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)
f) Shut down engine

11) High engine Oil Temperature - When the High Engine Oil Temperature malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)

12) High Transmission Oil Temperature - When the High Transmission Oil Temperature malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Turn BILGE PUMP OFF
b) Set THROTTLE to idle
c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)
f) Set tactical idle switch to ON

13) Low Transmission Oil Pressure - When the Low Transmission Oil Pressure malfunction executes during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF
c) Halt tank
d) Set PARKING BRAKE

e) Set SHIFT CONTROL to Neutral (N)
f) Shut down engine

3.5.3.1 Malfunctions and Emergency Conditions-TEV

In addition to the malfunctions and emergency conditions specified in the 'Common SRD' paragraphs, the CDT TEV shall meet the requirements listed in the following list of malfunctions and emergency conditions for the ABV and the JAB. All the malfunctions and emergency conditions listed herein shall present the appropriate feedback (e.g. abnormal vehicle dynamics, instrument readings, and aural cues) to the driver trainee consistent with the operation and performance of the ABV or the JAB. For the ABV malfunction and emergency conditions, all relevant crew indicators and warnings shall operate IAW TM 10984AOR/3 and TM 10984AOI/7. For the JAB malfunction and emergency conditions, all relevant crew indicators and warnings shall operate IAW TM 11374AOR/1 and TM 11374AOR/2. All malfunctions and emergency conditions listed below shall program to activate at specified points in pre-programmed scenarios or initiated and cleared by the instructor in free play scenarios unless otherwise specified herein. The CDT TEV shall include the following malfunctions and emergency conditions:

a. Malfunction and Emergency Condition Indications:

1) Engine Fire - Activation of the engine fire malfunction shall only be possible when the engine is running. There shall be three engine fire scenarios, each having an equal probability of occurrence when the engine fire malfunction is active.

2) Loss of Engine Power – Activation of the loss of engine power malfunction shall result in a lack of engine response to the throttle control and reduction of the maximum engine speed to idle speed with appropriate power output to the tracks. In addition, response to steering and service brake inputs shall reduce by 50% and the hydraulic pressure gauge shall have a low pressure reading (less than 1000 psi) to simulate the loss of hydraulic pressure. If the engine is shut-off, attempts to restart while the malfunction is active shall result in an abort. The loss of engine power malfunction shall cancel by instructor command.

b. Malfunction and Emergency Condition Responses:

1) Engine Fire

2) Loss of Engine Power – When the loss of engine power malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

a) Set THROTTLE to idle
b) Set TACTICAL IDLE switch to OFF

c) Halt tank
d) Set PARKING BRAKE
e) Set SHIFT CONTROL to Neutral (N)

The CDT TEV shall include the following ABV/JAB specific malfunctions and emergency conditions:

1) ABV Malfunction and Emergency Condition Indications:

a) Engine Fire - Activation of the engine fire malfunction shall only be possible when the engine is running. There shall be three engine fire scenarios, each having an equal probability of occurrence when the engine fire malfunction is active.

b) Loss of Engine Power – Activation of the loss of engine power malfunction shall result in a lack of engine response to the throttle control and reduction of the maximum engine speed to idle speed with appropriate power output to the tracks. In addition, response to steering and service brake inputs shall reduce by 50% and the hydraulic pressure gauge shall have a low pressure reading (less than 1000 psi) to simulate the loss of hydraulic pressure. If the engine is shut-off, attempts to restart while the malfunction is active shall result in an abort. The loss of engine power malfunction shall cancel by instructor command.

2) JAB Malfunction and Emergency Condition Indications

a) Hydraulic Power Unit (HPU) fails and the bridge launch or recover in backup or reversionary mode using only the turbine pump on the engine gearbox. It is much slower than using the HPU but meets the requirement.

b) Loss of Engine Power – When the loss of engine power malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 30 seconds for a satisfactory score:

i. Set THROTTLE to idle
ii. Set TACTICAL IDLE switch to OFF
iii. Halt tank
iv. Set PARKING BRAKE
v. Set SHIFT CONTROL to Neutral (N)

3.6 Training Scenarios

The CDT TV and TEV shall have access to all training scenarios previously developed for other CDT variant vehicles. The CDT TV shall have 100 scenarios available for Program of Instruction (POI) population. The 100 scenarios shall include those listed in Table 16.

Table 16. TV/TEV Variant Training Scenario Usage Requirements

PARAGRAPH		TV-M1A2	TV-M1A1	TEV-JAB	TEV-ABV
	TRAINING SCENARIOS				
1	31 scenarios developed from existing Tank Driver Trainer (TDT) scenario descriptions and training tasks.	X	X	X	X
2	25 general scenarios reused from the CDT SV.	X	X	X	X
3	10 GFE scenarios integrated into the CDT as part of the CDT TV pre-production contract	X	X	X	X
4	34 new CDT TV scenarios. The new CDT TV scenarios shall include six specifically related to the M1A1 SA and six specifically related to the M1A2 SEP V2. The remaining 22 scenarios shall be general M1A1 SA/M1A2 SEP V2 scenarios.	X	X	X	X
5	One ABV scenario which requires the driver and/or vehicle commander to utilize the FWMP, CDB, LDCS and LMS.				X
6	One ABV scenario which requires a crew to fill in a tank ditch and create path through a dirt berm.				X
7	One ABV scenario to use the CDB to clear a wire obstacle.				X
8	One ABV scenario that breaches a minefield (< 100m) with one LDC.				X
9	One ABV scenario that breaches a minefield (> 100m) with two LDCs.				X
10	One ABV scenario that uses the FWMP to clear a path in a minefield. When the FWMP is damaged beyond use, jettison the FWMP and retreat from minefield..				X
11	One ABV scenario that uses the CDB to gain entrance to an urban complex.				X

PARAGRAPH		TV-M1A2	TV-M1A1	TEV-JAB	TEV-ABV
12	One ABV scenario with CDB that comes under attack in an ambush.				X
13	One JAB scenario that has the deployment and recovery of the MLC 70 bridge.			X	
14	One JAB scenario that breaches a 40 foot road crater with the MLC 70 bridge on the route to an objective.			X	
15	One JAB scenario where the driver responds to malfunctions correctly and then deploys the MLC 70 bridge.			X	
16	One JAB scenario where own vehicle follows lead vehicle on a route with barriers and traffic to a breach site and deploy the MLC 70 bridge.			X	

ACRONYMS LIST

AAR	After Action Review
ABV/JAB	Assault Breacher Vehicle/Joint Assault Bridge
ACSL	Abrams Common Software Library
AVLB	Armored Vehicle Launched Bridge
BCP	Bridge Control Panel
BLM	Bridge Launcher Mechanism
CBRN	Chemical, Biological, Radiological, Nuclear
CCIP	Commander's Control and Indicator Panel
CCU	Command Control Unit
CDT	Common Driver Trainer
CVC	Combat Vehicle Crewman
D	Drive
DCIP	Driver's Controls and Indicator Panel
DCDP	Driver's Control Display Panel
DVE	Driver's Vision Enhancement
F	Fahrenheit
FEE	Front End Equipment
FOV	Field Of View
ft/sec	feet per second
HETS	Heavy Equipment Transport System
HIP	Hydraulic Power Control Panel
HMPU	Hull Mission Processor Unit
HPCP	Hydraulic Indicator Panel
HPDB	Hull Power Distribution Box
HPDU	Hull Power Distribution Unit
HPCP	Hydraulic Power Control Panel
HPU	Hydraulic Power Unit
Hz	Hertz
IA	Information Assurance
iDID	Improved Driver's Integrated Display
IED	Improvised Explosive Device
IOS	Instructor Operator Station
IVS	Integrated Viewing System
km	Kilometers
LDCS	Linear Demolition Charge System
LHC	Launch Hand Controller
LMS	Lane Marking System
L	Low
m	Meters
MCCIB	Mine Clearing Controls and Indicators Box
MCU	Multipurpose Control Unit
mph	miles per hour
MRCB	Mine Roller Control Box
ms	Milliseconds

N	Neutral
NBC	Nuclear, Biological, and Chemical
psi	pounds per square inch
PVT	Pivot
PdM VTS	Product Manager for Virtual Training Systems
RCS	Remote Control System
R	Reverse
RHNB	Redesigned Hull Network Box
RMCU	Remote Multipurpose Control Unit
RPG	rocket Propelled Grenade
rpm	revolutions per minute
SRD	System Requirement Document
SSIP	Slope and Status Indicator Panel
TBD	to be determined
TCALRF	Thermal Camera and Laser Rangefinder
TEV	Tank Engineering Variant
VOX	Voice Extension
WECP	Warning Emergency Control Panel
USA PEO STRI	US Army Program Executive Office Simulation Training and Instrumentation
UTCP	Upgraded Tank Commander's Panel

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL)
SYSTEM

APPENDIX D – TACTICAL WHEELED VARTIANT (TWV) – PHASE 1

VERSION 2.1

24 OCTOBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors only, due to vulnerability information, effective 30 August 2018. Other request for this document shall be referred to U.S. Army PEO STRI, ATTN: SFAE-STRI-TRADE-VTS.

Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

CHANGE HISTORY

Revision	Date	Section	Description
Version 1.0	14 April 2017	All	Initial Release
Version 1.1	7 June 2017	All	Spelling and format
Version 1.1.1	27 October 2017	3.2.3, 3.5.3.7, 3.5.3.8, 3.5.3.9, 3.5.3.10, 3.5.3.11	Add USMC's most critical requirement (Night Vision Google, liquid and solid loads)
Version 2.0	21 June 2018	3.2.1, 3.2.5, 3.5.1	Results of RFP Release
Version 2.0	14 September 2018	Cover Page	Update Distribution Statement
Version 2.1	24 October 2018	1.1.2	Results of Final RFP Release

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1.0 Scope

This appendix describes the requirements for the Tactical Wheeled Variant (TWV) simulated vehicle driver's compartment hardware and software. When the driver's compartment installed on a Common Driver Trainer (CDT) platform, the collective system becomes a CDT TWV that provides training for drivers of various types of TWV vehicles. The CDT TWV will provide training of TWV vehicles to drivers during New Equipment Training (NET) and sustainment training. The trainer will enable training in the critical driver tasks that can repetitively train in a simulator. It will also allow training of driver tasks that are dangerous and/or infrequently trained in the "real world" (driving on ice, fording streams, driving under blackout conditions, driving down a steep embankment when coming off an improved road, etc.).

This appendix contains the requirements for the vehicle specific kits. Each kit includes the vehicle specific driver's compartment hardware and simulation software needed to convert the base CDT TWV to match a specific vehicle's physical and functional characteristics.

1.1. Background

The U.S. Army has identified a need for initial and sustainment driver training for the various tracked, wheeled, and heavy equipment vehicles employed by the Army to accomplish its mission. The U.S. Marine Corps (U.S.M.C.) has equivalent driver training requirements with unique vehicle variants required to accomplish its mission. The CDT will be dual use and support both the U.S. Army and the U.S. Marine Corps with driver training capability for the identified military vehicles. The training must incorporate a variety of terrains, driving conditions and tactical situations.

A CDT configuration composes of common training subsystem modules. The common modules are the Instructor Operator Station (IOS), computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem, After Action Review (AAR) subsystem and Scenario Generation System. The CDT subsystems have documented hardware, software and electrical configurations and interfaces for simulated variant vehicle driver's compartment installation.

The vehicle variant subsystem includes the driver's compartment module and simulation software necessary to provide the configuration and vehicle dynamics of the variant vehicle. The main components of the driver's compartment module are the controls, instruments, switches, panels, seating and physical structure of the variant vehicle necessary to accomplish the required training tasks. The simulation software provides the driver's compartment control/switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks.

1.1.1 TWV

The CDT TWV is a variant for the CDT. This variant will include the specific modules necessary to provide the configuration and vehicle dynamics of the TWV family of vehicles. The CDT TWV will use all of the common modules as specified in the CDT Common Specifications Requirements Document (SRD) and the specific modules for the TWV as defined herein. The main components in the specific modules are the driver compartment, swappable vehicle specific dash panels with instruments and controls for the driver, space and visual

constraint modules (if necessary) and the software required to operate the driver compartment and interact with the common modules in the CDT.

1.1.2 TWV Family of Vehicles & Equipment

TWV major variants include the following vehicles and equipment:

- M1083A, Medium Tactical Vehicle (MTV)
- M1120A4, Heavy Expanded Mobility Tactical Truck (HEMTT)
- M915A3, Line Haul Tractor Truck
- M915A5, Line Haul Tractor Truck
- M1095, 5 Ton, Medium Tactical Vehicle Trailer (MTVT)
- M872A4, 34 Ton, Semitrailer
- M1076, Palletized Load System Trailer (PLST)
- M1077, Palletized Load System (PLS)

The following vehicles are new for TWV:

- High Mobility Multipurpose Wheeled Vehicle (HMMWV) (i.e. M1113, M1114, M1151, M1151A1, M1152, M1152A1, M1165, M1165A1, M1167 and M997A3 utility trucks) (new requirement to CDT)
- Medium Tactical Vehicle Replacement (MTVR) (i.e. AMK/MK23, AMK/MK25, AMK/MK27, AMK/MK28, AMK/MK29, AMK/MK30 and AMK/MK31 7 -Ton trucks) (new requirement to CDT)
- MK23 MTVR w/MAS (Marine Armor System) (new requirement to CDT)
- MRAP CAT III Buffalo (new requirement to CDT)
- Joint Light Tactical Vehicle (JLTV) (new requirement to CDT)
- Mine-Resistant Ambush Protected (MRAP) (4x4 and 6x6 both with and without ISS) (new requirement to CDT)
- MRAP All-Terrain Vehicle (M-ATV) (CAT I A1, CAT I A1 ISS, CAT II A1, CAT II A1 ISS, CAT I A2, CAT I A2 ISS, CAT II A2, CAT II A2 ISS, M1240, M1240A1, M1245 and Utility Task Vehicle (UTV)) (new requirement to CDT)
- Logistics Vehicle System Replacement (LVSR) (MKR18 ID 11313A, AMKR18 ID 12481A, MKR16 ID 11316A, AMKR16 ID 12493A)
- High Mobility Rocket System (HIMARS) (M142)
- M1101/M1102 Trailer, Light Tactical; M353 Trailer, General Purpose; M105, Trailer Cargo 1 ½ Ton; MK38, Trailer, Cargo Resupply, HIMARS; MK593 6Ton 4 Wheel Cargo Trailer; M149A2 Water Tank Trailer; Engineer Equipment Trailer (EET); M777 Howitzer, MK/AMK970 Aircraft Refueler

2.0 Applicable Documents

TM 9-2320-392-10 (Vol. 1-3), Technical Manual Operator's Manual, The M1083A1 Series 5 Ton, 6 X 6 Medium Tactical Vehicles (MTV) dated 1 Jan 2005, 2 Jan 2005 and 3 Mar 2009

TM 9-2320-345-10, Technical Manual Operator's Manual Truck, Load Handling System (LHS), W and W/O Winch, 8x8 M1120A4 dated 10 Oct 2008
TM 9-2320-302-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 52,000 GVWR, 6 X 4, M915A3 dated 10 Dec 2005
TM 9-2320-426-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 66,000 GVWR, 6 X 4, M915A5 dated 10 Jun 2010
TM 9-2330-394-13&P, Operator's, Field Level Manual M1095 Series, 5 Ton, Medium Tactical Vehicle Trailer (MTVT) dated Jan 2005
TM 9-2330-385-10, Technical Manual Operator's Manual, Palletized Load System Trailer (PLST), M1076 dated 10 Apr 2009
TM 9-2320-345-10, Technical Manual Operator's Manual for Truck, Load Handling System (LHS), 8X8, M1120A4 dated 25 February 2014
TM 9-3990-206-10, Technical Manual Operator's Manual, Palletized Load System (PLS) Flatrack, M1077/M1077A1 dated 10 Apr 2009
TM 9-2330-359-14&P, Technical Manual, Semitrailer, Flatbed: Breakbulk/Container, Transporter, 34 Ton, M872, A1, A2, A3 dated Aug 1991
TM 9-2330-331-14&P, Technical Manual, Semitrailer, Flatbed: Breakbulk/Container, Transporter, 34 Ton, M872A4 dated Dec 2005
TM 11-5855-311-12&P-2, Driver's Vision Enhancer (DVE) dated 15 Dec 2008

In the event of a conflict between the requirements of this document and those contained in the documents above, the requirements contained in this document, take precedence.

3.0 Requirements

3.1 System Level Requirements

The CDT TWV shall consist of the CDT Common Modules hardware and software and the reconfigurable TWV specific module hardware and software as specified herein. The CDT common modules are the IOS, computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem and AAR subsystem and Assistant Driver (AD) workstation. The CDT common modules have defined configurations, mechanical interfaces, electrical interfaces, and software architecture/interfaces. The reconfigurable TWV specific module shall interface to the CDT by the defined interfaces, and shall not degrade the performance of existing CDT variants. The reconfigurable TWV specific module shall integrate with the CDT common modules for the CDT TWV configuration. The CDT TWV specific module shall consist of the simulated reconfigurable driver's compartment, the CDT TWV common instruments and controls for the driver, an AD workstation and the software required to operate the driver's compartment, the AD's workstation and interact with the CDT common modules. The CDT TWV specific module shall include vehicle specific kits with each kit containing one or more removable dash panel assemblies, the software to provide the specific vehicle performance in response to driver inputs and, if necessary, the TWV cab space and visual constraints and auxiliary panels.

The M1083A1 MTV, M1120A4 HEMTT, M915A3, M915A5, HMMWV, 7-Ton Truck/MTVR, Buffalo, MRAP, M-ATV, LVSR, JLTV and HIMARS kits shall consist of hardware and software components which will reconfigure the CDT TWV to support driver training for drivers

of that applicable vehicle. The M1083A1 MTV, M1120A4 HEMTT, M915A3, M915A5, HMMWV, 7-Ton Truck, Buffalo, MRAP, M-ATV, LVSR, JLTV, and HIMARS specific modules shall consist of:

a. The simulated reconfigurable driver's compartments
b. The instruments and controls for the driver
c. The software required to operate the driver's compartment
d. The software to provide the specific vehicle performance in response to driver inputs and interaction with the Common Modules

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a M1083A1 MTV. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of the M1083A1 MTV, the requirements of this M1083A1 shall take precedence when testing the M1083A1 MTV configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a M1120A4 HEMTT. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the M1120A4 HEMTT, the requirements of this appendix shall take precedence when testing the M1120A4 HEMTT configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a M915A3. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the M915A3, the requirements of this appendix shall take precedence when testing the M915A3 configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a M915A5. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the M915A5, the requirements of this appendix shall take precedence when testing the M915A5 configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a HMMWV (all variants). In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the HMMWV (all variants), the requirements of this appendix shall take precedence when testing the HMMWV (all variants) configurations.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a 7 Ton Truck (all variants) vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the 7 Ton Truck (all variants) vehicle, the requirements of this appendix shall take precedence when testing the 7 Ton Truck (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a Buffalo vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the Buffalo vehicle, the requirements of this appendix shall take precedence when testing the Buffalo configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a MRAP (all variants) vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the MRAP (all variants) vehicle, the requirements of this appendix shall take precedence when testing the MRAP (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as an M-ATV (all variants). In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the M-ATV (all variants), the requirements of this appendix shall take precedence when testing the M-ATV (all variants) configuration).

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a LVSR (all variants). In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the LVSR (all variants), the requirements of this appendix shall take precedence when testing the LVSR (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a JLTV vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the JLTV vehicle, the requirements of this appendix shall take precedence when testing the JLTV configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a HIMARS. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the HIMARS, the requirements of this appendix shall take precedence when testing the HIMARS configuration.

3.2 Common Module Requirements

3.2.1 Instructor Operator Station (IOS)

The IOS shall control the operation of CDT Variant Vehicle Student Training Stations (STSs), select/modify training scenarios, monitor simulated vehicle status (e.g. instruments and switches), monitor driver and AD trainee performance and manage student records in accordance with (IAW) the requirements as described in the CDT Common SRD.

The IOS shall have Graphical User Interfaces (GUI) tailored to the operation of the Variant Vehicles as follows:

a) The IOS shall display on the Master Display the following information for each STS controlled:

1) STS Designation
2) Vehicle Being Simulated
3) Scenario Odometer
4) Scenario Elapsed Time
5) Speed
6) Engine Speed (Tachometer Reading)
7) Transmission Gear Selector
8) Steering Wheel Position (Graphical Indication)
9) Throttle Pedal Position (Graphical Indication)
10) Service Brake Pedal Position (Graphical Indication)
11) Trailer Brake position (Graphical Indication)
12) Parking Brake
13) Trailer Parking Brake
14) Dashboard Gauge Values
15) Dashboard and Auxiliary Panel Switch Status
16) Dashboard and Auxiliary Panel Indicator Status
17) Active Malfunction(s)
18) Scoring Events
19) Running Score for Driver
20) Running Score for AD
21) Playback Controls
22) AD Functions Status
23) Convoy Following Distance

b) The Topographical Map display shall segment to simultaneously display the topographical map for each STS when in individual or integrated modes. When in network mode, a single topographical map shall display the scenario. Each STS shall show on the appropriate topographical map with the features defined as described in the CDT Common SRD.

c) The Stealth View display shall segment to simultaneously display the stealth view of each STS as described in the CDT Common SRD during individual or integrated modes of operation. The stealth view of each vehicle shall initially be at a default tethered position above and behind the vehicle. The IOS shall have the capability to select a specific STS stealth view for full screen viewing and/or stealth view eye point positioning. When in network mode, the IOS shall be able to select a network STS vehicle stealth view to display on the IOS Stealth View display.

d) The IOS shall have STS video displays to simultaneously display the Out The Window (OTW) views, Drivers Vision Enhancer (DVE) view and camera view of each STS in a segmented display configuration. The IOS shall have the capability to select a specific STS video view for full screen viewing.

3.2.2 Computational Subsystem

The computational subsystem shall process all CDT Variant Vehicle software IAW the requirements as described in the CDT Common SRD. Computational spare for the CDT Variant Vehicle system shall define as each computer shall have a minimum of 10% spare processing capacity, with a total average across all computers of a minimum of 50% under worst case conditions.

3.2.3 Visual/Display Subsystem

The visual subsystem shall produce the visual imagery for the CDT Variant Vehicle IAW the image generation requirements as described in the CDT Common SRD. The visual database(s) used to produce the imagery for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD. The display system used to display the visual imagery for the CDT Variant Vehicle shall be in accordance with the display system requirements as described in the CDT Common SRD. The AD work station shall have the STS OTW imagery displayed on flat screen, color monitors to provide the same Field Of View (FOV) seen by the driver. In addition, if requested and this requirement states in the specific Delivery Order (DO), the visual subsystem shall be able to utilize and integrate Night Vision Goggle capabilities.

3.2.4 Aural/Communication Subsystem

The aural/communications system used in the CDT Variant Vehicle, including the AD work station, shall be in accordance with the requirements as described in the CDT Common SRD.

3.2.5 Motion Subsystem

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.6 After Action Review (AAR)

The AAR system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD. The AAR system shall combine with the AD work station to present the AAR output on one of the Assistant Driver/Vehicle Commander (AD/VC) workstation monitors.

3.2.7 Scenario Generation System (SGS)

The SGS for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.3 Operational Requirements

The CDT Variant Vehicle requirements for physical space, power requirements, safety limitations/considerations, system start times, setup times and reconfiguration times shall be IAW the requirements as described in the CDT Common SRD.

3.4 Variant Vehicle Requirements

3.4.1 TWV Configuration

The CDT TWV shall include a reconfigurable driver's compartment, AD workstation, vehicle specific kits, and simulation software that provide the physical configuration, controls,

instruments, vehicle operation, and vehicle dynamics of each of the supported vehicles in the TWV family of vehicles. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the TWV vehicle version necessary to accomplish the required training tasks. When configured as a specific TWV vehicle driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator which specific TWV configuration installs and provide an error message if there are any reconfigurable components mismatches or components not installed.

The main components of the AD work station shall be the monitors for the driver's cab OTW imagery (left, center, and right), an intra-vehicle communication system and computer workstation (Central Processing Unit (CPU) and keyboard) with a touch screen display. The monitors display the same imagery that the driver views OTW of the cab. The computer workstation uses to simulate the controls, instruments, switches, and panels of the variant vehicle necessary for the AD to accomplish the required training tasks.

3.4.1.1 M1083A1 MTV

The M1083A1 MTV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the M1083A1 MTV and the M1095 MTVT (trailer) (TM 9-2330-394-13&P). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M1083A1 MTV necessary to accomplish the required training tasks. When configured as a M1083A1 MTV driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.2 M1120A4 HEMTT

The M1120A4 HEMTT kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the M1120A4 HEMTT and the M1076 PLST (trailer) (TM 9-2330-385-10). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M1120A4 HEMTT necessary to accomplish the required training tasks. When configured as a M1120A4

HEMTT driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS the specific TWV configuration installed and provide an error message if there are any reconfigurable component mismatches or components not installed.

3.4.1.3 M915A3

The M915A3 kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the M915A3 truck and the M872A4 trailer (TM 9-2330-331-14&P). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M915A3 necessary to accomplish the required training tasks. When configured as a M915A3 driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.4 M915A5

The M915A5 kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the M915A5 truck and the M872A4 trailer. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M915A5 necessary to accomplish the required training tasks. When configured as a M915A5 driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An

error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.5 HMMWV

The HMMWV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the HMMWV (all variants), the M1101 with chassis (trailer), and the M1102 with chassis (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the HMMWV (all variants) necessary to accomplish the required training tasks. When configured as a HMMWV (all variants) driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.6 7-Ton Truck

The 7-Ton Truck kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the 7-Ton Truck (all variants) vehicle, the M353 (general purpose trailer), the M105A1 (cargo trailer), the M05A2 (cargo trailer), the M105A2C (cargo trailer), the MK38 (HIMARS RST), the M149A2 (water tank trailer), the MK593 (cargo trailer), the MT020/M322LT (ETT), the MK970 (tanker), the AMK970 (tanker), the M870A2 (transporter), and the M870A2S (transporter). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the 7-Ton Truck (all variants) cab necessary to accomplish the required training tasks. When configured as a 7-Ton Truck (all variants) vehicle driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.7 Buffalo

The Buffalo kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the Buffalo vehicle and its applicable trailer(s). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the Buffalo cab necessary to accomplish the required training tasks. When configured as a Buffalo cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.8 MRAP

The MRAP kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the MRAP (all variants) vehicle and the M105A1 (trailer), M105A2 (trailer), M105A2C (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the MRAP (all variants) cab necessary to accomplish the required training tasks. When configured as a MRAP (all variants) cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.9 M-ATV

The M-ATV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the M-ATV (all variants) the M105A1 (trailer), the M105A2 (trailer), and the M105A2C (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M-ATV (all variants) cab necessary to accomplish the required training tasks. When configured as an M-ATV (all variants) cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls,

instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.10 LVSR

The LVSR kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the LVSR (all variants), the M1076 (PLST), the M870A2 (transporter), and the M870A2S (transporter). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the LVSR (all variants) necessary to accomplish the required training tasks. When configured as a LVSR (all variants) driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any towed equipment loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.11 JLTV

The JLTV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the JLTV vehicle and the applicable trailer(s). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the JLTV cab necessary to accomplish the required training tasks. When configured as a JLTV cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable

for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.12 HIMARS

The HIMARS kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the HIMARS, and the MK38 (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the HIMARS necessary to accomplish the required training tasks. When configured as a HIMARS driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.2 Variant Vehicle Training Requirements

The CDT Variant Vehicle shall train the training tasks listed in the following paragraphs performed by the student(s), the performance assessed by the system and monitored by the instructor. The training tasks generally reflect the numerous and varied skills that comprise the task of operating a Variant Vehicle.

Variant Vehicle Driver Training Tasks:

1) Enter driver's compartment
2) Check door lock
3) Adjust driver's seat
4) Fasten seat belt
5) Check driver compartment fire extinguisher-manual
6) Perform systems check
7) Check warning and hazard lights
8) Operate the Container Handling Unit
9) Operate the Load Handling System
10) Operate Central Tire Inflation System (CTIS)
11) Check hazard lights
12) Check, monitor Driver's Instrument Panel
13) Operate driving controls
14) Operate transmission
15) Operate transfer case

16) Operate engine brake
17) Operate trailer brake
18) Operate steering
19) Operate brakes
20) Operate service lights
21) Slow/Fast forward driving
22) Reverse driving
23) Motor pool parking
24) Decelerate smoothly to a halt
25) Operate the DVE night vision device
26) Shut down engine/vehicle
27) Secure the station
28) Adjust the driver's seat (adjust for ingress/egress or operation)
29) Operate the vehicle in extreme cold (winter conditions)
30) Respond to malfunctions
31) Check door status
32) Vehicle starting (normal and cold start)
33) Vehicle shutdown
34) Drive on narrow roads
35) Drive on urban roads
36) Drive on highway / interstate highways
37) Drive in towns
38) Navigate overhead obstacles
39) Drive in a convoy
40) Fording
41) Drive in mountains
42) Drive on side slopes under 20 degrees
43) Drive on steep hills
44) Drive on plains terrain
45) Drive on rolling hills
46) Drive on forest trails
47) Drive in dessert conditions
48) Drive during inclement weather
49) Tactical road march
50) Drive over logs / obstacles
51) Drive on inclines under 45 degrees
52) Drive onto railroad car
53) Respond to ground guide commands
54) Cross bridges
55) Cross assault bridges
56) Loading on watercraft
57) Loading on aircraft
58) Herringbone formation
59) Minefield crossing
60) React to Improvised Explosive Device (IED) identification, explosion or ambush
61) Operate truck with trailer

Variant Vehicle AD Training Tasks:

1) Navigate using the Joint Capabilities Release Logistics (JCR-LOG) (applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)
2) Send and Receive text messages with the JCR-LOG(applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)
3) Operate the vehicle communications system
4) Assist in IED/threat/ambush recognition
5) Clear vehicle blind sides

3.4.3 Malfunction/Emergency Condition Training Requirements

The CDT Variant Vehicle shall simulate the following emergency conditions/malfunctions:

1) Vehicle Control - The vehicle control criteria shall monitor continuously during scenario execution. A vehicle control error shall be produced IAW the following criteria:

    a) Loss of Steering
    b) Loss of Brakes
    c) Loss of Brakes from overheating
    d) Loss of Trailer brakes
    e) Loss of Engine Power
    f) Flat Tire

    The CDT Variant Vehicle shall train the driver to react to the following indicators:

    a) Annunciator Panel Fault Indicator
    b) Check Engine Indicator
    c) Engine Oil Pressure Indicator
    d) Engine Coolant Temperature Indicator
    e) Restricted Airflow Indicator
    f) Low Air Pressure Indicator
    g) Low Fuel Indicator
    h) React to Transmission Control Malfunction Indicator
    i) Transmission Fluid Temperature Indicator
    j) Transmission Locked
    k) Transmission Fault Indicator
    l) Low Battery Voltage Indicator
    m) Anti-lock Braking System (ABS) Fault Indicator
    n) Park Brake On Indicator

2) AD's Station (ADS) Controls and Functions – The ADS controls and functions shall monitor continuously during scenario execution. A control or function error shall be produced IAW the following criteria:

a) Joint Capabilities Release-Logistics (JCR-LOG) not powering on (applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)
b) JCR-LOG loses signal and information (applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)
c) JCR-LOG communications drop (applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)

3.5 Specific Reconfigurable TWV Module Requirements

3.5.1 Simulated Driver Compartment

The CDT TWV driver's compartment shall be reconfigurable between supported vehicles in the TWV family of vehicles. The driver's compartment shall be composed of common components listed in Sec. 3.5.1.1 and specific components listed in Sec. 3.5.1.1.7 and Sec. 3.5.1.1.8 depending on the configuration selected. The specific components shall be, to the maximum extent possible, easily installed and removed to configure the driver's compartment properly for the specific vehicle configuration. The specific hardware configuration along with the specific simulation software shall define the driver's compartment as one of the supported TWV vehicles. The specific driver's compartment configuration shall simulate the physical and functional characteristics of the supported TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4.1 and 3.4.2 above depending on the configuration selected. When a vehicle specific kit installs, the CDT TWV driver's compartment configuration shall replicate all instruments, indicators, gauges, controls, lights, switches, displays, driver's door, and the components listed in Sec.3.5 or the vehicle variant configuration selected to support the training tasks defined in Sec. 3.4 of each vehicle type specified in this appendix. All instruments, indicators, gauges, controls, lights switches, displays and components of the driver's compartment that are non-tactile (i.e. viewed but not touched) and not used for training shall be dimensionally accurate to within +/- 20%. All non-tactile instruments, indicators, gauges, controls, lights, switches, displays and components of the driver's compartment used for training shall be dimensionally accurate to within +/- 15%. All tactile instruments, indicators, gauges, controls, lights, switches, displays and components of the driver's compartment used for training shall be dimensionally accurate within a tolerance of +/- 0.25 inches.

The location within the driver's compartment of tactile and non-tactile components that uses for training shall be accurate within +/- 2.0 inches and maintain the relation between adjacent components within +/- 0.25 inches. Non-tactile components that do not use for training shall be located within +/- 3.0 inches of their actual position. All measurements shall made from a single reference point.

The CDT TWV driver's compartment shall include universal mounting locations, interfaces, and cabling to support installation and use of the CDT TWV kits specified in this appendix.

Items normally present in the driver compartment of the vehicle, but not critical for training the required driver tasks shall present in mock-up form with the same size, shape, and location as the vehicle components. Detachable devices (i.e. DVE night vision device) on the vehicles used to drive the vehicle shall be part of the simulation. The vehicle body, if appropriate, and external frame assemblies shall replicate to provide appropriate visual and human factor obstructions.

The driver's compartment shall include a cross cab fresh air circulation and exchange system with sufficient airflow to maintain the internal temperature within +5 degrees F of the temperature outside the driver's compartment.

The cab exchange time(s) and interfaces shall be as described in the CDT Common SRD.

Re-configuring from one CDT TWV vehicle specific kit to another CDT TWV vehicle specific kit shall be achievable by a two person crew in less than 30 minutes, with a desired objective time of 15 minutes.

Each vehicle specific kit shall include one or more ruggedized storage containers for storing accessory panels, switchboxes, vision restriction plates, and space restrictors. Vehicle specific dashboards shall be stored on either fixed or mobile racks capable of holding multiple dashboards. All components required to simulate a particular vehicle or family of vehicles shall store within a single storage container. All storage containers shall meet the requirements for a two-man lift.

3.5.1.1 Driver' Compartment Subsystem Common Components

The driver's compartment subsystem shall simulate the following common components of the driver's compartment for the TWV vehicles:

1) Driver's Door
2) Steering Column and Wheel (common or unique vehicle-specific)
3) Throttle
4) Service Brake Pedal
5) Driver's Seat including 3-Point Seat Belt System
6) DVE Night Vision Device

The CDT TWV baseline vehicle cab shall replicate the overall driver's position dimensions of the M1083A1 MTV. Right hand side of the cab can truncate due to overall CDT cab width requirements.

Reconfiguration of the driver's compartment subsystem between supported vehicles in the TWV family of vehicles shall not require removal or replacement of any of the Driver's Compartment Subsystem Common Components.

The Driver's Compartment Common Components shall have the following capabilities and characteristics:

3.5.1.1.1 Driver's Door

The driver's door assembly shall be representative of the simulated TWV vehicles. The door shall have an approximate overall dimension of 41 inches wide by 55 inches tall. The door shall have a rectangular shape (no wheel well cutouts) with the front upper edge conforming to the slant. A latch mechanism shall provide to secure the door in the fully closed position. A door opening handle representative of the TWV vehicles shall provide on the inside and outside of the door. The door shall be safety interlocked to the motion subsystem to allow motion only when

the door is in the fully closed and secured position. The driver's door shall include mounting devices for mounting space and vision constraint modules included in vehicle specific kits, if applicable.

3.5.1.1.2 Steering Column and Wheel (common or unique vehicle-specific)

The Steering Wheel of the TWV cab shall be representative of the TWV vehicles simulated 18 inches in diameter. The steering column shall have the capability to tilt and telescope to accommodate the different steering wheel angles and heights of the TWV vehicles. The column and wheel shall position in the cab to be able to adjust to a representative configuration for each of the TWV vehicles. The steering wheel/column shall have a turn signal control (left) and a trailer brake hand control lever (right). The turn signal control shall have a push button on the end of the control and a pull switch (pull turn signal stalk towards the steering wheel) capability. The steering wheel shall have a button cap switch in the center that is programmable to be active. The pull switch capability and the push button shall be programmable to the function of the vehicle being simulated (i.e. headlight dimmer and horn). The steering simulation shall represent the appropriate force feel cues, sensitivity, deflection, and number of turns lock to lock required for steering and turning each of the simulated vehicles.

Specifically for the M1083A1 MTV, the turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e. service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the M1120A4 HEMTT, the turn signal control stalk shall move up for right turns and down for left turns. The turn signal stalk end push button shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The steering wheel center button shall program to activate the vehicle horn when pushed. The hazard lights switch shall be located under the turn signal lever (away from the steering wheel). A Trailer Handbrake control Lever is located on the right side of the steering column.

Specifically for the M915A3, steering column and wheel configuration shall be the same as the steering column and wheel specified for the TWV. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The steering wheel center button shall program to activate the vehicle horn when pushed. The hazard lights switch shall be located under the turn signal lever (away from the steering wheel). A Trailer Handbrake control Lever is located on the right side of the steering column.

Specifically for the M915A5, the steering column and wheel configuration for the M915A5 shall be the same as the steering column and wheel specified for the TWV. The turn signal control stalk shall move up for right turns and down for left turns. The button on the end of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The steering wheel center button shall program to activate the vehicle horn when pushed. The hazard lights switch shall be located under the turn signal lever (away from

the steering wheel). A Trailer Handbrake control Lever is located on the right side of the steering column.

Specifically for the HMMWV, the steering column and wheel for the HMMWV (all variants) shall be the same as the steering column and wheel specified for the TWV. The steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual HMMWV (all variants) steering wheel as described in TM 11033-OR. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the 7-Ton Truck, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual 7 Ton Truck (all variants) steering wheel as described in TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the Buffalo, the steering column and wheel for the Buffalo cab shall be the same as the steering column and wheel specified for the TWV. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the MRAP, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual MRAP (all variants) steering wheel as described in TM 11202D-OR. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the M-ATV, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual M-ATV (all variants) steering wheel as described in TM 11803A-ID/1 VOL 1. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the LVSR, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual LVSR (all variants) steering wheel as described in TM 11313A/12481A-OD/1A and TM 11316A/12493A-OD/1A. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light

dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the JLTV, the steering wheel shall replicate the form and function of the actual JLTV steering wheel as described in the applicable TM. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the HIMARS, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual HIMARS steering wheel as described in TM 9-2300-310-14&P. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

3.5.1.1.3 Throttle

The throttle pedal shall have the representative dimensions, range of motion, adjustments, and position as the TWV family of vehicles throttle pedal. The simulation shall represent the appropriate force feel cues and deflection required for accelerating each of the simulated vehicles.

3.5.1.1.4 Service Brake Pedal

The service brake pedal shall have the representative dimensions, range of motion, adjustments, and position as the TWV family of vehicles service brake pedal. The simulation shall represent the appropriate force feel cues and deflection required for decelerating each of the simulated vehicles. The service brake shall utilize compressed air to provide the feel and aural cues representative of actual vehicle operation.

3.5.1.1.5 Driver's Seat

The driver's seat shall have the representative dimensions, controls, range of motion, adjustments, and position as the TWV family of vehicles driver's seat. Fore and aft adjustments shall accommodate the seat to dash/steering wheel dimensions of the simulated vehicles. The seat height adjustment shall accommodate the seat height above floor dimension for each of the simulated vehicles. The driver's seat shall have the capability of being air suspended or locked at a specific height depending on the simulated vehicle.

3.5.1.1.6 DVE Night Vision Device

The CDT TWV driver's compartment shall include a DVE system. The DVE shall mount in the CDT TWV cab in the same location as operational vehicle cabs within the tolerances specified in Sec. 3.5.1. The DVE support shall replicate the size, shape, and adjustability of the operational system. A power and signal connector shall be provided. The DVE shall replicate the image (sensor location, field of view, and image characteristics) of the simulated TWV vehicle's DVE. The gain, level, brightness, and white hot/black hot controls shall be operational and modify the

displayed image as in the operational system. The look angle of the DVE shall control by the Pan and Tilt Module (PTM) controller. The PTM controller shall be located based on the variant specific location. The PTM controller shall function IAW TM 11-5855-311-12&P-2.

3.5.1.1.7 Specific Driver's Compartment Hardware Components

The baseline vehicle cab shall include the following specific hardware components:

a) Interchangeable Dashboard Panels
b) Cab
c) Auxiliary panels
d) Space Constraints

3.5.1.1.7.1 Interchangeable Dashboard Panels and Equipment

The CDT TWV driver's compartment shall include removable dashboard assemblies, consisting of all gauges, switches, controls, and indicators of the specific vehicle being simulated. The TWV cab shall include universal mounting locations to position each vehicle's dashboard assemblies in the proper position relative to the driver and driver's seat. These dashboard assemblies shall represent the simulated TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4 above or the vehicle specific appendices depending on the configuration selected.

Specifically, the driver's panel for the M1083A1 MTV shall consist of one or more removable assemblies that replicate the form and function of the M1083A1 MTV vehicle as described in TM 9-2320-392-10 (Vol. 1-3), Technical Manual Operator's Manual, The M1083A1 Series 5 Ton, 6x6 Medium Tactical Vehicles (MTV), dated Jan 2005. Unless specified, the items below are to be functional. The panels/clusters are as follows:

1) Voltmeter, 24Volt
2) Voltmeter, 12 Volts
3) Check Engine Indicator
4) Engine Oil Pressure Gauge
5) Water Temperature Gauge
6) Speedometer / Odometer
7) Front Brake Air Pressure Gauge
8) Rear Brake Air Pressure Gauge
9) Air Filter Restriction Indicator
10) Fuel Gauge
11) Fan Switch (non-functional mock-up)
12) Heat Control (non-functional mock-up)
13) Vent Control (non-functional mock-up)
14) System Park Switch
15) Trailer Air Supply Control
16) Lamp Test Switch
17) Warning Light Switch
18) Hazard Light Switch

19) Engine Fan Off Switch
20) Lo Idle/High Idle Switch
21) Warmup/Off/Retard Switch
22) Main Light Switch (New Style)
23) Turn signal/headlight dimmer control
24) Master Power Switch
25) Starter Button Switch
26) Parking Brake Indicator
27) ABS Indicator Light
28) Trailer ABS Indicator Light
29) High Beam Indicator Light
30) Check Trans Indicator
31) Stop Engine Warning Light
32) Check Engine Warning Light
33) Low Air Pressure Warning Light
34) WTEC III Tran Pushbutton Shift Selector
35) Left Turn Signal Indicator
36) Right Turn Signal Indicator
37) Coolant Temp Indicator
38) CTIS Over speed Indicator
39) Low Oil Pressure Indicator
40) Engine Fan Off Indicator
41) Battery Disconnect Indicator (non-functional)
42) Inlet Air Heater (non-functional)
43) Exhaust Brake Indicator
44) CTIS Off Indicator
45) No Charge Indicator
46) Audible Alarm
47) CTIS Panel

Specifically, the dash panel(s) for the M1120A4 HEMTT shall consist of one or more removable assemblies that replicate the form and function of the M1120A4 HEMTT vehicle as described in TM 9-2320-345-10, Technical Manual Operator's Manual, Truck, Load Handling System (LHS), W and W/O Winch, 8x8 M1120A4, dated October 2008. Unless specified, the items below are to be functional. The panels/clusters that are as follows:

1) Check Engine Indicator
2) Engine Oil Pressure Gauge
3) Low Engine Oil Pressure Indicator
4) High Engine Coolant Temperature Indicator
5) Engine Coolant Temperature Gauge
6) Speedometer
7) Tachometer
8) Air Filter Restriction Indicator
9) Front Air Pressure Gauge
10) Low Fuel Indicator

11) Fuel Gauge
12) Check Transmission Indicator
13) High Transmission Temperature Indicator
14) Transmission Oil Temperature Gauge
15) Liquid Crystal Display (LCD)
16) Mode (M) Button
17) Trip (T) Button
18) Odometer
19) Trip / Hours display
20) Battery Voltage
21) Drive Mode Display
22) Rear Air Pressure Gauge
23) Brake System Failure (Low Air) Indicator
24) Work Light Indicator (non-functional)
25) Stop Engine Indicator
26) Beacon Light Indicator (non-functional)
27) Clearance Light Indicator (non-functional)
28) Spare Tire Loose Indicator (illuminate on vehicle start up only)
29) Fan Speed Knob (non-functional)
30) Temperature Control Knob (non-functional)
31) Air Flow Direction Knob (non-functional)
32) Master Light Switch
33) Parking Brake Control Switch
34) Trailer Air Supply Control Switch
35) Beacon Light Switch (non-functional)
36) Engine Brake On/Off Switch
37) Engine Brake High/Medium/Low Switch (Three-Position)
38) High Idle Switch (non-functional)
39) Ignition/Engine Stop Switch
40) Work Light Switch (non-functional)
41) Chem Alarm Switch (non-functional)
42) B.O. Select Switch
43) B.O. Lights Switch (Three-Position)
44) Automatic Traction Control Indicator (ATC)
45) Dash Dimmer Switch (two position momentary)
46) Traction Control Switch
47) Gas Particle Filter Unit Switch (non-functional)
48) Master Lighting Switch (Three-Position)
49) Dome Light Switch (non-functional)
50) Ign/Eng Stop Switch
51) Eng Start Switch
52) Parking Brake Indicator
53) Trailer ABS Indicator
54) High Beam Indicator Light
55) Hydraulic Selector Switch
56) LHS Joy stick

57) Self-Recovery Winch Lever (non-functional)
58) Transfer case shift
59) Inter Axle / 8X8 Switch
60) Hydraulic Enable Switch
61) Aux Hyd Switch
62) Left Turn Indicator
63) Vehicle ABS Indicator
64) Right Turn Signal
65) Work Light Indicator (non-functional)
66) Over speed Indicator
67) Stop Engine Indicator
68) Automatic Traction Control Indicator
69) ABS Disable Indicator
70) Low Hyd Oil Indicator
71) High Idle Indicator (non-functional)
72) Charging System Indicator
73) Engine Brake Enable Indicator
74) Transfer Case Indicator
75) 8X8 Indicator
76) Inter Axle Indicator
77) Rear Diff Lock Indicator (non-functional)
78) Front Diff Lock Indicator (non-functional)
79) LHS Indicator
80) LHS NO Trans Indicator
81) LHS Overload Indicator
82) Main Hyd Enable Indicator
83) Suspension Air Indicator (non-functional)
84) Emergency Steering Indicator (non-functional)
85) Flat Rack Indicator
86) Aux HYD Enable (non-functional)
87) ABS Off-Rd Switch
88) Trans Selector

Specifically, the dash panel(s) for the M915A3 shall be a removable assembly or assemblies that replicated the form and function of the M915A3 TM 9-2320-302-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 52,000 GVWR, 6 x 4, M915A3, dated December 2005. Unless specified, the items below are to be functional. The panels/clusters are as follows:

1) Voltmeter
2) Engine Oil Pressure Gauge
3) Engine Water Temperature Gauge
4) Speedometer / Odometer
5) Tachometer
6) Primary Air Pressure Gauge
7) Secondary Air Pressure Gauge
8) Air Filter Restriction Indicator

9) Fuel Gauge
10) Trans Oil Temp Gauge
11) Fan Speed Knob(non-functional)
12) Temperature Control Knob (non-functional)
13) Air Flow Direction Knob (non-functional)
14) Trailer Air Supply Switch
15) Parking Brake Switch
16) Utility Light Switch (non-functional)
17) Panel Lights Control Knob Switch (non-functional)
18) Fog Lights Switch (non-functional)
19) Beacon Light Switch (non-functional)
20) Main Light Switch
21) Engine Brake Switch (2 Cycle)
22) Engine Brake Switch (4 Cycle)
23) Wiper/Washer Control Switch (non-functional)
24) Mirror Pwr Switch (Left) (non-functional)
25) Mirror Pwr Switch (Right) (non-functional)
26) Mirror Heat Switch (non-functional)
27) Inter Axle Lock/Unlock Switch
28) 5th Wheel Slide Control Switch (non-functional)
29) Ignition Switch
30) Engine Start Button
31) Parking Brake Indicator
32) Tractor ABS Indicator
33) Trailer ABS Indicator
34) High Beam Indicator
35) Check Transmission Indicator
36) STOP Engine Indicator
37) Check Engine Indicator
38) Low Air Pressure Indicator
39) Left Turn Signal Indicator
40) Right Turn Signal Indicator
41) Engine Oil Warning Indicator
42) Water Level Indicator
43) Engine Temp Warning Indicator
44) Shut Down Indicator
45) Mirror Heater Indicator (non-functional)
46) Axle Lock Indicator
47) Utility Light Indicator (non-functional)
48) Beacon Light Indicator (non-functional)
49) Collision Warning System (CWS) System
50) 12 Volt Power Outlet (non-functional)
51) Air Vent (non-functional)
52) Trans selector

Specifically, the dash panel(s) for the M915A5 shall be a removable assembly or assemblies that replicated the form and function of the M915A5 TM 9-2320-426-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 66,000 GVWR, 6 x 4, M915A5, dated June 2010. Unless specified, the items below are to be functional. The panels/clusters are as follows:

1) Voltmeter
2) Engine Oil Pressure Gauge
3) Engine Coolant Temperature Gauge
4) Speedometer / Odometer
5) Tachometer
6) Primary "A" Air Pressure Gauge
7) Secondary "B" Air Pressure Gauge
8) Air Filter Restriction Indicator
9) Fuel Gauge
10) Trans Oil Temp Gauge
11) A/C Heater Controls (non-functional)
12) Multifunctional Light Switch (Service/Parking/Blackout)
13) System Parking Brake Control Switch
14) Trailer Air Supply Control Switch
15) Interior Light Switch (non-functional)
16) Dash Lights Switch
17) Off Road Lights Switch
18) Fog Lights Switch
19) Beacon Light Switch (non-functional)
20) Load Lite Switch (non-functional)
21) Engine Brake Switch
22) High/Med/Low Brake Switch
23) Wiper High/Low Switch (non-functional)
24) On-Wiper Int Delay Switch (non-functional)
25) Mirror Switch (Right) (non-functional)
26) Mirror Switch (Left) (non-functional)
27) Mirror Defog Switch (non-functional)
28) Inter Axle Lock/Unlock Switch
29) 5th Wheel Switch (non-functional)
30) Ignition Switch
31) Deep Mud and Snow Switch
32) Air Vent (non-functional)
33) Transmission push button Shift Selector
34) Parking Brake Indicator
35) Tractor ABS Indicator
36) Trailer ABS Indicator
37) High Beam Indicator
38) Transmission Warning Indicator
39) Stop Engine Warning Indicator
40) Check Engine Caution Indicator
41) Automatic Traction Control /(ATC) Roll Stability Control (RSC) Indicator

42) Low Air Pressure Indicator
43) Utility Light Indicator (non-functional)
44) Beacon Light Indicator (non-functional)
45) Left Turn Signal Indicator
46) Right Turn Signal Indicator
47) CWS Warning System Display Panel
48) CWS Side Sensor Display
49) Transmission Pushbutton Shift Selector(Drive, Reverse, Up, Down, Neutral)
50) 12V Power Outlet (non-functional)

Specifically, the driver's panel for the HMMWV (all variants) shall consist of one or more removable assemblies that replicate the form and function of the HMMWV (all variants) as described in TM 11033-OR.

Specifically, the driver's panel for the 7-Ton Truck (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the 7 Ton Truck (all variants) cab as described in TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A.

Specifically, the drivers' panel for the Buffalo cab shall consist of one or more removable assemblies that replicate the form and function of the Buffalo cab. Unless specified as "not modeled," the dashboard, Shifter, and Side Panel items in Figure 1 and Figure 1 below are to be functional. The panels/clusters, switches and indicators that are replicated are as listed in Table 1, Table 2, Table 3, Table 4 and Table 5 below.

Dashboard

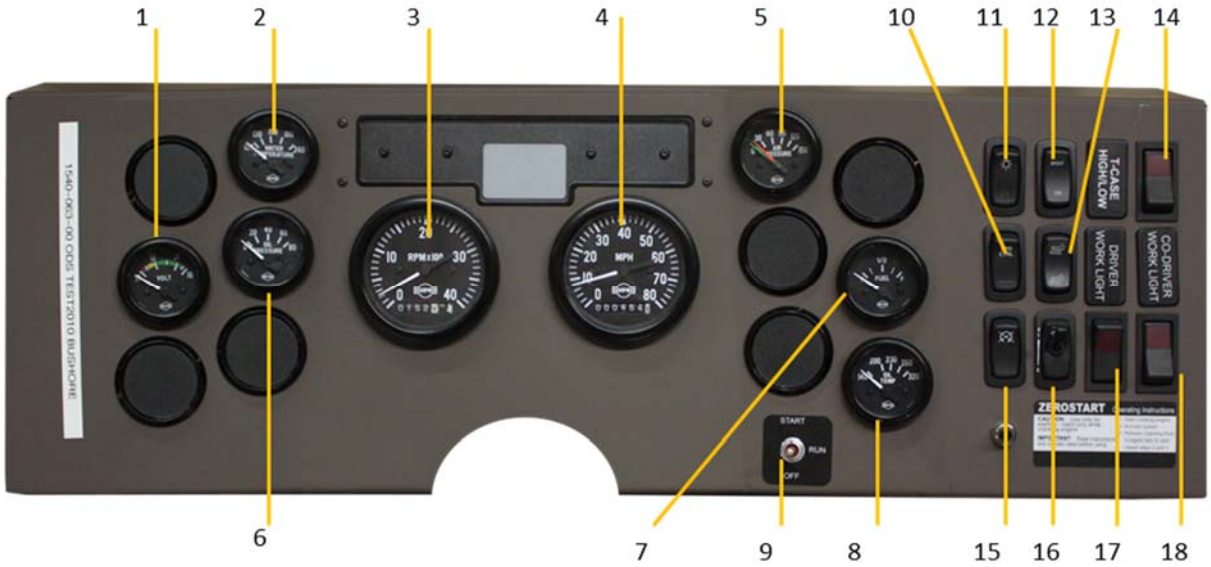

Figure 1 - Dashboard

Table 1 - Main Dash Switches and Gauges

Main Dash Switches and Gauges		
#	**Switch**	**Function**
1	12 Volt Gauge	Display voltage to the dash in the cab. Indicates 0 or operating voltage
2	Water temperature gauge	Indicates the temperature of the coolant solution in the engine
3	Tachometer	Displays engine RPM
4	Speedometer	Displays vehicle speed
5	Air Pressure Gauge	Displays air brake pressure in the cab
6	Oil pressure Gauge	Displays either normal operating pressure or 0 pressure
7	Fuel Gauge	Indicates the amount of fuel
8	Oil temperature gauge	Indicates 0 or operating engine oil temperature
9	Engine Ignition Switch	Starts the vehicle when held up, stops the vehicle by pushing switch down
10	Speed Control ON/Off	Speed Control ON/Off
11	Master Lighting switch	Master Lighting switch
12	Panel Dimmer Switch	Panel Dimmer Switch
13	Resume/Set Switch or Accel Switch	Resume/Set Switch or Accel Switch
14	Transfer Case Switch	Transfer Case Switch
15	Engine Override Shutdown Switch	Not modeled
16	Windshield Wiper Control	Not modeled

17	Driver Work Light	Not modeled
18	Co-Driver Work Light	Not modeled

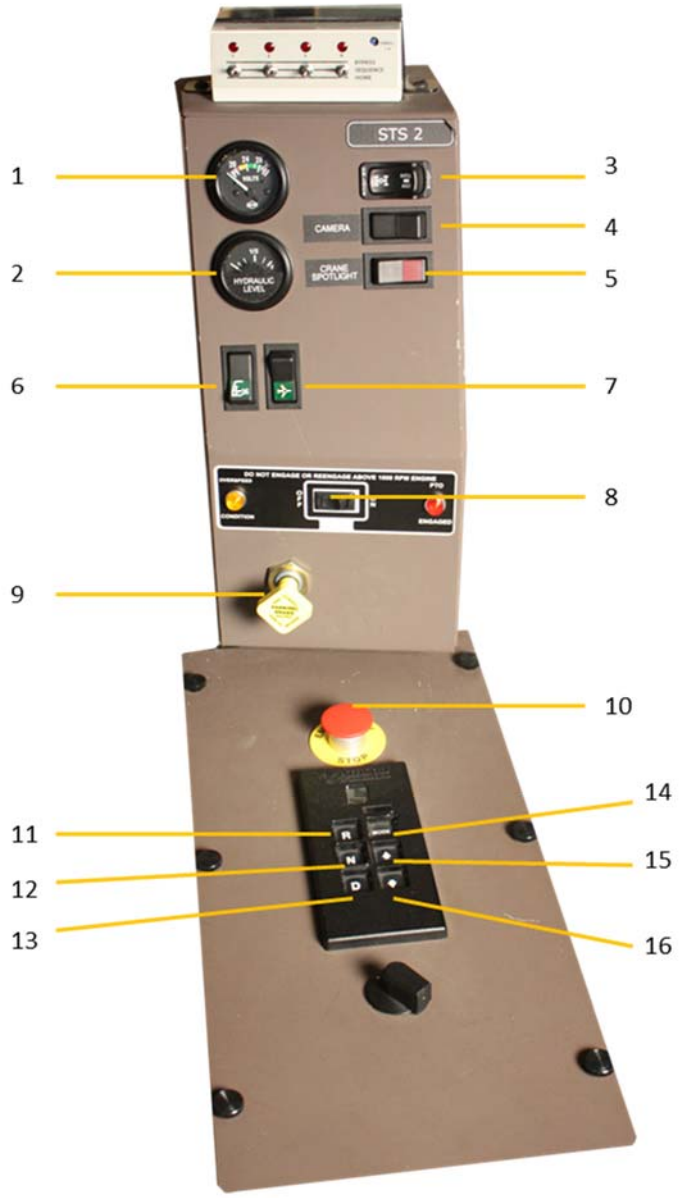

Figure 2 - Buffalo Simulator Shifter and Side Panel

Table 2 - Side Dash Switches and Gauges

Side Dash Switches and Gauges

#	**Switch**	**Function**
1	24 Volt Gauge	Display voltage to the dash in the cab, indicating 0 or operating voltage.
2	Hydraulic Gauge	Displays either normal operating level or empty.
3	Inter-axle Lock	Locks the intermediate and rear axles when engaged
4	Video Power Switch	Turns power on and off for all three cameras; front, rear, and crane.
5	Crane Spotlight	Not modeled
6	Fan Switch	Controls in-cab fan
7	Overhead Switch	Overhead View On/Off
8	PTO Switch	Not modeled
9	Parking Brake Control	Push to release the vehicle parking brakes. Pull to apply vehicle and trailer parking brakes
10	Emergency-Stop	Kills power to the steering and seat systems
11	Reverse	Put transmission in reverse
12	Neutral	Put transmission in neutral
13	Drive	Put transmission in drive
14	Mode	Not modeled
15	Shift Up	Shift transmission up one gear
16	Shift Down	Shift transmission down one gear

Table 3 - Additional Switches (Simulator specific)

Additional Switches (Simulator specific)		
Switch	**Function**	**Location**

Seat Belt Switch	Verifies that the seat belt is engaged	Seat Belt
Right Turn Switch	Engages right turn signal	Steering Column
Left Turn Switch	Engages left turn signal	Steering Column
Horn Switch	Engages Horn	Steering Wheel
High Beam Switch	Engages high beam	Steering Column
Wiper Low	No function	Steering Column
Wiper High	No function	Steering Column
Door Switch	Verifies the Door is closed	Door

Table 4 - Dash Indicator Top Row

Dash Indicator Top Row		
Light	**Vehicle**	**Function**
Left Turn Signal	Blinks when turn signal is engaged	Blinks when turn signal is engaged
Reverse Indicator	Indicates the transmission is in reverse	Indicates the transmission is in reverse
High Beam Indicator	Turns on with High beams	Turns on with High beams
Engine Shut Down Indicator*	Indicates a condition exists that requires the engine to shut down.	Not modeled
Steering Center Indicator	Not in vehicle	Indicates that the steering wheel is centered
Parking Brake Indicator	Turns on when the parking brake is applied	Turns on when the parking brake is applied
Inter Axle Power Divider (Differential Lock) Indicator	Indicates the Differential Lock is engaged	Indicates the Differential Lock is engaged

Low Air Pressure Indicator	Indicates low air pressure in the air brake system. Audible warning buzzer also will sound an alert.	Indicates low air pressure in the air brake system. Audible warning buzzer also will sound an alert.
Electronic Malfunction Indicator*	Lights up when the VCAD system detects an electronic malfunction	Not modeled
Right Turn Signal	Blinks when turn signal is engaged	Blinks when turn signal is engaged

Table 5 - Dash Indicator Bottom Row

Dash Indicator Bottom Row		
Light	**Vehicle**	**Function**
Cruise Control Indicator	Cruise control is not used in military vehicles	Not modeled
Check Transmission Indicator	Indicates the transmission oil temperature is above the warning limit	Not modeled
ABS Indicator*	Indicates an ABS malfunction.	Not modeled
Maintenance Due Indicator	Not used for military application.	Not modeled

Specifically, the driver's panel for the MRAP (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the MRAP (all variants) cab as described in TM 11202D-OR.

Specifically, the driver's panel for the M-ATV (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the M-ATV (all variants) cab as described in TM 11803A-ID/1 VOL 1.

Specifically, the driver's panel for the LVSR (all variants) shall consist of one or more removable assemblies that replicate the form and function of the LVSR (all variants) as described in TM 11316A/12493A-OD/1A and TM 11313A/12481A-OD/1A.

Specifically, the driver's panel for the JLTV cab shall consist of one or more removable assemblies that replicate the form and function of the JLTV cab as described in the applicable TM.

Specifically, the driver's panel for the HIMARS shall consist of one or more removable assemblies that replicate the form and function of the HIMARS as described in TM 11316A/12493A-OD/1A and TM 11313A/12481A-OD/1A.

3.5.1.1.7.2 Cab Windshield

N/A.

3.5.1.1.7.3 Auxiliary Panels

The driver's compartment shall include removable auxiliary panels, consisting of any gauges, switches, controls, and indicators of the specific vehicle being simulated not located on the dashboard assemblies. The TWV cab shall include universal mounting locations to position each vehicle's auxiliary panels in the proper position relative to the driver, driver's seat, and dashboard assemblies. These auxiliary panels shall represent the simulated TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4 above or the vehicle specific appendices depending on the configuration selected.

3.5.1.1.7.4 Space Constraints

The driver's compartment shall include removable space constraints, consisting of assemblies which limit arm, leg and head movements that replicates the specific vehicles. The TWV cab shall include universal mounting locations to position each space constraint assembly in the proper position relative to the driver, driver's seat and dashboard assemblies.

3.5.1.1.8 Additional Driver's Compartment Components

In addition, the following components not found in the TWV vehicle cabs but shall provide for adequate training and safety:

Specifically for the M1083A1 MTV, the reconfigurable Driver's assembly software stimulates or simulates all required M1083A1 MTV dashboard controls and indicators through the cab I/O subsystem, as specified in Sec. 3.5.1.1.8. All controls and indicators shall operate in accordance with TM 9-2320-392-10 (Vol. 1-3) dated Jan 2005 operator's manual.

Specifically for the M1120A4 HEMTT, the reconfigurable Driver's assembly software shall stimulate or simulate all required M1120A4 HEMTT dashboard controls and indicators through the cab Input / Output (I/O) subsystem. All controls and indicators shall operate in accordance with TM 9-2320-345-10 operator's manual.

Specifically for the M915A3, the reconfigurable Driver's assembly software shall stimulate or simulate all required M915A3 dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 9-2320-302-10 operator's manual.

Specifically for the M915A5, the reconfigurable Driver's assembly software shall stimulate or simulate all required M915A5 dashboard controls and indicators through the cab I/O subsystem.

All controls and indicators shall operate in accordance with TM 9-2320-426-10 operator's manual dated June 2010.

Specifically for the HMMWV, the reconfigurable Driver's assembly software stimulates or simulates all required HMMWV (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11033-OR.

Specifically for the 7-Ton Truck, the reconfigurable Driver's assembly software stimulates or simulates all required 7 Ton Truck (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A.

Specifically for the Buffalo, the reconfigurable Driver's assembly software stimulates or simulates all required Buffalo dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with the applicable vehicle's Operators Manual.

Specifically for the MRAP, the reconfigurable Driver's assembly software stimulates or simulates all required MRAP (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11202D-OR.

Specifically for the M-ATV, the reconfigurable Driver's assembly software stimulates or simulates all required M-ATV (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11803A-ID/1 VOL 1.

Specifically for the LVSR, the reconfigurable Driver's assembly software stimulates or simulates all required LVSR (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11313A/12481A-OD/1A and TM 11316A/12493A-OD/1A.

Specifically for the JLTV, the reconfigurable Driver's assembly software stimulates or simulates all required JLTV dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with the applicable vehicle's Operators Manual.

Specifically for the HIMARS, the reconfigurable Driver's assembly software stimulates or simulates all required HIMARS dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 9-2300-310-14&P.

3.5.1.1.8.1 Emergency lighting

The driver's compartment shall have an battery operated, electrically charged, emergency light that provides sufficient lighting for rapid and safe exit during emergency conditions. The emergency lighting shall illuminate immediately when the CDT loses electrical power.

3.5.1.1.8.2 Fresh Air Circulation Exchange

The driver's compartment shall have constant, cross cab, fresh and forced air circulation to minimize driver stress.

3.5.1.1.8.3 Fire Detection/Warning System

A smoke detector shall be located inside the driver's compartment. The smoke detector shall interface with the CDT smoke and fire detection system to initiate proper simulator action if smoke or fire detects. The driver's compartment shall have an audio and visual alarm (prominently visible to the driver) that interfaces with the CDT smoke and fire detection system to alert the driver to an emergency condition.

3.5.1.1.8.4 Emergency Stop

There shall be an emergency stop switch in the driver's compartment and it is accessible by the driver. The emergency stop switch shall interface with the CDT safety system.

3.5.1.1.8.5 Door and Driver's Seatbelt Interlock

There shall be a driver's compartment door and seatbelt interlock. The interlocks shall inhibit any motion system response if the door is not close properly or the seat belt is not fasten correctly. The interlocks shall pause the simulation, inhibit any motion system response to simulation control inputs, and settle the motion system to the fully lowered position in a controlled manner when the door is open or the seatbelt unbuckled during a training scenario.

3.5.1.1.8.6 Cab Auxiliary Lighting

There shall be a switchable light or lights in the TWV cab. The light shall be of sufficient brightness and location to support student transfers, dashboard, and auxiliary panel installation and cab maintenance.

3.5.2 Assistant Driver's Workstation

3.5.2.1 Assistant Driver's Workstation Software Components

The AD's workstation software shall stimulate or simulate the JCR-Log (applicable to TWV M1083A1, M915A3, M915A5, and M1120A4 only) system to include the following:

a) Create SPOT Report
b) Create Medical Evacuation (MEDEVAC) Request
c) Create MAYDAY Message
d) Respond to a Log Task Management Message
e) Process messages in Flash, Immediate, Priority, or Routine (FIPR)
f) Process Warning Messages
g) Process Received Messages
h) Create Position Report
i) Create Bridge Report
j) Create Obstacle Report

k) Employ Quick Send functions
l) Conduct Local Tag Collection Assistant Driver's Workstation Software Components

3.5.3 Vehicle Simulation

3.5.3.1 Vehicle Dynamics Performance

The CDT TWV shall simulate the vehicle dynamics of each simulated vehicle to the level of detail required to support the training tasks in Sec. 3.4 above. Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g. engine and transmission), suspension (e.g. springing, damping and range of travel), and moments of inertia of each vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics model shall also respond to nearby explosions. The magnitude of the response shall be a function of explosion size and location (distance and azimuth). The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment. The vehicle dynamic performance shall model based on data provided by Government Subject Matter Experts.

Specifically for the M1083A1 MTV, the default configuration shall be the unloaded vehicle.

Specifically for the M1120A4 HEMTT, the vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the M1120A4 HEMTT vehicle. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull.

Specifically for the M915A3, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the M915A3 vehicle. The default M915A3 configuration with the trailer shall be an unloaded trailer. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, trailer, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver's cab.

Specifically for the M915A5, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the M915A5 vehicle. The default

M915A5 configuration with the trailer shall be an unloaded trailer. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, trailer, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver's cab.

Specifically for the HMMWV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the HMMWV (all variants). The default HMMWV (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the 7-Ton Truck, the vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the 7 Ton Truck (all variants) vehicle. The default 7 Ton Truck (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the Buffalo, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the Buffalo vehicle. The default Buffalo configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the MRAP, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the MRAP (all variants) vehicle. The default MRAP (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography

and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the M-ATV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the M-ATV (all variants). The default M-ATV (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the LVSR, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the LVSR (all variants). The default LVSR (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the JLTV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the JLTV vehicle. The default JLTV configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the HIMARS, the vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the HIMARS. The default HIMARS configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results

shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

3.5.3.2 Engine Model

The following operational parameters of the engine shall be simulated IAW the applicable vehicle variant's TM:

a) Engine Torque - The engine output torque shall derive as a function of engine speed, load due to terrain topography and tractability, and throttle angle.

b) Engine Speed - The rotational speed of the engine shall be determined as a function of throttle position, load torque, and engine/transmission inertia. The tachometer in the driver's compartment (if equipped) and the engine speed aural cue shall drive by this output.

c) Fuel Consumption - The fuel consumption shall be determined as a function of throttle position. The fuel level in the fuel tanks shall be determined by subtracting the fuel used from the amount of fuel remaining in the tanks. The fuel gauges in the driver compartment shall drive by the amount of fuel remaining in the tanks. The fuel system model for each vehicle shall replicate the fuel tank capacities for that vehicle. All fuel tanks shall be full at the start of each training scenario. Activation of the low fuel malfunction shall reduce the fuel level in the fuel tank(s) to less than 12% of capacity in eight minutes.

3.5.3.3 Transmission Model

The following output parameters of the transmission shall be simulated IAW the applicable vehicle variant's TM:

a) Transmission operation – The transmission model shall simulate the number of gear ratios in the specific TWV vehicle. The transmission model shall allow for full automatic shifting in drive or driver selection of the gear desired with the gear selection controls.

b) Gear selections - The automatic gear selections (both up and down) shall determine by the position of the transmission shift selector on the vehicle dashboard, the vehicle speed, throttle angle and engine load. The gear selection shall limit the range of output of the transmission dynamics model as appropriate for the selected gear.

3.5.3.4 Steering and Brake Model

The steering and brake model shall be a physics-based model of the actual real world performance of each simulated vehicle. The position of the service brake pedal and the engaged/disengaged status of the parking brake shall be input to the brake model. Appropriate real time brake force parameters shall be determined and applied to the CDT motion control software.

3.5.3.5 Suspension Model

The model of the suspension system shall include computation of the forces acting on the suspension components. The effects of the terrain on each wheel, including slope and height shall combine with the forces due to the mass and momentum of the hull to determine the suspension force acting on the hull. Pitch torque and roll torque shall be computed as inputs to the hull model by transferring the combined forces on the own vehicle through the damping and spring characteristics of the suspension at each wheel.

3.5.3.6 Hull Model

The position, velocity and acceleration of the own vehicle center of gravity shall be determined in six degrees of freedom by the hull model. Inputs from the power train, suspension, and terrain models shall combine to resolve the updated vehicle position and derive the velocities and accelerations.

3.5.3.7 Trailer Dynamics Performance

Specifically, the M1083A1 MTV kit software shall simulate the vehicle dynamics of the M1095 Series, 5 Ton Medium Tactical Vehicle Trailer (MTVT). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the M1120A4 HEMTT kit software shall simulate the vehicle dynamics of the M1076 Palletized Load System Trailer (PLST). The trailer vehicle dynamics shall include the trailer size, weight, CG, suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the M915A3 kit software shall simulate the vehicle dynamics of the 872A4 Flatbed Semitrailer. The trailer vehicle dynamics shall include the trailer size, weight, Center of Gravity (CG) suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to the tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and

with weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the M915A5 kit software shall simulate the vehicle dynamics of the 872A4 Flatbed Semitrailer. The trailer vehicle dynamics shall include the trailer size, weight, suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to the tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the HMMWV kit software shall simulate the vehicle dynamics of the M1101 with chassis (trailer), and the M1102 with chassis (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the 7-Ton Truck kit software shall simulate the vehicle dynamics of the M353 (general purpose trailer), the M105A1 (cargo trailer), the M05A2 (cargo trailer), the M105A2C (cargo trailer), the MK38 (HIMARS RST), the M149A2 (water tank trailer), the MK593 (cargo trailer), the MT020/M322LT (ETT), the MK1076, the M870A2 (MHET), and the M870A2S (MHET). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the Buffalo kit software shall simulate the vehicle dynamics of the applicable trailer(s). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity

(CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the MRAP kit software shall simulate the vehicle dynamics of the M105A1 (trailer), the M105A2 (trailer), and the M105A2C (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the M-ATV kit software shall simulate the vehicle dynamics of the M105A1 (trailer), the M105A2 (trailer), and the M105A2C (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the LVSR kit software shall simulate the vehicle dynamics of the M1076 (PLST) when connected to the MKR18 ID 11313A and AMRK18 ID 12481A. The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the JLTV kit software shall simulate the vehicle dynamics of the applicable trailer(s). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the HIMARS kit software shall simulate the vehicle dynamics of the MK38 (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.8 Transporter Dynamics Performance

Specifically for the 7-Ton Truck, the LVSR kit software shall simulate the vehicle dynamics of the M870A2 MHET and the M870A2S MHET when connected to the MKR/AMKR16 Tractor Truck, MK31 Tractor Truck, and the AMK31 Tractor Truck. The transporter vehicle dynamics shall include the transporter size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The transporter tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The transporter shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the transporter dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine transporter vehicle dynamics. The transporter vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.9 Tanker Dynamics Performance

Specifically for the 7-Ton Truck, the LVSR kit software shall simulate the vehicle dynamics of the MK970 tanker and the AMK970 tanker when connected to the MK31 Tractor Truck and AMK31 Tractor Truck. The tanker vehicle dynamics shall include the tanker size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The tanker tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The tanker shall model in an empty, half and full load configurations, with liquid

and solid loads and with the weight evenly distributed. The parameters for the tanker dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine tanker vehicle dynamics. The tanker vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.10 Howitzer Dynamics Performance

Specifically for the 7-Ton Truck, the LVSR kit software shall simulate the vehicle dynamics of the M777 Howitzer and the M777A2 Howitzer when connected to the MK23 Cargo Truck, the AMK 23 Cargo Truck, the MK25 Cargo Truck, and the AMK25 Cargo Truck. The howitzer vehicle dynamics shall include the howitzer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The howitzer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The howitzer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the howitzer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine howitzer vehicle dynamics. The howitzer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.11 Flatrack and International Standards Organization (ISO) Container Dynamics Performance

The kit software shall simulate the characteristics of the M1077/M1077A1 PLS Flatrack (IAW TM 9-3990-206-10) and an ISO container. The vehicle dynamics shall include the size weight and handling characteristics of the PLS Flatrack or ISO container loaded on the M1120A4 HEMTT. The Flatrack and ISO container (20’ X 8’ X 8’) shall be modeled in an empty, half and full load configuration, with liquid and solid loads and with the weight evenly distributed. When the vehicle aligns with the respective load in conjunction with the ground guide and the Load Handling Unit (LHU) or Container Handling Unit (CHU) deploys properly, the CDT will automatically connect the load. The driver shall control the operation of the LHS to load the Flatrack or the CHU to load the ISO container and travel locks. The M1120A4 HEMTT vehicle dynamics shall exhibit proper vehicle motions encountered during loading along with the aural cues of loading. After loading, the vehicle dynamics shall then reflect the vehicle with the load attached. The rear view mirrors shall show proper visual movement of the load during loading and the stable secured load after loading. The reverse visual imagery, aural cues, and motion simulation response shall provide when unloading the load.

3.5.4 Malfunctions and Emergency Conditions

The CDT TWV shall meet the requirements listed in the list of malfunctions and emergency conditions for each supported vehicle. All the malfunctions and emergency conditions listed herein shall present the appropriate feedback (e.g. abnormal vehicle dynamics, instrument readings, and aural cues) to the driver trainee consistent with the operation and performance of the specific vehicle. For each vehicle’s malfunction and emergency conditions, all relevant

driver's compartment indicators and warnings shall operate IAW the specific vehicle operator's manual. All relevant warning verbal messages, caution alert tones, and indicators shall operate IAW the specific vehicle operator's manual. All malfunctions and emergency conditions shall be able to program to activate at specified points in scripted scenarios and cleared by the instructor or initiated and cleared by the instructor in free play scenarios unless otherwise specified herein. The CDT shall score the student's performance in response to emergency conditions and malfunctions based on the student's ability to perform the correct, timely responses to the emergency conditions and malfunctions. The CDT shall include the following malfunctions and emergency conditions:

a) Vehicle Control - The vehicle control criteria shall monitor continuously during scenario execution. A vehicle control error shall be produced in accordance with the following criteria:

1) Skidding and/or Sliding

i. Due to Turning – An error shall be assigned due to improper turning when the own vehicle slides across the terrain for at least one second and the rate of turn commanded from the steering/throttle control at the onset of the slide exceeds six degrees per second. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the drive wheels speed is greater than two Miles Per Hour (MPH).

ii. Due to Braking - An error shall be assigned due to improper braking when the own vehicle slides across the terrain for at least one second, and the service or parking brake was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.

iii. Due to Acceleration - An error shall be assigned due to improper acceleration when the own vehicle slides across the terrain for at least one second, and, neither the service nor parking brake was applied at the onset of the slide and the throttle was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.

iv. Due to Terrain – An error shall be assigned for skidding and/or sliding due to poor terrain selection when the own vehicle slides across the terrain for at least one second and the criteria for other causes for a slide or skid are not met. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH. Skid scoring shall be inhibited while exiting the mud, or ice and while any wheel is in contact with any loose gravel type terrain.

2) Loss of Mobility

i. Due to a Mired Own Vehicle – An error shall be assigned for loss of mobility due to a mired own vehicle when the terrain type on which the own vehicle is located indicates that it is impassable.
ii. Due to Bellied Own Vehicle – An error shall be assigned for loss of mobility due to a bellied own vehicle when a collision is detected on the underside of the own vehicle chassis.

3) Collisions

i. Hard Collisions – An error shall assign whenever a collision occurs with hard collision objects at speeds greater than 3 MPH.
ii. Slow Speed Hard Collisions - An error shall be assigned whenever a collision occurs with hard collision objects at speeds less than or equal to 3 MPH.
iii. Soft Collisions – An error shall assign whenever a collision occurs with soft collision objects at any speed.

b) Equipment Malfunction

1) Loss of Engine Power - Indicators are lack of response to throttle control and reduction of speed to idle. Steering and brake response reduce by 50% and the hydraulic pressure gauge (if applicable) reads low simulating loss of hydraulic pressure. When these symptoms occur, the driver has 30 seconds to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Notify instructor

2) Loss of Steering - Indication is a lack of response of the steering control. When this occurs, the driver has 30 seconds to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Notify instructor

3) Loss of Brakes - Indication is a lack of response the brake pedal (brake fade). When this occurs, the driver has 30 seconds to:

    i. Maintain control of the vehicle
    ii. Apply service brake lightly
    iii. Engage engine brake
    iv. Downshift transmission
    v. Move to right as far as possible
    vi. Halt vehicle
    vii. Apply parking brake
    viii. Place the transmission in Neutral (N)
    ix. Apply hazard flasher
    x. Notify instructor

4) Flat Tire (one or more, cab or trailer) - After the malfunction is activated, if the malfunction involves a front tire, any attempt to steer causes a series of jolts through the steering and motion subsystems and aural cues heard through the CDT sound subsystem. Any other flat tire malfunction shall produce vibrations through the motion subsystems and aural cues heard through the CDT sound subsystem. When any flat tire malfunction occurs, the driver has 30 seconds from the start of the blown tire aural cues to:

    i. Maintain control of the vehicle
    ii. Apply service brake lightly
    iii. Downshift transmission
    iv. Move to right as far as possible
    v. Halt vehicle
    vi. Apply parking brake
    vii. Place the transmission in Neutral (N)
    viii. Apply hazard flasher
    ix. Notify instructor

5) Low Fuel - When the Low Fuel indication is illuminated (approximately 8 minutes after executing the low fuel malfunction) during a scripted or free play scenario, the trainee shall execute the following sequence of responses within 30 seconds:

    i. Maintain control of the vehicle
    ii. Apply service brake lightly
    iii. Move to right as far as possible
    iv. Halt vehicle
    v. Apply parking brake
    vi. Place the transmission in Neutral (N)
    vii. Apply Hazard flasher
    viii. Notify instructor

6) Low Engine Oil Pressure - This malfunction is available only when the engine is running. Activation reduces the oil pressure gauge reading and illuminates the Engine Oil Pressure

Low indicator or check engine indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indication). If the driver has not completed the response sequence below within 30 seconds of activation, the engine will shut down. Once the engine shuts down, any attempt to restart the engine results in an additional scoring deduction.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

7) High Water Temperature - This malfunction is available only when the engine is running. Activation increases the water/coolant temperature gauge reading and illuminates the High Water Temperature indicator or check engine indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indications). If the driver has not completed the response sequence below within 30 seconds of activation, the engine will shut down. Once the engine shuts down, any attempt to restart the engine results in an additional scoring deduction.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

8) High Transmission Oil Temperature - This malfunction is available only when the engine is running. Activation increases the Transmission Oil Temperature Gauge reading (if equipped) and illuminates the High Transmission Oil Temperature or check transmission indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indication). If the driver has not completed the response sequence below within 90 seconds of activation, the transmission will transfer no power to the drive wheels.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle

v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

3.5.5 Training Scenarios

The CDT TWV shall have access to all training scenarios previously developed for other CDT variant vehicles. The CDT TWV shall provide 40 TWV scenarios based on current fielded CDT databases available for the Program of Instruction (POI). The scenarios for each specific vehicle intended to train Soldiers and Leaders using the crawl, walk, and run method of training. All tasks and elements from the Training Tasks in Sec. 3.4 shall be included in the 40 preprogrammed scenarios.

The CDT TWV shall also provide non-preprogrammed (free-run) scenarios, which have no-predefined ideal paths or training tasks to be completed and allows the student to travel anywhere in the terrain database (within the limits of terrain traversability).

4.0 Acronyms List

AAR	After Action Review
ABS	Anti-lock Braking System
AD	Assistant Driver
AD/VC	Assistant Driver / Vehicle Commander
ADS	AD's Station
CDT	Common Driver Trainer
CG	Center Gravity
CPU	Central Processing Unit
CTIS	Central Tire Inflation System
CCTV	Closed Circuit TV
CS	Control Station
DVE	Driver Vision Enhancer
FIPR	Flash, Immediate, Priority, or Routine
FM	Field Manual
FOV	Field Of View
GUI	Graphical User Interface
GVWR	Gross Vehicle Weight Rating
HEMTT	Heavy Expanded Mobility Tactical Truck
HETS	Heavy Equipment Transport System
HIMARS	High Mobility Artillery Rocket Systems
HMMWV	High Mobility Multipurpose Wheeled Vehicle
Hz	Hertz
IED	Improvised Explosive Device
IO	Input/Output
IOS	Instructor Operator Station
JCR-LOG	Joint Capabilities Release – Logistics
JLTV	Joint Light Tactical Vehicle
LHS	Load Handling System
LTVT	Light Tactical Vehicle Trailer
LVSR	Logistics Vehicle System Replacement\
M-ATV	MRAP All-Terrain Vehicle
MAYDAY	Distress call
MEDEVAC	Medical Evacuation
MHET	Medium Heavy Equipment Transporter
MPH	Miles Per Hour
MRAP	Mine-Resistant Ambush Protected
MRT	Military Rugged Tablet
MTS	Movement Tracking System
MTV	Medium Tactical Vehicle
MTVR	Medium Tactical Vehicle Replacement
MTVT	Medium Tactical Vehicle Trailer
N	Neutral
OTW	Out The Window
PLS	Palletized Load System

PLST	Palletized Load System Trailer
POI	Program of Instruction
PdM VTS	Product Manager for Virtual Training Systems
PTM	Pan & Tilt Module
RPG	Rocket Propelled Grenade
RPM	Revolutions Per Minute
RPSTL	Repair Parts and Special Tools List
RST	Re-Supply Trailer
SRD	System Requirement Document
STS	Student Training Station
TM	Technical Manual
TWV	Tactical Wheeled Variant

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX D – TACTICAL WHEELED VARTIANT (TWV) – PHASE 2

VERSION 2.1

24 OCTOBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors only, due to vulnerability information, effective 30 August 2018. Other request for this document shall be referred to U.S. Army PEO STRI, ATTN: SFAE-STRI-TRADE-VTS.

Engineering

ERDMANN.KEVIN.G.1364877974 Digitally signed by ERDMANN.KEVIN.G.1364877974 Date: 2018.07.18 12:33:41 -04'00'

Prepared By:
Lead Engineer, PM TRASYS
Kevin Erdmann

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.19 11:57:38 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

STOKES.SHAUNA.C.1113537554 Digitally signed by STOKES.SHAUNA.C.1113537554 Date: 2018.07.18 12:30:19 -04'00'

Prepared By
Logistics Management Specialist, PM TRASYS
Shauna Stokes

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.19 15:19:41 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

CHANGE HISTORY

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1.0 Scope

This appendix describes the requirements for the Tactical Wheeled Variant (TWV) simulated vehicle driver's compartment hardware and software. When the driver's compartment installed on a Common Driver Trainer (CDT) platform, the collective system becomes a CDT TWV that provides training for drivers of various types of TWV vehicles. The CDT TWV will provide training of TWV vehicles to drivers during New Equipment Training (NET) and sustainment training. The trainer will enable training in the critical driver tasks that can repetitively train in a simulator. It will also allow training of driver tasks that are dangerous and/or infrequently trained in the "real world" (driving on ice, fording streams, driving under blackout conditions, driving down a steep embankment when coming off an improved road, etc.).

This appendix contains the requirements for the vehicle specific kits. Each kit includes the vehicle specific driver's compartment hardware and simulation software needed to convert the base CDT TWV to match a specific vehicle's physical and functional characteristics.

1.1. Background

The U.S. Army has identified a need for initial and sustainment driver training for the various tracked, wheeled, and heavy equipment vehicles employed by the Army to accomplish its mission. The U.S. Marine Corps (USMC) has equivalent driver training requirements with unique vehicle variants required to accomplish its mission. The CDT TWV will be dual use and support the U.S. Marine Corps with driver training capability for the identified military vehicles. The training must incorporate a variety of terrains, driving conditions and tactical situations.

A CDT configuration composes of common training subsystem modules. The common modules are the Instructor Operator Station (IOS), computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem, After Action Review (AAR) subsystem and Scenario Generation System. The CDT subsystems have documented hardware, software and electrical configurations and interfaces for simulated variant vehicle driver's compartment installation.

The vehicle variant subsystem includes the driver's compartment module and simulation software necessary to provide the configuration and vehicle dynamics of the variant vehicle. The main components of the driver's compartment module are the controls, instruments, switches, panels, seating and physical structure of the variant vehicle necessary to accomplish the required training tasks. The simulation software provides the driver's compartment control/switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required training tasks.

1.1.1 TWV

The CDT TWV is a variant for the CDT. This variant will include the specific modules necessary to provide the configuration and vehicle dynamics of the TWV family of vehicles. The CDT TWV will use all of the common modules as specified in the CDT Common Specifications Requirements Document (SRD) and the specific modules for the TWV as defined herein. The main components in the specific modules are the driver compartment, swappable vehicle specific dash panels with instruments and controls for the driver, space and visual

constraint modules (if necessary) and the software required to operate the driver compartment and interact with the common modules in the CDT.

1.1.2 TWV Family of Vehicles & Equipment

TWV major variants include the following vehicles and equipment:

- High Mobility Multipurpose Wheeled Vehicle (HMMWV) (i.e. M1113, M1114, M1151, M1151A1, M1152, M1152A1, M1165, M1165A1, M1167 and M997A3 utility trucks) (new requirement to CDT)
- Medium Tactical Vehicle Replacement (MTVR) (i.e. AMK/MK23, AMK/MK25, AMK/MK27, AMK/MK28, AMK/MK29, AMK/MK30, AMK/MK31 and AMK/MK36 7 -Ton trucks and MK23 MTVR with MTVR Armor System) (new requirement to CDT)
- MK23 MTVR w/MAS (Marine Armor System) (new requirement to CDT)
- MRAP CAT III Buffalo (new requirement to CDT)
- Joint Light Tactical Vehicle (JLTV) (new requirement to CDT)
- Mine-Resistant Ambush Protected (MRAP) (4x4 and 6x6 both with and without ISS) (new requirement to CDT)
- MRAP All-Terrain Vehicle (M-ATV) (CAT I A1, CAT I A1 ISS, CAT II A1, CAT II A1 ISS, CAT I A2, CAT I A2 ISS, CAT II A2, CAT II A2 ISS, M1240, M1240A1, M1245 and Utility Task Vehicle (UTV)) (new requirement to CDT)
- Logistics Vehicle System Replacement (LVSR) (MKR18 ID 11313A, AMKR18 ID 12481A, MKR16 ID 11316A, AMKR16 ID 12493A)
- High Mobility Rocket System (HIMARS) (M142)
- M1101/M1102 Trailer, Light Tactical; M353 Trailer, General Purpose; M105 Trailer, Cargo 1 ½ Ton; MK593 6-Ton 4-Wheel Cargo Trailer; M149A2 Water Tank Trailer; Engineer Equipment Trailer (EET), M777, Howitzer, MK/AMK970, Aircraft Refueler; Palletized Load System Trailer (PLST)

2.0 Applicable Documents

TM 9-2320-392-10 (Vol. 1-3), Technical Manual Operator's Manual, The M1083A1 Series 5 Ton, 6 X 6 Medium Tactical Vehicles (MTV) dated 1 Jan 2005, 2 Jan 2005 and 3 Mar 2009

TM 9-2320-345-10, Technical Manual Operator's Manual Truck, Load Handling System (LHS), W and W/O Winch, 8x8 M1120A4 dated 10 Oct 2008

TM 9-2320-302-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 52,000 GVWR, 6 X 4, M915A3 dated 10 Dec 2005

TM 9-2320-426-10, Technical Manual Operator's Manual, Truck, Tractor, Line Haul, 66,000 GVWR, 6 X 4, M915A5 dated 10 Jun 2010

TM 9-2330-394-13&P, Operator's, Field Level Manual M1095 Series, 5 Ton, Medium Tactical Vehicle Trailer (MTVT) dated Jan 2005

TM 9-2330-385-10, Technical Manual Operator's Manual, Palletized Load System Trailer (PLST), M1076 dated 10 Apr 2009

TM 9-2320-345-10, Technical Manual Operator's Manual for Truck, Load Handling System (LHS), 8X8, M1120A4 dated 25 February 2014
TM 9-3990-206-10, Technical Manual Operator's Manual, Palletized Load System (PLS) Flatrack, M1077/M1077A1 dated 10 Apr 2009
TM 9-2330-359-14&P, Technical Manual, Semitrailer, Flatbed: Breakbulk/Container, Transporter, 34 Ton, M872, A1, A2, A3 dated Aug 1991
TM 9-2330-331-14&P, Technical Manual, Semitrailer, Flatbed: Breakbulk/Container, Transporter, 34 Ton, M872A4 dated Dec 2005
TM 11-5855-311-12&P-2, Driver's Vision Enhancer (DVE) dated 15 Dec 2008

In the event of a conflict between the requirements of this document and those contained in the documents above, the requirements contained in this document, take precedence.

3.0 Requirements

3.1 System Level Requirements

The CDT TWV shall consist of the CDT Common Modules hardware and software and the reconfigurable TWV specific module hardware and software as specified herein. The CDT common modules are the IOS, computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem and AAR subsystem and Assistant Driver (AD) workstation. The CDT common modules have defined configurations, mechanical interfaces, electrical interfaces, and software architecture/interfaces. The reconfigurable TWV specific module shall interface to the CDT by the defined interfaces, and shall not degrade the performance of existing CDT variants. The reconfigurable TWV specific module shall integrate with the CDT common modules for the CDT TWV configuration. The CDT TWV specific module shall consist of the simulated reconfigurable driver's compartment, the CDT TWV common instruments and controls for the driver, an AD workstation and the software required to operate the driver's compartment, the AD's workstation and interact with the CDT common modules. The CDT TWV specific module shall include vehicle specific kits with each kit containing one or more removable dash panel assemblies, the software to provide the specific vehicle performance in response to driver inputs and, if necessary, the TWV cab space and visual constraints and auxiliary panels.

The HMMWV, 7-Ton Truck/MTVR, Buffalo, MRAP, M-ATV, LVSR, JLTV and HIMARS kits shall consist of hardware and software components which will reconfigure the CDT TWV to support driver training for drivers of that applicable vehicle. The HMMWV, MTVR, Buffalo, MRAP, M-ATV, LVSR, JLTV, and HIMARS specific modules shall consist of:

a. The simulated reconfigurable driver's compartments
b. The instruments and controls for the driver
c. The software required to operate the driver's compartment
d. The software to provide the specific vehicle performance in response to driver inputs and interaction with the Common Modules

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a HMMWV (all variants). In

case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the HMMWV (all variants), the requirements of this appendix shall take precedence when testing the HMMWV (all variants) configurations.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a MTVR (all variants) vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the MTVR (all variants) vehicle, the requirements of this appendix shall take precedence when testing the MTVR (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a Buffalo vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the Buffalo vehicle, the requirements of this appendix shall take precedence when testing the Buffalo configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a MRAP (all variants) vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the MRAP (all variants) vehicle, the requirements of this appendix shall take precedence when testing the MRAP (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as an M-ATV (all variants). In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the M-ATV (all variants), the requirements of this appendix shall take precedence when testing the M-ATV (all variants) configuration).

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a LVSR (all variants). In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the LVSR (all variants), the requirements of this appendix shall take precedence when testing the LVSR (all variants) configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a JLTV vehicle. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the JLTV vehicle, the requirements of this appendix shall take precedence when testing the JLTV configuration.

Unless specifically modified in this appendix, the requirements specified for the CDT TWV baseline vehicle shall apply when the CDT TWV configures as a HIMARS. In case of a conflict between the requirements of the CDT TWV SRD and the requirements of this appendix for the HIMARS, the requirements of this appendix shall take precedence when testing the HIMARS configuration.

3.2 Common Module Requirements

3.2.1 Instructor Operator Station (IOS)

The IOS shall control the operation of CDT Variant Vehicle Student Training Stations (STSs), select/modify training scenarios, monitor simulated vehicle status (e.g. instruments and switches), monitor driver and AD trainee performance and manage student records in accordance with (IAW) the requirements as described in the CDT Common SRD.

The IOS shall have Graphical User Interfaces (GUI) tailored to the operation of the Variant Vehicles as follows:

a) The IOS shall display on the Master Display the following information for each STS controlled:

1) STS Designation
2) Vehicle Being Simulated
3) Scenario Odometer
4) Scenario Elapsed Time
5) Speed
6) Engine Speed (Tachometer Reading)
7) Transmission Gear Selector
8) Steering Wheel Position (Graphical Indication)
9) Throttle Pedal Position (Graphical Indication)
10) Service Brake Pedal Position (Graphical Indication)
11) Trailer Brake position (Graphical Indication)
12) Parking Brake
13) Trailer Parking Brake
14) Dashboard Gauge Values
15) Dashboard and Auxiliary Panel Switch Status
16) Dashboard and Auxiliary Panel Indicator Status
17) Active Malfunction(s)
18) Scoring Events
19) Running Score for Driver
20) Running Score for AD
21) Playback Controls
22) AD Functions Status
23) Convoy Following Distance
24) Hours Operated
25) Fuel consumption
26) Transfer case
27) Miles driven
28) Elapsed total overall driving time (per student)

b) The Topographical Map display shall segment to simultaneously display the topographical map for each STS when in individual or integrated modes. When in network mode, a single topographical map shall display the scenario. Each STS shall

show on the appropriate topographical map with the features defined as described in the CDT Common SRD.

c) The Stealth View display shall segment to simultaneously display the stealth view of each STS as described in the CDT Common SRD during individual or integrated modes of operation. The stealth view of each vehicle shall initially be at a default tethered position above and behind the vehicle. The IOS shall have the capability to select a specific STS stealth view for full screen viewing and/or stealth view eye point positioning. When in network mode, the IOS shall be able to select a network STS vehicle stealth view to display on the IOS Stealth View display.

d) The IOS shall have STS video displays to simultaneously display the Out The Window (OTW) views, Drivers Vision Enhancer (DVE) view and camera view of each STS in a segmented display configuration. The IOS shall have the capability to select a specific STS video view for full screen viewing.

3.2.2 Computational Subsystem

The computational subsystem shall process all CDT Variant Vehicle software IAW the requirements as described in the CDT Common SRD. Computational spare for the CDT Variant Vehicle system shall define as each computer shall have a minimum of 10% spare processing capacity, with a total average across all computers of a minimum of 50% under worst case conditions.

3.2.3 Visual/Display Subsystem

The visual subsystem shall produce the visual imagery for the CDT Variant Vehicle IAW the image generation requirements as described in the CDT Common SRD. The visual database(s) used to produce the imagery for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD. The display system used to display the visual imagery for the CDT Variant Vehicle shall be in accordance with the display system requirements as described in the CDT Common SRD. The AD work station shall have the STS OTW imagery displayed on flat screen, color monitors to provide the same Field Of View (FOV) seen by the driver. In addition, the visual subsystem shall be able to utilize and integrate Night Vision Goggle capabilities.

3.2.4 Aural/Communication Subsystem

The aural/communications system used in the CDT Variant Vehicle, including the AD work station, shall be in accordance with the requirements as described in the CDT Common SRD.

3.2.5 Motion Subsystem

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.1 Motion System Safety

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.2 Interlocks

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.3 Warning Visuals

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.4 Vehicle Simulation

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.5 Vehicle Dynamics

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.5.6 Motion Simulation

The motion capability provided for a fixed site shall simulate the motion (pitch, roll, yaw, heave, surge and sway) associated with the operation of the actual vehicle variant with fidelity to train students. At a minimum, the motion capability provided for a mobile site shall simulate the motion (pitch, roll, surge and sway) associated with the operation of the actual vehicle variant with fidelity to train students. In addition and at a minimum, the CDT TWV Phase 2 shall also provide simulated motion associated with the following when applicable to a variant resulting from terrain surface conditions (e.g. hard, gravel, mud, sand, ice, snow, and water).

a. acceleration;
b. deceleration;
c. braking;
d. rate of turn;
e. collisions;
f. skids;
g. banks;
h. turns;
i. sluggish steering;
j. pivot steering;
k. loose or thrown tracks;
l. tire blowout;
m. loss of steering;
n. loss of brakes;
o. brakes locked;

p. transmission lock-up;
q. engine overspeed;
r. clogged filters (oil, air, fuel);
s. terrain following;
t. speed;
u. traction;
v. suspension;
w. motion;

In addition, interactions with the environment and appended equipment (e.g., mud, snow, ice, rain, collisions, plows, and rollers) shall appropriately simulate.

3.2.5.7 Steering Force Feedback Subsystem

The motion system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.2.6 After Action Review (AAR)

The AAR system for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD. The AAR system shall combine with the AD work station to present the AAR output on one of the Assistant Driver/Vehicle Commander (AD/VC) workstation monitors.

3.2.7 Scenario Generation System (SGS)

The SGS for the CDT Variant Vehicle shall be IAW the requirements as described in the CDT Common SRD.

3.3 Operational Requirements

The CDT Variant Vehicle requirements for physical space, power requirements, safety limitations/considerations, system start times, setup times and reconfiguration times shall be IAW the requirements as described in the CDT Common SRD.

3.4 Variant Vehicle Requirements

3.4.1 TWV Configuration

The CDT TWV shall include a reconfigurable driver's compartment, AD workstation, vehicle specific kits, and simulation software that provide the physical configuration, controls, instruments, vehicle operation, and vehicle dynamics of each of the supported vehicles in the TWV family of vehicles. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the TWV vehicle version necessary to accomplish the required training tasks. When configured as a specific TWV vehicle driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide

realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator which specific TWV configuration installs and provide an error message if there are any reconfigurable components mismatches or components not installed.

The main components of the AD work station shall be the monitors for the driver's cab OTW imagery (left, center, and right), an intra-vehicle communication system and computer workstation (Central Processing Unit (CPU) and keyboard) with a touch screen display. The monitors display the same imagery that the driver views OTW of the cab. The computer workstation uses to simulate the controls, instruments, switches, and panels of the variant vehicle necessary for the AD to accomplish the required training tasks.

3.4.1.1 HMMWV

The HMMWV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the HMMWV (all variants), the M1101 with chassis (trailer), and the M1102 with chassis (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the HMMWV (all variants) necessary to accomplish the required training tasks. When configured as a HMMWV (all variants) driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.2 MTVR

The MTVR kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the MTVR (all variants) vehicle, the M353 (general purpose trailer), the M105A1 (cargo trailer), the M05A2 (cargo trailer), the M105A2C (cargo trailer), the MK38 (HIMARS RST), the M149A2 (water tank trailer), the MK593 (cargo trailer), the MT020/M322LT (ETT), the MK970 (tanker), the AMK970 (tanker), the M870A2 (transporter), and the M870A2S (transporter). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the MTVR (all variants) cab necessary to accomplish the required training tasks. When configured as a MTVR (all variants) vehicle driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and

simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.3 Buffalo

The Buffalo kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the Buffalo vehicle and its applicable trailer(s). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the Buffalo cab necessary to accomplish the required training tasks. When configured as a Buffalo cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.4 MRAP

The MRAP kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the MRAP (all variants) vehicle. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the MRAP (all variants) cab necessary to accomplish the required training tasks. When configured as a MRAP (all variants) cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.5 M-ATV

The M-ATV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the M-ATV (all variants). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the M-ATV (all variants) cab necessary to accomplish the required training tasks. When configured as an M-ATV (all variants) cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.6 LVSR

The LVSR kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation and vehicle dynamics of the LVSR (all variants), the M1076 (PLST), the M870A2 (transporter), and the M870A2S (transporter). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the LVSR (all variants) necessary to accomplish the required training tasks. When configured as a LVSR (all variants) driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any towed equipment loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.7 JLTV

The JLTV kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the JLTV vehicle and the applicable trailer(s). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the JLTV cab necessary to accomplish the required training tasks. When configured as a JLTV cab driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator

response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.1.8 HIMARS

The HIMARS kit shall include simulation hardware and software that replicates the controls, instruments, vehicle operation, and vehicle dynamics of the HIMARS, and the MK38 (trailer). The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the HIMARS necessary to accomplish the required training tasks. When configured as a HIMARS driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches, and panels necessary to accomplish the required TWV training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator at the IOS of the specific TWV configuration, and the loading condition of the primary vehicle, and any trailer loading if attached. Loading conditions shall be adjustable for discrete loading of empty, half full and full states. The default condition shall be empty loading for all adjustable loads. An error message shall display if there are any reconfigurable component mismatches or components not installed.

3.4.2 Variant Vehicle Training Requirements

The CDT Variant Vehicle shall train the training tasks listed in the following paragraphs performed by the student(s), the performance assessed by the system and monitored by the instructor. The training tasks generally reflect the numerous and varied skills that comprise the task of operating a Variant Vehicle.

Variant Vehicle Driver Training Tasks:

1) Enter driver's compartment
2) Check door lock
3) Adjust driver's seat
4) Fasten seat belt
5) Check driver compartment fire extinguisher-manual
6) Perform systems check
7) Check warning and hazard lights

8) Operate the Container Handling Unit
9) Operate the Load Handling System
10) Operate Central Tire Inflation System (CTIS)
11) Check hazard lights
12) Check, monitor Driver's Instrument Panel
13) Operate driving controls
14) Operate transmission
15) Operate transfer case
16) Operate engine brake
17) Operate trailer brake
18) Operate steering
19) Operate brakes
20) Operate service lights
21) Slow/Fast forward driving
22) Reverse driving
23) Motor pool parking
24) Decelerate smoothly to a halt
25) Operate the DVE night vision device
26) Shut down engine/vehicle
27) Secure the station
28) Adjust the driver's seat (adjust for ingress/egress or operation)
29) Operate the vehicle in extreme cold (winter conditions)
30) Respond to malfunctions
31) Check door status
32) Vehicle starting (normal and cold start)
33) Vehicle shutdown
34) Drive on narrow roads
35) Drive on urban roads
36) Drive on highway / interstate highways
37) Drive in towns
38) Navigate overhead obstacles
39) Drive in a convoy
40) Fording
41) Drive in mountains
42) Drive on side slopes as per vehicle variant TM
43) Drive on steep hills
44) Drive on plains terrain
45) Drive on rolling hills
46) Drive on forest trails
47) Drive in dessert conditions
48) Drive during inclement weather
49) Tactical road march
50) Drive over logs / obstacles
51) Drive on inclines as per vehicle variant TM
52) Drive onto railroad car
53) Respond to ground guide commands

54) Cross bridges
55) Cross assault bridges
56) Loading on watercraft
57) Loading on aircraft
58) Herringbone formation
59) Minefield crossing
60) React to Improvised Explosive Device (IED) identification, explosion or ambush
61) Operate truck with trailer

Variant Vehicle AD Training Tasks:

1) Navigate using the Joint Capabilities Release Logistics (JCR-LOG)
2) Send and Receive text messages with the JCR-LOG
3) Operate the vehicle communications system
4) Assist in IED/threat/ambush recognition
5) Clear vehicle blind sides

3.4.3 Malfunction/Emergency Condition Training Requirements

The CDT Variant Vehicle shall simulate the following emergency conditions/malfunctions:

1) Vehicle Control - The vehicle control criteria shall monitor continuously during scenario execution. A vehicle control error shall be produced IAW the following criteria:
    a) Loss of Steering
    b) Loss of Brakes
    c) Loss of Brakes from overheating
    d) Loss of Trailer brakes
    e) Loss of Engine Power
    f) Flat Tire

The CDT Variant Vehicle shall train the driver to react to the following indicators:

a) Annunciator Panel Fault Indicator
b) Check Engine Indicator
c) Engine Oil Pressure Indicator
d) Engine Coolant Temperature Indicator
e) Restricted Airflow Indicator
f) Low Air Pressure Indicator
g) Low Fuel Indicator
h) React to Transmission Control Malfunction Indicator
i) Transmission Fluid Temperature Indicator
j) Transmission Locked
k) Transmission Fault Indicator
l) Low Battery Voltage Indicator
m) Anti-lock Braking System (ABS) Fault Indicator

n) Park Brake On Indicator

2) AD's Station (ADS) Controls and Functions – The ADS controls and functions shall monitor continuously during scenario execution. A control or function error shall be produced IAW the following criteria:
   a) Joint Capabilities Release-Logistics (JCR-LOG) not powering on
   b) JCR-LOG loses signal and information
   c) JCR-LOG communications drop

3.5 Specific Reconfigurable TWV Module Requirements

3.5.1 Simulated Driver Compartment

The CDT TWV driver's compartment shall be reconfigurable between supported vehicles in the TWV family of vehicles. The driver's compartment shall be composed of common components listed in Sec. 3.5.1.1 and specific components listed in Sec. 3.5.1.1.7 and Sec. 3.5.1.1.8 depending on the configuration selected. The specific components shall be, to the maximum extent possible, easily installed and removed to configure the driver's compartment properly for the specific vehicle configuration. The specific hardware configuration along with the specific simulation software shall define the driver's compartment as one of the supported TWV vehicles. The specific driver's compartment configuration shall simulate the physical and functional characteristics of the supported TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4.1 and 3.4.2 above depending on the configuration selected. When a vehicle specific kit installs, the CDT TWV driver's compartment configuration shall replicate all instruments, indicators, gauges, controls, lights, switches, displays, driver's door, and the components listed in Sec.3.5 or the vehicle variant configuration selected to support the training tasks defined in Sec. 3.4 of each vehicle type specified in this appendix. All instruments, indicators, gauges, controls, lights switches, displays and components of the driver's compartment that are non-tactile (i.e. viewed but not touched) and not used for training shall be dimensionally accurate to within +/- 20%. All non-tactile instruments, indicators, gauges, controls, lights, switches, displays and components of the driver's compartment used for training shall be dimensionally accurate to within +/- 15%. All tactile instruments, indicators, gauges, controls, lights, switches, displays and components of the driver's compartment used for training shall be dimensionally accurate within a tolerance of +/- 0.25 inches.

The location within the driver's compartment of tactile and non-tactile components that uses for training shall be accurate within +/- 2.0 inches and maintain the relation between adjacent components within +/- 0.25 inches. Non-tactile components that do not use for training shall be located within +/- 3.0 inches of their actual position. All measurements shall made from a single reference point.

The CDT TWV driver's compartment shall include universal mounting locations, interfaces, and cabling to support installation and use of the CDT TWV kits specified in this appendix.

Items normally present in the driver compartment of the vehicle, but not critical for training the required driver tasks shall present in mock-up form with the same size, shape, and location as the vehicle components. Detachable devices (i.e. DVE night vision device) on the vehicles used to

drive the vehicle shall be part of the simulation. The vehicle body, if appropriate, and external frame assemblies shall replicate to provide appropriate visual and human factor obstructions. The driver's compartment shall include a cross cab fresh air circulation and exchange system with sufficient airflow to maintain the internal temperature within +5 degrees F of the temperature outside the driver's compartment.

The cab exchange time(s) and interfaces shall be as described in the CDT Common SRD.

Re-configuring from one CDT TWV vehicle specific kit to another CDT TWV vehicle specific kit shall be achievable by a two person crew in less than 30 minutes, with a desired objective time of 15 minutes.

Each vehicle specific kit shall include one or more ruggedized storage containers for storing accessory panels, switchboxes, vision restriction plates, and space restrictors. Vehicle specific dashboards shall be stored on either fixed or mobile racks capable of holding multiple dashboards. All components required to simulate a particular vehicle or family of vehicles shall store within a single storage container. All storage containers shall meet the requirements for a two-man lift.

3.5.1.1 Driver' Compartment Subsystem Common Components

The driver's compartment subsystem shall simulate the following common components of the driver's compartment for the TWV vehicles:

1) Driver's Door
2) Steering Column and Wheel (common or unique vehicle-specific)
3) Throttle
4) Service Brake Pedal
5) Driver's Seat including 3-Point Seat Belt System
6) DVE Night Vision Device

The CDT TWV baseline vehicle cab shall replicate the overall driver's position dimensions of the M1083A1 MTV. Right hand side of the cab can truncate due to overall CDT cab width requirements.

Reconfiguration of the driver's compartment subsystem between supported vehicles in the TWV family of vehicles shall not require removal or replacement of any of the Driver's Compartment Subsystem Common Components.

The Driver's Compartment Common Components shall have the following capabilities and characteristics:

3.5.1.1.1 Driver's Door

The driver's door assembly shall be representative of the simulated TWV vehicles. The door shall have an approximate overall dimension of 41 inches wide by 55 inches tall. The door shall have a rectangular shape (no wheel well cutouts) with the front upper edge conforming to the slant. A latch mechanism shall provide to secure the door in the fully closed position. A door

opening handle representative of the TWV vehicles shall provide on the inside and outside of the door. The door shall be safety interlocked to the motion subsystem to allow motion only when the door is in the fully closed and secured position. The driver's door shall include mounting devices for mounting space and vision constraint modules included in vehicle specific kits, if applicable.

3.5.1.1.2 Steering Column and Wheel (common or unique vehicle-specific)

The Steering Wheel of the TWV cab shall be representative of the TWV vehicles simulated 18 inches in diameter. The steering column shall have the capability to tilt and telescope to accommodate the different steering wheel angles and heights of the TWV vehicles. The column and wheel shall position in the cab to be able to adjust to a representative configuration for each of the TWV vehicles. The steering wheel/column shall have a turn signal control (left) and a trailer brake hand control lever (right). The turn signal control shall have a push button on the end of the control and a pull switch (pull turn signal stalk towards the steering wheel) capability. The steering wheel shall have a button cap switch in the center that is programmable to be active. The pull switch capability and the push button shall be programmable to the function of the vehicle being simulated (i.e. headlight dimmer and horn). The steering simulation shall represent the appropriate force feel cues, sensitivity, deflection, and number of turns lock to lock required for steering and turning each of the simulated vehicles.

Specifically for the HMMWV, the steering column and wheel for the HMMWV (all variants) shall be the same as the steering column and wheel specified for the TWV. The steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual HMMWV (all variants) steering wheel as described in TM 11033-OR. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the MTVR, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual MTVR (all variants) steering wheel as described in TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the Buffalo, the steering column and wheel for the Buffalo cab shall be the same as the steering column and wheel specified for the TWV. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the MRAP, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual MRAP (all variants) steering wheel as described in

TM 11202D-OR. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the M-ATV, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual M-ATV (all variants) steering wheel as described in TM 11803A-ID/1 VOL 1. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the LVSR, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual LVSR (all variants) steering wheel as described in TM 11313A/12481A-OD/1A and TM 11316A/12493A-OD/1A. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the JLTV, the steering wheel shall replicate the form and function of the actual JLTV steering wheel as described in the applicable TM. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

Specifically for the HIMARS, the steering wheel shall be interchangeable. The steering wheel shall replicate the form and function of the actual HIMARS steering wheel as described in TM 9-2300-310-14&P. The turn signal control stalk shall move up for right turns and down for left turns. The pull switch capability of the turn signal stalk shall program to switch between high and low beam service lights (i.e., service light dimmer switch). The turn stalk end button shall program to activate the vehicle horn when pushed.

3.5.1.1.3 Throttle

The throttle pedal shall have the representative dimensions, range of motion, adjustments, and position as the TWV family of vehicles throttle pedal. The simulation shall represent the appropriate force feel cues and deflection required for accelerating each of the simulated vehicles.

3.5.1.1.4 Service Brake Pedal

The service brake pedal shall have the representative dimensions, range of motion, adjustments, and position as the TWV family of vehicles service brake pedal. The simulation shall represent the appropriate force feel cues and deflection required for decelerating each of the simulated vehicles. The service brake shall utilize compressed air to provide the feel and aural cues representative of actual vehicle operation.

3.5.1.1.5 Driver's Seat

The driver's seat shall have the representative dimensions, controls, range of motion, adjustments, and position as the TWV family of vehicles driver's seat. Fore and aft adjustments shall accommodate the seat to dash/steering wheel dimensions of the simulated vehicles. The seat height adjustment shall accommodate the seat height above floor dimension for each of the simulated vehicles. The driver's seat shall have the capability of being air suspended or locked at a specific height depending on the simulated vehicle.

3.5.1.1.6 DVE Night Vision Device

The CDT TWV driver's compartment shall include a DVE system. The DVE shall mount in the CDT TWV cab in the same location as operational vehicle cabs within the tolerances specified in Sec. 3.5.1. The DVE support shall replicate the size, shape, and adjustability of the operational system. A power and signal connector shall be provided. The DVE shall replicate the image (sensor location, field of view, and image characteristics) of the simulated TWV vehicle's DVE. The gain, level, brightness, and white hot/black hot controls shall be operational and modify the displayed image as in the operational system. The look angle of the DVE shall control by the Pan and Tilt Module (PTM) controller. The PTM controller shall be located based on the variant specific location. The PTM controller shall function IAW TM 11-5855-311-12&P-2.

3.5.1.1.7 Specific Driver's Compartment Hardware Components

The baseline vehicle cab shall include the following specific hardware components:

a) Interchangeable Dashboard Panels
b) Cab
c) Auxiliary panels
d) Space Constraints

3.5.1.1.7.1 Interchangeable Dashboard Panels and Equipment

The CDT TWV driver's compartment shall include removable dashboard assemblies, consisting of all gauges, switches, controls, and indicators of the specific vehicle being simulated. The TWV cab shall include universal mounting locations to position each vehicle's dashboard assemblies in the proper position relative to the driver and driver's seat. These dashboard assemblies shall represent the simulated TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4 above or the vehicle specific appendices depending on the configuration selected.

Specifically, the driver's panel for the HMMWV (all variants) shall consist of one or more removable assemblies that replicate the form and function of the HMMWV (all variants) as described in TM 11033-OR.

Specifically, the driver's panel for the MTVR (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the MTVR (all variants) cab as described in TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A.

Specifically, the drivers' panel for the Buffalo cab shall consist of one or more removable assemblies that replicate the form and function of the Buffalo cab. Unless specified as "not

modeled," the dashboard, Shifter, and Side Panel items in Figure 1 and Figure 1 below are to be functional. The panels/clusters, switches and indicators that are replicated are as listed in Table 1, Table 2, Table 3, Table 4 and Table 5 below.

Dashboard

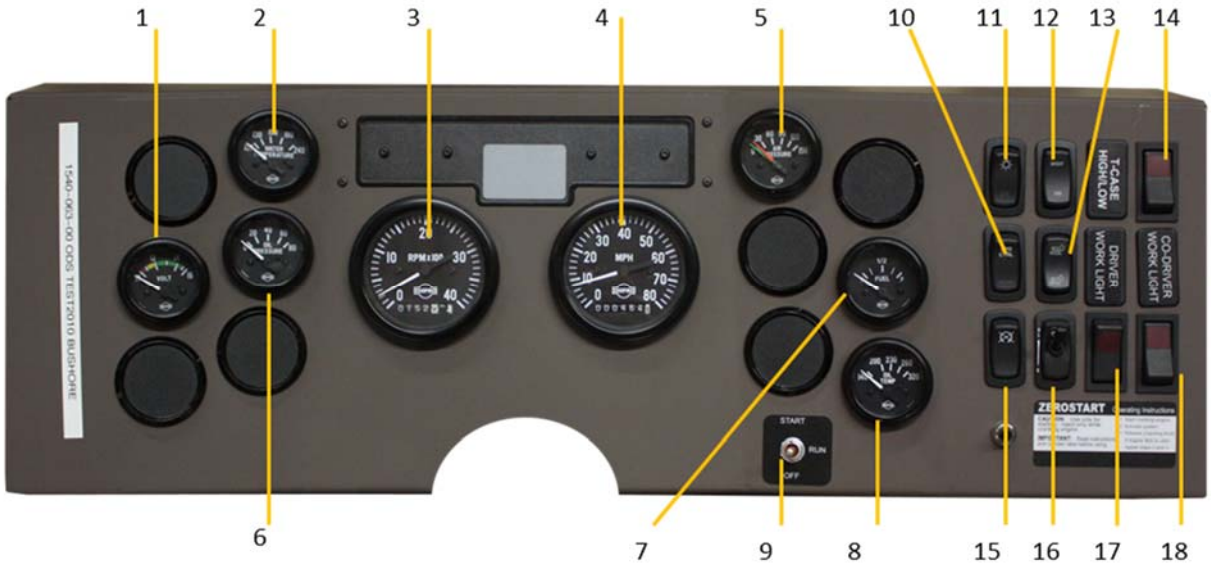

Figure 1 - Dashboard

Table 1 - Main Dash Switches and Gauges

Main Dash Switches and Gauges		
#	**Switch**	**Function**
1	12 Volt Gauge	Display voltage to the dash in the cab. Indicates 0 or operating voltage
2	Water temperature gauge	Indicates the temperature of the coolant solution in the engine
3	Tachometer	Displays engine RPM
4	Speedometer	Displays vehicle speed
5	Air Pressure Gauge	Displays air brake pressure in the cab
6	Oil pressure Gauge	Displays either normal operating pressure or 0 pressure

7	Fuel Gauge	Indicates the amount of fuel
8	Oil temperature gauge	Indicates 0 or operating engine oil temperature
9	Engine Ignition Switch	Starts the vehicle when held up, stops the vehicle by pushing switch down
10	Speed Control ON/Off	Speed Control ON/Off
11	Master Lighting switch	Master Lighting switch
12	Panel Dimmer Switch	Panel Dimmer Switch
13	Resume/Set Switch or Accel Switch	Resume/Set Switch or Accel Switch
14	Transfer Case Switch	Transfer Case Switch
15	Engine Override Shutdown Switch	Not modeled
16	Windshield Wiper Control	Not modeled
17	Driver Work Light	Not modeled
18	Co-Driver Work Light	Not modeled

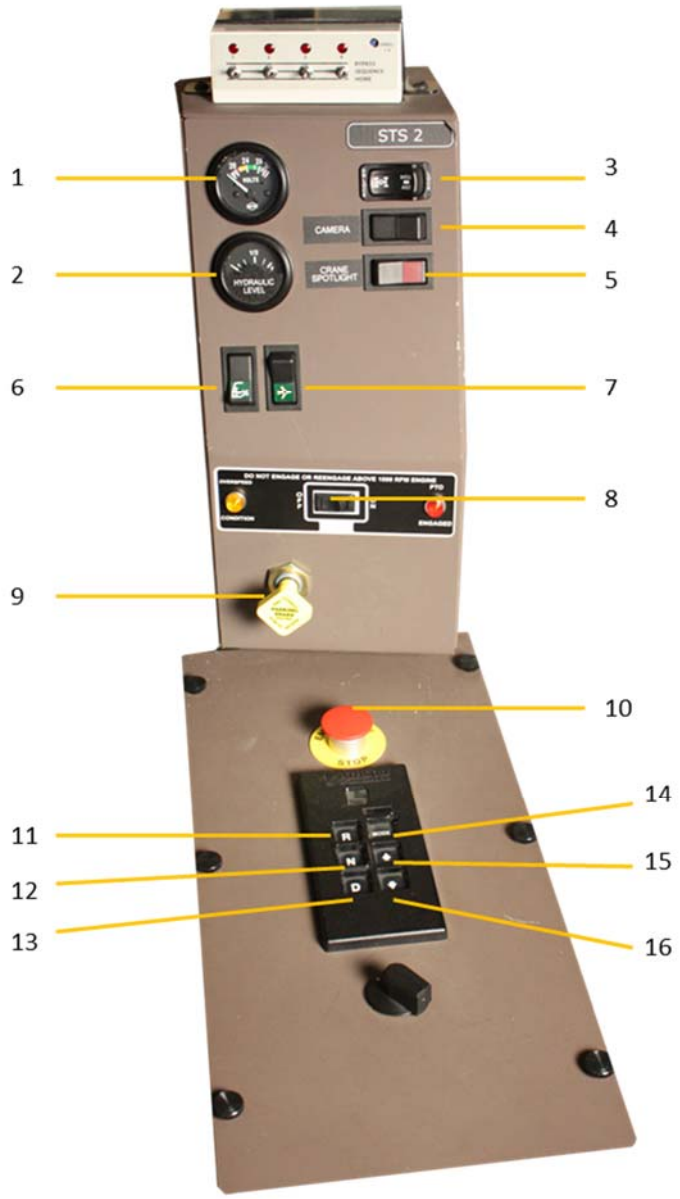

Figure 2 - Buffalo Simulator Shifter and Side Panel

Table 2 - Side Dash Switches and Gauges

Side Dash Switches and Gauges		
#	**Switch**	**Function**
1	24 Volt Gauge	Display voltage to the dash in the cab, indicating 0 or operating voltage.

2	Hydraulic Gauge	Displays either normal operating level or empty.
3	Inter-axle Lock	Locks the intermediate and rear axles when engaged
4	Video Power Switch	Turns power on and off for all three cameras; front, rear, and crane.
5	Crane Spotlight	Not modeled
6	Fan Switch	Controls in-cab fan
7	Overhead Switch	Overhead View On/Off
8	PTO Switch	Not modeled
9	Parking Brake Control	Push to release the vehicle parking brakes. Pull to apply vehicle and trailer parking brakes
10	Emergency-Stop	Kills power to the steering and seat systems
11	Reverse	Put transmission in reverse
12	Neutral	Put transmission in neutral
13	Drive	Put transmission in drive
14	Mode	Not modeled
15	Shift Up	Shift transmission up one gear
16	Shift Down	Shift transmission down one gear

Table 3 - Additional Switches (Simulator specific)

Additional Switches (Simulator specific)		
Switch	**Function**	**Location**
Seat Belt Switch	Verifies that the seat belt is engaged	Seat Belt
Right Turn Switch	Engages right turn signal	Steering Column

Left Turn Switch	Engages left turn signal	Steering Column
Horn Switch	Engages Horn	Steering Wheel
High Beam Switch	Engages high beam	Steering Column
Wiper Low	No function	Steering Column
Wiper High	No function	Steering Column
Door Switch	Verifies the Door is closed	Door

Table 4 - Dash Indicator Top Row

Dash Indicator Top Row		
Light	**Vehicle**	**Function**
Left Turn Signal	Blinks when turn signal is engaged	Blinks when turn signal is engaged
Reverse Indicator	Indicates the transmission is in reverse	Indicates the transmission is in reverse
High Beam Indicator	Turns on with High beams	Turns on with High beams
Engine Shut Down Indicator*	Indicates a condition exists that requires the engine to shut down.	Not modeled
Steering Center Indicator	Not in vehicle	Indicates that the steering wheel is centered
Parking Brake Indicator	Turns on when the parking brake is applied	Turns on when the parking brake is applied
Inter Axle Power Divider (Differential Lock) Indicator	Indicates the Differential Lock is engaged	Indicates the Differential Lock is engaged
Low Air Pressure Indicator	Indicates low air pressure in the air brake system.	Indicates low air pressure in the air brake system.

	Audible warning buzzer also will sound an alert.	Audible warning buzzer also will sound an alert.
Electronic Malfunction Indicator*	Lights up when the VCAD system detects an electronic malfunction	Not modeled
Right Turn Signal	Blinks when turn signal is engaged	Blinks when turn signal is engaged

Table 5 - Dash Indicator Bottom Row

Dash Indicator Bottom Row		
Light	**Vehicle**	**Function**
Cruise Control Indicator	Cruise control is not used in military vehicles	Not modeled
Check Transmission Indicator	Indicates the transmission oil temperature is above the warning limit	Not modeled
ABS Indicator*	Indicates an ABS malfunction.	Not modeled
Maintenance Due Indicator	Not used for military application.	Not modeled

Specifically, the driver's panel for the MRAP (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the MRAP (all variants) cab as described in TM 11202D-OR.

Specifically, the driver's panel for the M-ATV (all variants) cab shall consist of one or more removable assemblies that replicate the form and function of the M-ATV (all variants) cab as described in TM 11803A-ID/1 VOL 1.

Specifically, the driver's panel for the LVSR (all variants) shall consist of one or more removable assemblies that replicate the form and function of the LVSR (all variants) as described in TM 11316A/12493A-OD/1A and TM 11313A/12481A-OD/1A.

Specifically, the driver's panel for the JLTV cab shall consist of one or more removable assemblies that replicate the form and function of the JLTV cab as described in the applicable TM.

Specifically, the driver's panel for the HIMARS shall consist of one or more removable assemblies that replicate the form and function of the HIMARS as described in TM 11316A/12493A-OD/1A and TM 11313A/12481A-OD/1A.

3.5.1.1.7.2 Cab Windshield

N/A.

3.5.1.1.7.3 Auxiliary Panels

The driver's compartment shall include removable auxiliary panels, consisting of any gauges, switches, controls, and indicators of the specific vehicle being simulated not located on the dashboard assemblies. The TWV cab shall include universal mounting locations to position each vehicle's auxiliary panels in the proper position relative to the driver, driver's seat, and dashboard assemblies. These auxiliary panels shall represent the simulated TWV vehicle with sufficient fidelity to adequately train the students in the training tasks listed in Sec. 3.4 above or the vehicle specific appendices depending on the configuration selected.

3.5.1.1.7.4 Space Constraints

The driver's compartment shall include removable space constraints, consisting of assemblies which limit arm, leg and head movements that replicates the specific vehicles. The TWV cab shall include universal mounting locations to position each space constraint assembly in the proper position relative to the driver, driver's seat and dashboard assemblies.

3.5.1.1.8 Additional Driver's Compartment Components

In addition, the following components not found in the TWV vehicle cabs but shall provide for adequate training and safety:

Specifically for the HMMWV, the reconfigurable Driver's assembly software stimulates or simulates all required HMMWV (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11033-OR.

Specifically for the MTVR, the reconfigurable Driver's assembly software stimulates or simulates all required MTVR (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 10629A-OR/A, TM 10632A-OR/A, and TM 11165A-OR/A.

Specifically for the Buffalo, the reconfigurable Driver's assembly software stimulates or simulates all required Buffalo dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with the applicable vehicle's Operators Manual.

Specifically for the MRAP, the reconfigurable Driver's assembly software stimulates or simulates all required MRAP (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11202D-OR.

Specifically for the M-ATV, the reconfigurable Driver's assembly software stimulates or simulates all required M-ATV (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11803A-ID/1 VOL 1.

Specifically for the LVSR, the reconfigurable Driver's assembly software stimulates or simulates all required LVSR (all variants) dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 11313A/12481A-OD/1A and TM 11316A/12493A-OD/1A.

Specifically for the JLTV, the reconfigurable Driver's assembly software stimulates or simulates all required JLTV dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with the applicable vehicle's Operators Manual.

Specifically for the HIMARS, the reconfigurable Driver's assembly software stimulates or simulates all required HIMARS dashboard controls and indicators through the cab I/O subsystem. All controls and indicators shall operate in accordance with TM 9-2300-310-14&P.

3.5.1.1.8.1 Emergency lighting

The driver's compartment shall have an battery operated, electrically charged, emergency light that provides sufficient lighting for rapid and safe exit during emergency conditions. The emergency lighting shall illuminate immediately when the CDT loses electrical power.

3.5.1.1.8.2 Fresh Air Circulation Exchange

The driver's compartment shall have constant, cross cab, fresh and forced air circulation to minimize driver stress.

3.5.1.1.8.3 Fire Detection/Warning System

A smoke detector shall be located inside the driver's compartment. The smoke detector shall interface with the CDT smoke and fire detection system to initiate proper simulator action if smoke or fire detects. The driver's compartment shall have an audio and visual alarm (prominently visible to the driver) that interfaces with the CDT smoke and fire detection system to alert the driver to an emergency condition.

3.5.1.1.8.4 Emergency Stop

There shall be an emergency stop switch in the driver's compartment and it is accessible by the driver. The emergency stop switch shall interface with the CDT safety system.

3.5.1.1.8.5 Door and Driver's Seatbelt Interlock

There shall be a driver's compartment door and seatbelt interlock. The interlocks shall inhibit any motion system response if the door is not close properly or the seat belt is not fasten correctly. The interlocks shall pause the simulation, inhibit any motion system response to simulation control inputs, and settle the motion system to the fully lowered position in a controlled manner when the door is open or the seatbelt unbuckled during a training scenario.

3.5.1.1.8.6 Cab Auxiliary Lighting

There shall be a switchable light or lights in the TWV cab. The light shall be of sufficient brightness and location to support student transfers, dashboard, and auxiliary panel installation and cab maintenance.

3.5.2 Assistant Driver's Workstation

3.5.2.1 Assistant Driver's Workstation Software Components

The AD's workstation software shall stimulate or simulate the JCR-Log system to include the following:

a) Create SPOT Report
b) Create Medical Evacuation (MEDEVAC) Request
c) Create MAYDAY Message
d) Respond to a Log Task Management Message
e) Process messages in Flash, Immediate, Priority, or Routine (FIPR)
f) Process Warning Messages
g) Process Received Messages
h) Create Position Report
i) Create Bridge Report
j) Create Obstacle Report
k) Employ Quick Send functions
l) Conduct Local Tag Collection Assistant Driver's Workstation Software Components

3.5.3 Vehicle Simulation

3.5.3.1 Vehicle Dynamics Performance

The CDT TWV shall simulate the vehicle dynamics of each simulated vehicle to the level of detail required to support the training tasks in Sec. 3.4 above. Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g. engine and transmission), suspension (e.g. springing, damping and range of travel), and moments of inertia of each vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics model shall also respond to nearby explosions. The magnitude of the response shall be a function of explosion size and location (distance and azimuth). The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment. The vehicle dynamic performance shall model based on data provided by Government Subject Matter Experts.

Specifically for the HMMWV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the HMMWV (all variants). The default HMMWV (all variants) configuration shall be unloaded vehicle. The parameters for

these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the MTVR, the vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the MTVR (all variants) vehicle. The default MTVR (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the Buffalo, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the Buffalo vehicle. The default Buffalo configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the MRAP, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the MRAP (all variants) vehicle. The default MRAP (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the M-ATV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the M-ATV (all variants). The default M-ATV (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver

compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the LVSR, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the LVSR (all variants). The default LVSR (all variants) configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the JLTV, the vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the JLTV vehicle. The default JLTV configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

Specifically for the HIMARS, the vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the HIMARS. The default HIMARS configuration shall be unloaded vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment.

3.5.3.2 Engine Model

The following operational parameters of the engine shall be simulated IAW the applicable vehicle variant's TM:

a) Engine Torque - The engine output torque shall derive as a function of engine speed, load due to terrain topography and tractability, and throttle angle.

b) Engine Speed - The rotational speed of the engine shall be determined as a function of throttle position, load torque, and engine/transmission inertia. The

tachometer in the driver's compartment (if equipped) and the engine speed aural cue shall drive by this output.

c) Fuel Consumption - The fuel consumption shall be determined as a function of throttle position. The fuel level in the fuel tanks shall be determined by subtracting the fuel used from the amount of fuel remaining in the tanks. The fuel gauges in the driver compartment shall drive by the amount of fuel remaining in the tanks. The fuel system model for each vehicle shall replicate the fuel tank capacities for that vehicle. All fuel tanks shall be full at the start of each training scenario. Activation of the low fuel malfunction shall reduce the fuel level in the fuel tank(s) to less than 12% of capacity in eight minutes.

3.5.3.3 Transmission Model

The following output parameters of the transmission shall be simulated IAW the applicable vehicle variant's TM:

a) Transmission operation – The transmission model shall simulate the number of gear ratios in the specific TWV vehicle. The transmission model shall allow for full automatic shifting in drive or driver selection of the gear desired with the gear selection controls.

b) Gear selections - The automatic gear selections (both up and down) shall determine by the position of the transmission shift selector on the vehicle dashboard, the vehicle speed, throttle angle and engine load. The gear selection shall limit the range of output of the transmission dynamics model as appropriate for the selected gear.

3.5.3.4 Steering and Brake Model

The steering and brake model shall be a physics-based model of the actual real world performance of each simulated vehicle. The position of the service brake pedal and the engaged/disengaged status of the parking brake shall be input to the brake model. Appropriate real time brake force parameters shall be determined and applied to the CDT motion control software.

3.5.3.5 Suspension Model

The model of the suspension system shall include computation of the forces acting on the suspension components. The effects of the terrain on each wheel, including slope and height shall combine with the forces due to the mass and momentum of the hull to determine the suspension force acting on the hull. Pitch torque and roll torque shall be computed as inputs to the hull model by transferring the combined forces on the own vehicle through the damping and spring characteristics of the suspension at each wheel.

3.5.3.6 Hull Model

The position, velocity and acceleration of the own vehicle center of gravity shall be determined in six degrees of freedom by the hull model. Inputs from the power train, suspension, and terrain

models shall combine to resolve the updated vehicle position and derive the velocities and accelerations.

3.5.3.7 Trailer Dynamics Performance

Specifically, the HMMWV kit software shall simulate the vehicle dynamics of the M1101 with chassis (trailer), and the M1102 with chassis (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the MTVR kit software shall simulate the vehicle dynamics of the M353 (general purpose trailer), the M105A1 (cargo trailer), the M05A2 (cargo trailer), the M105A2C (cargo trailer), the MK38 (HIMARS RST), the M149A2 (water tank trailer), the MK593 (cargo trailer), the MT020/M322LT (ETT), the MK1076, the M870A2 (MHET), and the M870A2S (MHET). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the Buffalo kit software shall simulate the vehicle dynamics of the applicable trailer(s). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the MRAP kit software shall simulate the vehicle dynamics of the M105A1 (trailer), the M105A2 (trailer), and the M105A2C (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment

to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the M-ATV kit software shall simulate the vehicle dynamics of the M105A1 (trailer), the M105A2 (trailer), and the M105A2C (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the LVSR kit software shall simulate the vehicle dynamics of the M1076 (PLST) when connected to the MKR18 ID 11313A and AMRK18 ID 12481A. The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the JLTV kit software shall simulate the vehicle dynamics of the applicable trailer(s). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

Specifically, the HIMARS kit software shall simulate the vehicle dynamics of the MK38 (trailer). The trailer vehicle dynamics shall include the trailer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The trailer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The trailer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the trailer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine trailer vehicle dynamics. The trailer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.8 Transporter Dynamics Performance

Specifically for the MTVR, the LVSR kit software shall simulate the vehicle dynamics of the M870A2 MHET and the M870A2S MHET when connected to the MKR/AMKR16 Tractor Truck, MK31 Tractor Truck, and the AMK31 Tractor Truck. The transporter vehicle dynamics shall include the transporter size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The transporter tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The transporter shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the transporter dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine transporter vehicle dynamics. The transporter vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.9 Tanker Dynamics Performance

Specifically for the MTVR, the LVSR kit software shall simulate the vehicle dynamics of the MK970 tanker and the AMK970 tanker when connected to the MK31 Tractor Truck and AMK31 Tractor Truck. The tanker vehicle dynamics shall include the tanker size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The tanker tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The tanker shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the tanker dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine tanker vehicle dynamics. The tanker vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.10 Howitzer Dynamics Performance

Specifically for the MTVR, the LVSR kit software shall simulate the vehicle dynamics of the M777 Howitzer and the M777A2 Howitzer when connected to the MK23 Cargo Truck, the AMK 23 Cargo Truck, the MK25 Cargo Truck, and the AMK25 Cargo Truck. The howitzer

vehicle dynamics shall include the howitzer size, weight, center of gravity (CG), suspension characteristics, and attachment to tow vehicle. The howitzer tracking and turning shall respond correctly to tow vehicle dynamics in both forward and reverse movement. The howitzer shall model in an empty, half and full load configurations, with liquid and solid loads and with the weight evenly distributed. The parameters for the howitzer dynamic model shall evaluate at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with inputs from the tow vehicle to determine howitzer vehicle dynamics. The howitzer vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment as applicable.

3.5.3.11 Flatrack and International Standards Organization (ISO) Container Dynamics Performance

The kit software shall simulate the characteristics of the M1077/M1077A1 PLS Flatrack (IAW TM 9-3990-206-10) and an ISO container. The vehicle dynamics shall include the size weight and handling characteristics of the PLS Flatrack or ISO container loaded on the M1120A4 HEMTT. The Flatrack and ISO container (20’ X 8’ X 8’) shall be modeled in an empty, half and full load configuration, with liquid and solid loads and with the weight evenly distributed. When the vehicle aligns with the respective load in conjunction with the ground guide and the Load Handling Unit (LHU) or Container Handling Unit (CHU) deploys properly, the CDT will automatically connect the load. The driver shall control the operation of the LHS to load the Flatrack or the CHU to load the ISO container and travel locks. The M1120A4 HEMTT vehicle dynamics shall exhibit proper vehicle motions encountered during loading along with the aural cues of loading. After loading, the vehicle dynamics shall then reflect the vehicle with the load attached. The rear view mirrors shall show proper visual movement of the load during loading and the stable secured load after loading. The reverse visual imagery, aural cues, and motion simulation response shall provide when unloading the load.

3.5.4 Malfunctions and Emergency Conditions

The CDT TWV shall meet the requirements listed in the list of malfunctions and emergency conditions for each supported vehicle. All the malfunctions and emergency conditions listed herein shall present the appropriate feedback (e.g. abnormal vehicle dynamics, instrument readings, and aural cues) to the driver trainee consistent with the operation and performance of the specific vehicle. For each vehicle’s malfunction and emergency conditions, all relevant driver’s compartment indicators and warnings shall operate IAW the specific vehicle operator’s manual. All relevant warning verbal messages, caution alert tones, and indicators shall operate IAW the specific vehicle operator’s manual. All malfunctions and emergency conditions shall be able to program to activate at specified points in scripted scenarios and cleared by the instructor or initiated and cleared by the instructor in free play scenarios unless otherwise specified herein. The CDT shall score the student’s performance in response to emergency conditions and malfunctions based on the student’s ability to perform the correct, timely responses to the emergency conditions and malfunctions. The CDT shall include the following malfunctions and emergency conditions:

a) Vehicle Control - The vehicle control criteria shall monitor continuously during scenario execution. A vehicle control error shall be produced in accordance with the following criteria:

1) Skidding and/or Sliding

i. Due to Turning – An error shall be assigned due to improper turning when the own vehicle slides across the terrain for at least one second and the rate of turn commanded from the steering/throttle control at the onset of the slide exceeds six degrees per second. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the drive wheels speed is greater than two Miles Per Hour (MPH).

ii. Due to Braking - An error shall be assigned due to improper braking when the own vehicle slides across the terrain for at least one second, and the service or parking brake was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.

iii. Due to Acceleration - An error shall be assigned due to improper acceleration when the own vehicle slides across the terrain for at least one second, and, neither the service nor parking brake was applied at the onset of the slide and the throttle was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.

iv. Due to Terrain – An error shall be assigned for skidding and/or sliding due to poor terrain selection when the own vehicle slides across the terrain for at least one second and the criteria for other causes for a slide or skid are not met. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH. Skid scoring shall be inhibited while exiting the mud, or ice and while any wheel is in contact with any loose gravel type terrain.

2) Loss of Mobility

i. Due to a Mired Own Vehicle – An error shall be assigned for loss of mobility due to a mired own vehicle when the terrain type on which the own vehicle is located indicates that it is impassable.

ii. Due to Bellied Own Vehicle – An error shall be assigned for loss of mobility due to a bellied own vehicle when a collision is detected on the underside of the own vehicle chassis.

3) Collisions

i. Hard Collisions – An error shall assign whenever a collision occurs with hard collision objects at speeds greater than 3 MPH.
ii. Slow Speed Hard Collisions - An error shall be assigned whenever a collision occurs with hard collision objects at speeds less than or equal to 3 MPH.
iii. Soft Collisions – An error shall assign whenever a collision occurs with soft collision objects at any speed.

b) Equipment Malfunction

1) Loss of Engine Power - Indicators are lack of response to throttle control and reduction of speed to idle. Steering and brake response reduce by 50% and the hydraulic pressure gauge (if applicable) reads low simulating loss of hydraulic pressure. When these symptoms occur, the driver has 30 seconds to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Notify instructor

2) Loss of Steering - Indication is a lack of response of the steering control. When this occurs, the driver has 30 seconds to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Notify instructor

3) Loss of Brakes - Indication is a lack of response the brake pedal (brake fade). When this occurs, the driver has 30 seconds to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Engage engine brake
iv. Downshift transmission
v. Move to right as far as possible
vi. Halt vehicle
vii. Apply parking brake

viii. Place the transmission in Neutral (N)
ix. Apply hazard flasher
x. Notify instructor

4) Flat Tire (one or more, cab or trailer) - After the malfunction is activated, if the malfunction involves a front tire, any attempt to steer causes a series of jolts through the steering and motion subsystems and aural cues heard through the CDT sound subsystem. Any other flat tire malfunction shall produce vibrations through the motion subsystems and aural cues heard through the CDT sound subsystem. When any flat tire malfunction occurs, the driver has 30 seconds from the start of the blown tire aural cues to:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Downshift transmission
iv. Move to right as far as possible
v. Halt vehicle
vi. Apply parking brake
vii. Place the transmission in Neutral (N)
viii. Apply hazard flasher
ix. Notify instructor

5) Low Fuel - When the Low Fuel indication is illuminated (approximately 8 minutes after executing the low fuel malfunction) during a scripted or free play scenario, the trainee shall execute the following sequence of responses within 30 seconds:

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply Hazard flasher
viii. Notify instructor

6) Low Engine Oil Pressure - This malfunction is available only when the engine is running. Activation reduces the oil pressure gauge reading and illuminates the Engine Oil Pressure Low indicator or check engine indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indication). If the driver has not completed the response sequence below within 30 seconds of activation, the engine will shut down. Once the engine shuts down, any attempt to restart the engine results in an additional scoring deduction.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle

v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

7) High Water Temperature - This malfunction is available only when the engine is running. Activation increases the water/coolant temperature gauge reading and illuminates the High Water Temperature indicator or check engine indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indications). If the driver has not completed the response sequence below within 30 seconds of activation, the engine will shut down. Once the engine shuts down, any attempt to restart the engine results in an additional scoring deduction.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

8) High Transmission Oil Temperature - This malfunction is available only when the engine is running. Activation increases the Transmission Oil Temperature Gauge reading (if equipped) and illuminates the High Transmission Oil Temperature or check transmission indicator (depending on vehicle variant – see below in this appendix for each of the specified vehicle indication). If the driver has not completed the response sequence below within 90 seconds of activation, the transmission will transfer no power to the drive wheels.

i. Maintain control of the vehicle
ii. Apply service brake lightly
iii. Move to right as far as possible
iv. Halt vehicle
v. Apply parking brake
vi. Place the transmission in Neutral (N)
vii. Apply hazard flasher
viii. Shut off engine
ix. Notify instructor

3.5.5 Training Scenarios

The CDT TWV shall have access to all training scenarios previously developed for other CDT variant vehicles. The CDT TWV shall provide 40 TWV scenarios based on current fielded CDT databases available for the Program of Instruction (POI). The scenarios for each specific vehicle

intended to train Soldiers and Leaders using the crawl, walk, and run method of training. All tasks and elements from the Training Tasks in Sec. 3.4 shall be included in the 40 preprogrammed scenarios.

The CDT TWV shall also provide non-preprogrammed (free-run) scenarios, which have no-predefined ideal paths or training tasks to be completed and allows the student to travel anywhere in the terrain database (within the limits of terrain traversability).

4.0 Acronyms List

AAR	After Action Review
ABS	Anti-lock Braking System
AD	Assistant Driver
AD/VC	Assistant Driver / Vehicle Commander
ADS	AD's Station
CDT	Common Driver Trainer
CG	Center Gravity
CPU	Central Processing Unit
CTIS	Central Tire Inflation System
CCTV	Closed Circuit TV
CS	Control Station
DVE	Driver Vision Enhancer
FIPR	Flash, Immediate, Priority, or Routine
FM	Field Manual
FOV	Field Of View
GUI	Graphical User Interface
GVWR	Gross Vehicle Weight Rating
HEMTT	Heavy Expanded Mobility Tactical Truck
HETS	Heavy Equipment Transport System
HIMARS	High Mobility Artillery Rocket Systems
HMMWV	High Mobility Multipurpose Wheeled Vehicle
Hz	Hertz
IED	Improvised Explosive Device
IO	Input/Output
IOS	Instructor Operator Station
JCR-LOG	Joint Capabilities Release – Logistics
JLTV	Joint Light Tactical Vehicle
LHS	Load Handling System
LTVT	Light Tactical Vehicle Trailer
LVSR	Logistics Vehicle System Replacement\
M-ATV	MRAP All-Terrain Vehicle
MAYDAY	Distress call
MEDEVAC	Medical Evacuation
MHET	Medium Heavy Equipment Transporter
MPH	Miles Per Hour
MRAP	Mine-Resistant Ambush Protected
MRT	Military Rugged Tablet
MTS	Movement Tracking System
MTV	Medium Tactical Vehicle
MTVR	Medium Tactical Vehicle Replacement
MTVT	Medium Tactical Vehicle Trailer
N	Neutral
OTW	Out The Window
PLS	Palletized Load System

PLST	Palletized Load System Trailer
POI	Program of Instruction
PdM VTS	Product Manager for Virtual Training Systems
PTM	Pan & Tilt Module
RPG	Rocket Propelled Grenade
RPM	Revolutions Per Minute
RPSTL	Repair Parts and Special Tools List
RST	Re-Supply Trailer
SRD	System Requirement Document
STS	Student Training Station
TM	Technical Manual
TWV	Tactical Wheeled Variant

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX F – STRYKER VARIANT (SV)

VERSION 2.2

24 OCTOBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors only, due to vulnerability information, effective 30 August 2018. Other request for this document shall be referred to U.S. Army PEO STRI, ATTN: SFAE-STRI-TRADE-VTS.

Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

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1.0 Scope

This appendix describes the requirements for the Stryker Variant (SV) simulated vehicle driver's compartment hardware and software. When the driver's compartment installs on a Common Driver Trainer (CDT) platform, the collective system becomes a CDT SV that provides training for drivers of various types of SV vehicles. The CDT SV shall assist in the training of Stryker tactical vehicle drivers during Initial Entry Training (IET) and sustainment training. The simulator(s) shall enable training in the critical driver tasks that repetitively train in a simulator are dangerous and/or infrequently trained in the "real world" (driving on ice, fording streams, driving under blackout conditions, driving down a steep embankment when coming off an improved road).

Reconfigurable versions among Stryker vehicle platforms simulations range from the simulated Infantry Carrier Vehicle (ICV) to the Mobile Gun System (MGS). The CDT SV will have the capability to network, so that one instructor can control several driver trainer platforms. The driver training scenarios can be "scripted" to enable practice encountering the same terrain/traffic conditions repetitively, or programmed for random variations in traffic along the same route. The driver cab hardware configurations may the same for each Stryker vehicle or have be slightly differences, primarily with the vehicle type simulation response to account for the varying mass and loading conditions. The following are Stryker ICV vehicle type modules:

a. Nuclear, Biological, Chemical Reconnaissance Vehicle (NBC RV)
b. Anti-Tank Guided Missile (ATGM)
c. Medical Evacuation Vehicle (MEV)
d. Mortar Carrier (MC) (versions Alpha & Bravo)
e. Engineer Squad Vehicle (ESV) (all configurations)
f. Commanders Vehicle (CV)
g. Fire Support Vehicle (FSV)
h. Reconnaissance Vehicle (RV)

The Stryker MGS variant vehicle consists of the basic vehicle with General Dynamics Land System (GDLS) fully stabilized shoot-on-the-move Low Profile Turret.

2.0 Applicable Documents

Stryker Common Instructor Guide, dated August 2003 (Rev. E.1).

TM 9-2320-311-10-5 Draft Technical Manual; Operator's Manual – Reconnaissance/Scout Vehicle; 2320-01-481-8572; Stryker dated Nov 2003.

Training Job Aide, Stryker Family of Vehicle (FOV), Common Procedures, General Motors Defense, 1/10/2002

Technical Manual, Operator Manual, Common Items for All Variants, Stryker, 7/01/2003. Headquarter, Department of Army.

3.0 Requirements

3.1 Basic Driver Training Tasks

The CDT SV shall simulate at a minimum the following training tasks:

Task #	General Description
171-155-0001	Operate Engine on Stryker
171-155-0002	Drive Stryker
171-155-0003	Tow a Similar Vehicle with Stryker
171-155-0011	Operator Driver's Control and Instruments on a Stryker
171-155-0012	Operate the Driver's Vision Enhancer (DVE)
171-155-0014	Prepare Stryker Drive Station for Operation
171-155-0017	Secure Driver's Station on a Stryker
171-155-0020	Prepare the Stryker for Operation after Transportation
171-155-0021	Operate the Personnel Engine Coolant Circulating Heater (PECCH)
171-155-0023	Operator Auxiliary Power Unit (APU) on a Stryker
171-155-0040	Operate the Ramp on a Stryker
071-326-0608	Use Visual Signaling Techniques
Additional tasks:	Operate engine compartment fire extinguisher – Auto
	Operate engine compartment fire extinguisher – Manual
	Operate driver compartment fire extinguisher – Manual
	Operate Outside lights
	Operate intercom system
	Respond to malfunctions
	Connect NBC M25 protective mask, verify air flow and don the mask

a. Operate Vehicle under Normal Conditions

(1) Drive vehicle with automatic transmission
(2) Perform vehicle maintenance checks and services during operations
(3) Start vehicle using cold and warm weather procedures
(4) Perform braking/stopping of vehicle
(5) React to traffic signs, signals, and lights
(6) Enter, drive on, and exit straight and curvy, multiple-lane highways (to include lane changing, overtaking, passing, and observing proper distance between other vehicles)
(7) Enter, drive on, and exit straight and curvy, two-lane highways (to include lane changing, overtaking, passing, and observing proper distance between other vehicles)
(8) Drive vehicle in convoy during day and night
(9) Drive loaded vehicle (with 50 to 100 percent carrying load weight capacity)
(10) Drive vehicle with reactive armor

(11) Drive vehicle with slat

b. Backing

(1) Back vehicle without trailer
(2) Back vehicle with trailer
(3) Back vehicle with like vehicle
(4) Maintain correct backing speed and safety
(5) React to wheeled vehicle ground guide day or night

c. Transport Vehicle

(1) Load vehicle on HETS (Heavy Equipment Transport System)
(2) Load vehicle on Aircraft
(3) Load vehicle on Rail Car
(4) Load vehicle on Ship Transporter

d. Emergency Driving

(1) Take defensive measures when faced with roadway obstacles
(2) Drive vehicle with a blow-out (on any tire or combination of tires)
(3) Execute downhill braking procedures using defensive driving methods

e. Adverse Condition Driving

(1) Drive vehicle on ice
(2) Drive vehicle in dust
(3) Drive vehicle in snow (all snow conditions)
(4) Drive vehicle in snow/ice with chains
(5) Drive vehicle in fog
(6) Drive vehicle in sandy areas
(7) Drive vehicle on secondary roads/trails/cross-country
(8) Operate the Central Tire Inflation System (CTIS)
(9) Drive vehicle at night with headlights
(10) Drive vehicle at night with blackout conditions
(11) Drive vehicle in mud, marsh, swampy areas
(12) Drive vehicle at night with Driver's Vision Enhancer (DVE)
(13) Drive vehicle in contaminated area

Note: The lists above are not all inclusive; one should refer to the Stryker Common Instructor Guide, Rev E.1, dated Aug 1, 2003 for more detailed steps in order to come up with a set of realistic simulated actions and responses to the tasks on hands.

3.2 System Level Requirements

The CDT SV shall consist of the Common Modules and the Specific Modules as specified in the CDT SRD. The Stryker Specific Modules shall consist of the simulated driver compartments, visual display sub-system, the instruments, and controls for the driver and the software required to operate the driver compartment and interact with the Common Modules. The set up time for the Stryker Variant software shall not exceed ten minutes.

The set up time for removing and/or replacing the driver compartment and any hardware associated with the Stryker family of vehicle variant shall not exceed one hour.

The CDT SV shall comply with all the System Level Requirements for the CDT and shall have the same limitations.

3.2.1 Common Modules Requirements

The CDT SV shall meet the requirements for the common modules as defined in the Common SRD for the CDT.

3.2.1.1 Vehicle Simulation

The CDT SV shall simulate the Stryker vehicle dynamically to the level of detail required to support the training tasks in paragraph 3.1. The CDT SV shall replicate the performance and handling of the Stryker vehicle and shall include any differences in performance/handling of the variations within the Stryker family of vehicles.

3.2.1.2 Vehicle Dynamics

The CDT SV shall meet the requirements as specified in the CDT Common SRD and shall simulate the dynamics of the Stryker vehicle and any of its variations, depending on the vehicle been trained.

3.2.1.3 Instructor Operator Station (IOS)

The CDT SV shall meet the requirements as specified in the CDT Common SRD.

3.2.1.3.1 Malfunctions/Emergency Condition

The CDT SV Variant Vehicle shall simulate the following emergency conditions/malfunctions:

a. Vehicle Control - The vehicle control criteria shall monitor continuously during scenario execution. A vehicle control error shall produce IAW the following criteria:

(1) Loss of Steering
(2) Loss of Brakes
(3) React Flat Tire
(4) React to System Fault indicator in Hydro Mechanical Unit (HMU)

(5) React to Over-Speed condition (CTIS)

The CDT Variant Vehicle shall train the driver to react to the following indicators:

(1) Radiation Defense Indicator
(2) Chemical Agent Indicator
(3) Engine Fire Indicator
(4) Annunciator Panel Fault Indicator
(5) Central Tire Inflation System (CTIS) Failure Indicator
(6) Check Engine Indicator
(7) Engine Oil Pressure Indicator
(8) Engine Coolant Temperature Indicator
(9) Restricted Airflow Indicator
(10) Low Air Pressure Indicator
(11) Low Fuel Indicator
(12) React to Transmission Control Malfunction Indicator
(13) Transmission Fluid Temperature Indicator
(14) Hydraulic Fluid Level Indicator
(15) Hydraulic Fluid Temperature Indicator
(16) Backup Steering Pump Failure Indicator
(17) Towed Vehicle Brake Engaged Indicator
(18) Check Power Pack Interface Indicator
(19) Voltage Regulator Fault Indicator
(20) Alternator Fault Indicator
(21) Low Battery Voltage Indicator
(22) Anti-lock Braking System (ABS) Fault Indicator
(23) Park Brake On Indicator

3.2.1.4 Visual Simulation

The CDT SV shall meet the requirements as specified in the CDT Visual SRD. The visual simulation shall operate in two modes of operation: 1) Open Hatch Mode, and 2) Close Hatch Mode. Operation of the CDT in either mode shall allow the student to conduct the training tasks specified in paragraph 3.1.

3.2.1.4.1 Visual Scenes

Visibility range shall be to the degree of fidelity necessary to support realistic training. The visual scenes shall be capable of presenting friendly, threat, and neutral platforms in sufficient details to support target recognition and target identification. It shall replicate the different times of the day (day, night, dusk, and dawn), and it shall be capable to simulate different weather conditions (to include but not limited to rain, snow, fog, dust, battlefield smoke, etc.), other terrain conditions and battlefield conditions.

3.2.1.4.2 Display Configuration

The CDT SV shall meet the requirements as specified in the CDT Visual SRD.

3.2.1.4.2.1 Out The Window (OTW) Displays

A display system that provides a minimum field of view of 180 degrees Horizontal by 32 degrees Vertical shall provide support to the front and side drivers viewing volume when operating in the "Open Hatch" Mode. The student shall be able to utilize the night vision device use in the Stryker vehicle.

3.2.1.4.2.2 Mirror Displays

Side view and rear view mirror imagery shall provide to simulate the rear and side mirror views of the vehicle.

3.2.1.4.2.3 Periscope/Close Hatch Displays

When operating the trainer in the "Close Hatch" Mode, the CDT SV shall be able to simulate the devices used in the actual vehicle such as periscopes and Drivers Vision Enhancer (DVE). A display system shall replicate the views through these devices as encountered in the actual vehicle.

3.2.1.4.2.4 Sensor Image Simulation

The system shall provide a sensor simulation capability that replicates the Drivers Vision Enhancer (DVE) available in the actual vehicles. The capability to change pointing direction and image source shall be the same as in the actual vehicle. The sensor simulation modes shall be available at all times, where appropriate, during a simulation session. The sensor simulation shall utilize the visual database with additional descriptors and object data necessary to generate images with the fundamental characteristics of the simulated sensor. The simulated sensor imagery shall include the effects of artificial illumination (e.g., headlights, flares, weapons flashes, and cultural light sources).

3.2.1.4.3 Image Display Subsystem

The CDT SV shall meet the requirements as specified in the CDT Visual SRD.

3.2.1.5 Detailed Training Environment and Model Requirements

The CDT SV training environments, at a minimum, shall conform to the following requirements;

a. Training Postures:
   (1) Normal Driving
      i. Full Day
      ii. 25 Percent Ambient Light
      iii. 50 Percent Ambient Light

iv. Night Using Headlights
v. Night Using Blackout Markers (Convoy)
vi. Bright Night (Starlight and moon light)
vii. Dark Night
viii. Thermal conditions: Warm, hot, and cold in combinations of weather and visibility

(2) Adverse Conditions
i. Full Day
ii. Full Day, NBC
iii. 25 Percent Ambient Light
iv. 50 Percent Ambient Light
v. Night Using Headlights
vi. Night, NBC, Using Headlights
vii. (e) Night, Using Blackout Markers
viii. Night, NBC, Using Blackout Markers
ix. Night, Using DVE
x. Night, NBC, Using DVE
xi. Bright Night (Starlight and moon)
xii. Dark Night
xiii. Thermal conditions: Warm, hot, and cold in combinations of weather and visibility

b. Terrain / Environmental Features and Conditions:
(1) Villages (several types, small with narrow streets, and medium size)

(2) Hills
i. The Stryker vehicle shall operate in a maximum grade of 60 degree and maximum slope 30 degrees. However, the CDT shall have hills with values greater that these.
ii. Steep hills with a variety of paved and unpaved roads
iii. Mountainous terrain with steep winding roads, roll-outs, tunnels, and near vertical cliffs

(3) Obstacles:
i. Fallen logs (trees)
ii. Ditches of various widths and lengths
iii. Walls of various heights
iv. Steep inclines (several shall be greater than 60 degrees grade or 30 degrees slope, and including knife edge ridges)
v. Overhead obstacles (bridges, power or telephone wires)
vi. Mine fields with and without markers (allows driver to negotiate around marked mines)
vii. Pipes
viii. Simple Obstacles (log cribs, berms, abatis)
ix. Deep and shallow water fording locations

x. Wadi
xi. Farm complexes
xii. Urban complexes
xiii. Dragon teeth
xiv. Road craters
xv. Concertina wire
xvi. Bridges

(4) Fields
i. Plowed and grass covered
ii. Flat grassy areas
iii. Farm areas with cultivated fields

(5) Woods

(6) Vegetation (bushes, trees, rocks, etc.)

(7) Roads:
i. Major highways (high-speed autobahns)
ii. Secondary roads (with sharp turns, hills, etc.)
iii. Trails (narrow, unimproved, narrow roads, tank trails)
iv. Road signs
v. Narrow paved roads

(8) Terrain/Soil types:
i. Dirt (dry and wet)
ii. Rocks
iii. Grass
iv. Mud
v. Sand (dry and wet, packed, loose, soft, mixed)
vi. Marsh
vii. Sand dunes
viii. Pavement (dry and wet)
ix. Rock
x. Grass (wet and dry)
xi. Ice
xii. Snow

(9) Weather Conditions:
i. Snow
ii. Ice
iii. Black Ice
iv. Rain (slick roads, mud)
v. Low visibility (fog, haze, smoke, 25 percent ambient light, 50 percent ambient light, dark)
vi. Dust

vii. Sandstorm
viii. Wind

(10) Training Features/Environments/Conditions:
i. Desert Terrain
ii. European Terrain (Winter, Winter with snow and Summer)

(11) Special training requirements:
i. Bridges (highway, tactical, assault)
ii. Tunnels (one and two lane)
iii. Convoys
iv. Opposing traffic
v. Road Signs
vi. Motor Pool area with rows of parked vehicles with empty spaces available
vii. Loading dock/rail load/HETS (Heavy Equipment Transport System)/Aircraft loading/ship loading
viii. Ability to train with DVE
ix. Simulation of the gas mask connection and air flow through the student's gasmask (gas masks provided to each student)
x. Appropriate trees, bushes, and shrubs for the various types of terrain and climate
xi. Appropriate buildings for the various types of terrain environment (Desert and European)

(12) Miscellaneous:
i. Drive with traffic
ii. Drive without traffic
iii. Drive in convoys
iv. Congested urban driving environment with traffic, parked vehicles, pedestrians, construction situations, detours, slow moving conditions, highway conditions, highway entrances and exit ramps, building and other constraints to movement and visibility

(13) Simulated Vehicle Models shall include (stationary and moving);

Model
Light Wheeled Vehicle – Civilian Chevy Caprice Taxi or similar Fiat Sedan or similar Toyota pickup truck or similar
Medium Wheeled Vehicle – Civilian Heavy Wheeled Vehicle – Civilian Motorcycles, Bicycles, Scooters FedEx Truck or similar Volvo Cargo Truck or similar VW Van/Ambulance or similar
Vehicle – Friendly Military

M1A1, Challenger, M60A3, LECLERC, AMX 30/10rc, Merkava – II, LEO I/II, Centurion, AAAV
Stryker Vehicle (Variants) ATGM, CV, ESV, FSV, ICV, MC, MEV, MGS, NBCRV, RV
Vehicle – Threat T80, T72, BMP2, BRDM-2

(14) Explosions (mines, artillery rounds)

(15) Cities

(16) Streams and rivers with various sizes of bridges with various weight limits and various depths of streams with fording locations

(17) Simulated Human Models and States shall include:

Model	**Type**	**State**
Dismounted Noncombatant – Civilian (man)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (woman)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (child)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (man - group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (woman - group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (child – group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Combatant – Ground Guide	Unarmed	Standing/Walking/Displaying Hand and Arm Signals
Animals	Unarmed	Standing/Walking/Running/Falling/Dead
Threat Human Models		

Dismounted – Civilian (man, woman and/or child)	Armed	Standing/Walking/Running/Falling/Dead
Dismounted	Armed	RPG Teams

3.2.1.6 After Action Review

The CDT SV shall meet the requirements as specified in the CDT Common SRD.

3.2.2 Aural Cues/Communications

The CDT SV shall meet the requirements as specified in the CDT Common SRD.

The sounds produced by the CDT SV shall include those sounds due to the vehicle movement, malfunctions, terrain, and gun fire. The CDT shall include at a minimum the aural cues listed below (listed in order of priority);

a. Own vehicle Hit. Activated when a RPG hits the vehicle or the vehicle hits a mine.
b. Hard Collision. Produced when the own vehicle collides with an object in the database.
c. Main Gun Firing (MGS). Only active when friendly/enemy fire is active. It produces the sound of the main gun firing - MK-19, 50 cal., 240, and TOW firing sounds.
d. Nearby Explosion. Activated when friendly/enemy fire enabled. This effect produces the sound of an explosion when a simulated round impacts within 200 meters of the vehicle.
e. Soft/Glancing Collision. Produces the sound of scraping metal. It occurs when the vehicle has a Soft/ Glancing Collision with an object in the database.
f. Fire Extinguisher Shot. It sounds like high pressure gas escaping through a valve. It activates when the crew fire extinguisher discharges.
g. Flat tire(s). This sound shall continue until the driver stops the vehicle.
h. Vehicle Turning. Produces additional creaking and squeal as long as the vehicle is turning.
i. Road noise. A continuous sound for as long as the vehicle is moving. The noise level depends on the speed of the vehicle.
j. Parking Brake Engaging. Makes the air sounds heard when setting the parking brake.
k. Engine Shutdown. Activated during the engine shutdown sequence. It produces the sound of the engine shutting down.
l. Engine Startup. It produces the whine of the starter motor and of the engine turning up. The cue activates during the engine startup sequence.
m. Starter Motor. Activates when holding the starter switch. It produces the whine of the starter motor.
n. Engine Noise. Activates when the engine is running, noise varies as the RPM of the engine increases or decreases.
o. Personnel Heater Fan. Activates when the Personnel Heater Start/Off/Run Fan switch is in the Start or Run/Fan positions.
p. Gas Particulate Filter Fan. Activates when the master switch is ON and the Gas Particulate Filter switch is ON.
q. Silence. It is active on any of the audio channels that are not producing any of the other cues. Its purpose is to suppress any audio hum produced by the amplifier and other electrical components.
r. Fault alarms.
s. Minefield explosions

t. Blown tire
u. Height Management Unit activating
v. Loading sounds while loading vehicle to aircraft, HETS, rail car.
w. Hydraulics on the plow and roller
x. Scrapping of dirt and rocks
y. CTIS sounds
z. Braking sounds (air brakes).
aa. Sound of ramp opening/closing.

3.2.3 Computational Sub-System

The CDT SV shall meet the requirements as specified in the CDT Common SRD.

3.2.4 Training Scenarios

The CDT SV shall meet the requirements as specified in the CDT Common SRD. Unique training scenarios for the Stryker Family of vehicles shall be define:

a. The CDT SV shall have preprogrammed and non-preprogrammed training sessions. The system shall include a library of at least 100 preprogrammed training scenarios to train the tasks/conditions contained in paragraph 3.1 for all the variations of the Stryker Family of Vehicles.

b. Fifty of the 100 preprogrammed scenarios shall be unique, consisting of a preprogrammed ideal path for the simulated vehicle and a set of training tasks to be completed. The remaining 50 scenarios shall consist of variations in weather/visibility and/or malfunction conditions of the original 50 unique scenarios. All tasks and elements from the Training Tasks in paragraph 3.1 shall be included in the 100 preprogrammed scenarios.

c. The CDT SV shall provide non-preprogrammed (free-run) scenarios, which have no predefined ideal paths or training tasks to be completed and allows the student to travel anywhere in the terrain database (within the limits of terrain traversability).

3.3 Specific Modules Requirements

3.3.1 Simulated Driver Compartments

The CDT SV shall simulate the physical and functional characteristics of the vehicle driver compartment with sufficient fidelity to adequately train the students. All critical instruments, indicators, gauges, controls, lights, circuit breakers, switches, displays, and the like required to support the training tasks defined in paragraph 3.1 shall be provided. In addition, the above items shall be located in the same relative position as in the actual vehicle. Detachable devices (i.e. Drivers Vision Enhancer (DVE)) on the vehicles shall simulate. Items normally present in the driver compartment of the vehicle but not critical for training the required driver tasks shall presents itself in mock-up form. The driver seats and headrests shall replicate to include all

adjustments and range of motion available in the actual vehicle. The vehicle frame assemblies and windshields shall functionally replicate to provide appropriate visual obstructions. The simulated driver compartments shall be equipped with the decals and instructional plates normally visible from the driver's position in the vehicle.

3.3.2 Interface Software

The CDT SV shall meet the requirements as specified in the CDT Common SRD.

ACRONYMS LIST

AAR	After Action Review
ABS	Anti-Lock Brake System
APU	Auxiliary Power Unit
ATGM	Anti-Tank Guided Missile
CDT	Common Driver Trainer
CDT SV	Common Driver Trainer Stryker Variant
CTIS	Central Tire Inflation System
CV	Commanders Vehicle
DVE	Drivers Vision Enhancer
ESV	Engineer Squad Vehicle
FSV	Fire Support Vehicle
FOV	Family of Vehicles
GDLS	General Dynamics Land Systems
HETS	Heavy Equipment Transport System
HMU	Hydro Mechanical Unit
IA	Information Assurance
ICV	Infantry Carrier Vehicle
IET	Initial Entry Training
IOS	Instructor Operator Station
MC	Mortar Carrier
MGS	Main Gun System
MEV	Medical Evacuation Vehicle
NBC RV	Nuclear Biological Chemical Reconnaissance Vehicle
PECCH	Personnel Engine Coolant Circulating Heater
PdM VTS	Product Manager for Virtual Training Systems
RPG	Rocket Propelled Grenade
RPM	Revolutions per Minute
RV	Reconnaissance Vehicle
SE Core	Synthetic Environment Core
SRD	System Requirement Document
SV	Stryker Variant
TM	Technical Manual
PEO STRI	Program Executive Office Simulation Training and Instrumentation

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL) SYSTEM

APPENDIX G – MINE RESISTANT AMBUSH PROTECTED (MRAP) VARIANT (MV)

VERSION 2.1

14 SEPTEMBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

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Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

CHANGE HISTORY

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Version 2.0	21 Jun 2018	3.0	Results of Draft RFP
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1.0 SCOPE

This appendix to the System Requirements Document (SRD) describes the requirements for the Mine Resistant Ambush Protected MRAP Variant (MV) driver's compartment hardware and software. When the driver's compartment is installed on a Common Driver Trainer (CDT) platform, the collective system becomes a Common Driver Trainer/MRAP Variant (CDT/MV) that provides training for drivers of various types of MRAP vehicles. The CDT/MV will provide training of MRAP tactical vehicle drivers during New Equipment Training and sustainment. The trainer will enable training in the critical driver tasks that can be repetitively trained in a simulator. It will also allow training of driver tasks that are dangerous and/or infrequently trained in the "real world" (driving on ice, fording streams, driving under blackout conditions, driving down a steep embankment when coming off an improved road, etc.).

This appendix contain the requirements for vehicle specific kits. Each kit includes the vehicle specific driver's compartment hardware and simulation software needed to convert the base CDT/MV to match a specific vehicle's physical and functional characteristics.

1.1 MRAP Variant

The CDT/MV is a variant for the CDT. This variant shall include the specific modules necessary to provide the configuration and vehicle dynamics of the MRAP family of vehicles. The CDT/MV shall use all of the common modules as specified in the CDT SRD and the specific modules for the MRAP Variant as defined herein. The main components in the specific modules are the driver compartment, swappable dash panels with instruments and controls for the driver, space and visual constraint modules (if necessary) and the software required to operate the driver compartment and interact with the common modules in the CDT.

1.2 MRAP Family of Vehicles

MRAP major variants include the MRAP All Terrain Vehicle (M-ATV), CAT I and CAT II. The CAT II serves as the CDT/MV baseline vehicle. Commonalty is based on the CAT II.

1.2.1 CAT I

There are five configurations of the MRAP CAT I vehicles which include:

a. Navistar MaxxPro,
b. BAE/TVS Caiman 6x6,
c. BAE RG33 4x4**,
d. General Dynamics Land Systems-Canada RG31 4x4,
e. Force Protection Industries Cougar 4x4 *

Note, the "*" is for CAT II and it's a bigger vehicle; and the "**" is for CAT I and it's a smaller vehicle.

1.2.2 CAT II

There are two configurations of the MRAP CAT II vehicles which include:

a. BAE RG33L 6x6
b. Force Protection Industries Cougar 6x6 *

Note, the "*" is for CAT II and it's a bigger vehicle.

1.2.3 M-ATV

There is one configuration of the MRAP All Terrain Vehicle:

a. Oshkosh M-ATV

2.0 APPLICABLE DOCUMENTS

TM 9-2355-106-10	Operator's Manual, Navistar MaxxPro
TM 9-2355-107-10	Operator's Manual BAE/TVS (Caiman)
TM 9-2355-108-10	Operator's Manual, BAE RG33 and RG33L
TM 9-2355-315-10	Operator's Manual General Dynamics Land Systems RG31
TM 9-2355-335-10	Operator's Manual Oshkosh M-ATV
COTS TM 10001624 REV B	Force Protection Industries (Cougar)

In the event of a conflict between the requirements of this document and those contained in the documents above, the requirements contained in this document take precedence.

3.0 REQUIREMENTS

3.1 System Level Requirements

The CDT/MV shall consist of the CDT Common Modules and the reconfigurable MRAP specific module as specified herein. The CDT common modules are the IOS, computational subsystem, visual/display subsystem, aural/communication subsystem, motion subsystem, scenario generation system (SGS), and AAR subsystem. The CDT common modules have defined configurations, mechanical interfaces, electrical interfaces and software architecture/interfaces. The reconfigurable MRAP specific module shall interface to the CDT by the defined interfaces for the CDT modules listed above and shall not degrade the performance of existing CDT variants. The reconfigurable MRAP specific module shall be integrated with the CDT common modules for the CDT/MV configuration. The CDT/MV specific module shall consist of the simulated reconfigurable driver's compartment, the CDT/MV common instruments

and controls for the driver and the software required to operate the driver's compartment and interact with the CDT Common Modules. The CDT/MV specific module shall include vehicle specific kits with each kit containing a removable dash panel, the software to provide the specific vehicle performance in response to driver inputs and, if necessary, space and visual constraint modules.

The RG33 is the MRAP CAT I variant of the RG33L MRAP CAT II vehicle. The RG33 is the four-wheeled version of the RG33L. The primary differences between the CAT I RG33 and the CAT II RG33L are the vehicle's overall length, turning radius, curb weight and gross vehicle weight. These differences affect the overall vehicle dynamics and own vehicle models. Since the vehicles use the same driver's cab components, no additional hardware is required to reconfigure the baseline CDT/MV cab to support training drivers of the RG33.

The Caiman is available in both a MRAP CAT I and a MRAP CAT II version. This kit contains only the requirements for configuring the CDT/MV as a MRAP CAT I Caiman variant. The Caiman is a 6x6 armored vehicle with blast resistant body design to protect the crew from mine blasts, fragmentary and direct fire weapons. It supports operations to include mounted patrols, reconnaissance, communications, command and control, convoy lead, explosive ordnance disposal, ambulance and combat engineering. It is designed for use over all types of roads, cross-country terrain, and in all weather conditions. The primary differences between the CAT I Caiman and the CDT/MV baseline CAT II RG33L are the vehicle's overall width, length, height, turning radius, curb weight and gross vehicle weight. These differences affect the overall vehicle dynamics and own vehicle models. Since the vehicles use different driver's cab components, some additional hardware as specified in this appendix is required to reconfigure the baseline CDT/MV cab to support training drivers of the CAT I Caiman. In addition, the Caiman vehicle can be modified with an independent suspension system (ISS) that replaces the original solid axle/leaf spring suspension system.

The Navistar MaxxPro is a MRAP CAT I variant. The Navistar MaxxPro is capable of carrying six persons including the driver. The vehicle is four-wheel drive and is designed for small unit combat operations in urban or confined areas. The primary differences between the CAT I Navistar MaxxPro and the CDT/MV baseline CAT II RG33L are the vehicle's overall width, length, height, turning radius, curb weight and gross vehicle weight. These differences affect the overall vehicle dynamics and own vehicle models. Since the vehicles use different driver's cab components, some additional hardware as specified in this appendix is required to reconfigure the baseline CDT/MV cab to support training drivers of the Navistar MaxxPro. In addition, the Navistar MaxxPro vehicle can be modified with an independent suspension system (ISS) that replaces the original solid axle/leaf spring suspension system.

The RG31 is the MRAP CAT I variant. The RG31 is a 4x4 armor protected personnel carrier to protect the crew against small arms fire. The primary differences between the CAT I RG31 and the CDT/MV baseline are the vehicle's overall width, length, height, turning radius, curb weight and gross vehicle weight. These differences affect the overall

vehicle dynamics and own vehicle models. Since the vehicles use different driver's cab components, some additional hardware as specified in this appendix is required to reconfigure the baseline CDT/MV cab to support training drivers of the RG31.

Unless specifically modified in this appendix, the requirements specified for the CDT/MV baseline vehicle shall apply when the CDT/MV is configured as a M-ATV. In case of a conflict between the requirements of the CDT/MV SRD and the requirements of this appendix, the requirements of this appendix shall take precedence when testing the M-ATV configuration.

3.2 Common Module Requirements

The CDT MV shall meet the requirements for the common modules as defined in the Common SRD for the CDT.

3.3 Vehicle Specific Requirements

The CDT/MV shall include a reconfigurable driver's compartment, vehicle specific kits and simulation software that provides the physical configuration, controls, instruments, vehicle operation and vehicle dynamics of each of the supported vehicles in the MRAP family of vehicles. The main components of the driver's compartment are the controls, instruments, switches, panels, seating and physical structure of the MRAP vehicle version necessary to accomplish the required training tasks. When configured as a specific MRAP vehicle driver's compartment, the simulation software shall provide the driver's compartment control and switch interaction and simulator response for the controls, instruments, switches and panels necessary to accomplish the required MRAP training tasks. The simulation software shall provide realistic vehicle dynamic responses to driver control inputs and simulated training environment interactions. The driver's compartment shall provide the status of hardware and software to the CDT system through the defined interfaces during CDT daily readiness tests. During initialization, the system shall check the installed configuration and provide an indication to the instructor/operator which specific MRAP configuration installed and provide an error message if there are any reconfigurable components mismatches or components not installed.

3.4 MV Training Requirements

The CDT/MV shall train the driver training tasks listed in the following paragraphs to be performed by the student, the performance to be assessed by the system and monitored by the instructor. The training tasks generally reflect the numerous and varied skills that comprise the task of driving a MRAP vehicle.

3.4.1 MV Training Tasks:

a. Operate Vehicle under Normal Conditions
   - Drive vehicle with automatic transmission

- Perform vehicle maintenance checks and services during operations
- Start vehicle using cold and warm weather procedures
- Perform braking/stopping of vehicle
- React to traffic signs, signals and lights
- Enter, drive on, and exit straight and curvy, multiple-lane highways (to include lane changing, overtaking, passing and observing proper distance between other vehicles)
- Enter, drive on, and exit straight and curvy, two-lane highways (to include lane changing, overtaking, passing and observing proper distance between other vehicles)
- Drive vehicle in convoy during day and night
- Drive loaded vehicle (with 50 to 100 percent carrying load weight capacity)

b. Backing
- Back vehicle without trailer
- Maintain correct backing speed and safety
- React to wheeled vehicle ground guide day or night

c. Transport Vehicle
- Load vehicle on HETS (Heavy Equipment Transport System)
- Load vehicle on Rail Car
- Load vehicle on Ship Transporter

d. Emergency Driving
- Take defensive measures when faced with roadway obstacles
- Drive vehicle with a blow-out (on any tire or combination of tires)
- Execute downhill braking procedures using defensive driving methods

e. Adverse Condition Driving
- Drive vehicle on ice
- Drive vehicle in dust
- Drive vehicle in rain
- Drive vehicle in snow/ice (all snow conditions)
- Drive vehicle in sandy areas
- Drive vehicle on secondary roads/trails/cross-country
- Operate vehicle with run flats tires
- Drive vehicle at night with headlights
- Drive vehicle at night with blackout conditions
- Drive vehicle in mud, marsh, swampy areas
- Drive vehicle at night with driver's vision enhancer (DVE)

3.4.2 Malfunction/Emergency Condition Training Requirements

The CDT/MV shall simulate the following emergency conditions/malfunctions:

a. Loss of Steering
b. Loss of Brakes
c. Flat Tire

The CDT/MV shall train the driver to react to the following indicators:

a. Engine Fire Indicator
b. Annunciator Panel Fault Indicator
c. Check Engine Indicator
d. Engine Oil Pressure Indicator
e. Engine Coolant Temperature Indicator
f. Restricted Airflow Indicator
g. Low Air Pressure Indicator
h. Low Fuel Indicator
i. React to Transmission Control Malfunction Indicator
j. Transmission Fluid Temperature Indicator
k. Hydraulic Fluid Level Indicator
l. Hydraulic Fluid Temperature Indicator
m. Backup Steering Pump Failure Indicator
n. Towed Vehicle Brake Engaged Indicator
o. Check Power Pack Interface Indicator
p. Voltage Regulator Fault Indicator
q. Alternator Fault Indicator
r. Low Battery Voltage Indicator
s. Anti-lock Braking System (ABS) Fault Indicator
t. Park Brake On Indicator

3.4.3 Specific Reconfigurable MRAP Module Requirements

3.4.3.1 Simulated Driver Compartment

The CDT/MV driver's compartment shall be reconfigurable between supported vehicles in the MRAP family of vehicles. The specific components shall be, to the maximum extent possible, easily installed and removed to configure the driver's compartment properly for the specific vehicle configuration. The specific hardware configuration along with the specific simulation software shall define the driver's compartment as one of the supported MRAP vehicles. The specific driver's compartment configuration shall simulate the physical and functional characteristics of the supported MRAP vehicle with sufficient fidelity to adequately train the students in the training tasks listed in paragraph 3.4.1 – MV Training Tasks or the vehicle specific depending on the configuration selected. External storage cases for unused specific alternate configuration components shall be provided with each CDT/MV driver's compartment. All instruments, indicators, gauges, controls, lights switches, displays, driver's hatch or door, and components of the driver's compartment that are non-tactile (i.e., viewed but not touched) and not used for training shall be dimensionally accurate to within +/- 20%. All non-tactile instruments,

indicators, gauges, controls, lights, switches, displays, driver's hatch or door, and components of the driver's compartment used for training shall be dimensionally accurate to within +/- 15%. All tactile instruments, indicators, gauges, controls, lights, switches, displays, driver's hatch or door, and components of the driver's compartment used for training shall be dimensionally accurate within a tolerance of +/- 0.25 inches.

The location within the driver's compartment of tactile and non-tactile components that are used for training shall be accurate within +/- 2.0 inch and maintain the relation between adjacent components within +/- 0.25 inches. Non-tactile components that are not used for training shall be located within +/- 3.0 inches of their actual position. All measurements shall be made from a single reference point.

The CDT/MV driver's compartment shall include mounting locations with all necessary hardware and electrical interfaces with all necessary cabling to support installation and use of the CDT/MV kits specified in the appendices.

Items normally present in the driver compartment of the vehicle but not critical for training the required driver tasks shall be presented in mock-up form with the same size, shape and location as the vehicle components. Detachable devices (i.e. DVE night vision device) on the vehicles used to drive the vehicle shall also be simulated. The driver's seat and headrest shall be replicated to include all adjustments and range of motion available in the actual vehicle. The driver's compartment shall include a fresh air circulation and exchange system with sufficient airflow to maintain the internal temperature within +5 degrees F of the temperature outside the driver's compartment. The simulated driver compartment shall be equipped with the decals and instructional plates visible in the driver's compartment of the vehicle with limitations of placing labels per the baseline vehicle cab (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV).

The set up time for removing and/or replacing the driver compartment and any hardware associated with the MRAP variant shall not exceed one hour. The set up time for the MRAP Variant software shall not exceed ten minutes.

The CDT/MV cab re-configurability shall be designed such that reconfiguration by instructor/operator personnel between supported vehicle configurations can be accomplished in less than 30 minutes, with a desired objective time of 15 minutes.

3.4.3.1.1 Driver's Compartment Subsystem Common Components

The driver's compartment subsystem shall simulate the following common components of the driver's compartment for the MRAP vehicles:

a. Driver's Door
b. Steering Column and Wheel
c. Throttle
d. Service Brake Pedal

e. Driver's Seat including 5 point seat belt system
f. DVE Night Vision Device

Reconfiguration of the driver's compartment subsystem between supported vehicles in the MRAP family of vehicles shall not require removal or replacement of any of the Driver's Compartment Subsystem Common Components.

The Driver's Compartment Common Components shall have the following capabilities and characteristics:

3.4.3.1.1.1 Driver's Door

The driver's door assembly shall physically and functionally replicate (location, dimensions and movement) the driver's door of the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab. A latch mechanism shall be provided to lock the door in the fully closed position. The door shall be safety interlocked to the motion subsystem to allow motion only when the door is in a locked position. The driver's door shall include mounting devices for mounting space and vision constraint modules included in vehicle specific kits, if applicable.

3.4.3.1.1.2 Steering Column and Wheel

The Steering Column and Wheel from the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab shall be physically and functionally replicated in the driver's compartment. The steering column and wheel shall have the same dimensions, controls, range of motion, and adjustments as the operational equipment. The simulation shall represent the appropriate force feel cues and deflection required for steering and turning the vehicle.

3.4.3.1.1.3 Throttle

The Throttle from the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab shall be physically and functionally replicated in the driver's compartment. The throttle pedal shall have the same dimensions, controls, range of motion, and adjustments as the operational equipment. The simulation shall represent the appropriate force feel cues and deflection required for accelerating the vehicle.

3.4.3.1.1.4 Service Brake Pedal

The service brake pedal assembly shall replicate physically (location, dimensions and movement) and functionally the service brake pedal in the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab.

3.4.3.1.1.5 Driver's Seat

The Driver's Seat from the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab shall be physically and functionally replicated in the driver's compartment. The driver's seat and seat belts shall have the same dimensions, controls, range of motion, and adjustments as the operational equipment.

3.4.3.1.1.6 DVE Night Vision Device

The CDT/MV driver's compartment shall include a Driver's Vision Enhancement (DVE) system. The DVE shall be mounted in the CDT/MV cab in the same location as in the baseline vehicle (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV) cab. The DVE support shall replicate the size, shape and adjustability of the operational system. A power and signal connector shall be provided. The DVE shall replicate the image (field of view and image characteristics) of a MRAP vehicle DVE. The gain, level, brightness and white hot/black hot controls shall be operational and modify the displayed image as in the operational system.

3.4.3.1.1.7 Interchangeable Dashboard Panels and Equipment

The CDT/MV driver's compartment shall include removable instrument panels, consisting of all gauges, switches, controls and indicators. Each instrument panel, representing a MRAP variant, shall be housed on removable panel(s). These panels will represent the MRAP family of vehicles with sufficient fidelity to adequately train the students in the training tasks listed in paragraph 3.4.1 – MV Training Tasks or the vehicle specific appendices depending on the configuration selected. All other cab equipment (gear selector, fire suppression controls, etc.) required for training shall be designed to be easily fitted and removed to form the MRAP variants.

3.4.3.1.2 Baseline Vehicle Cab (RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar with ISS, RG31, and M-ATV) Specific Driver's Compartment Components

The CDT/MV baseline vehicle cab shall replicate the MRAP CAT II RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, M-ATV cab.

3.4.3.1.3 Specific Driver's Compartment Hardware Components

The CDT/MV baseline vehicle cab does not have specific hardware components.

3.4.3.1.4 Specific Driver's Compartment Software Components

The driver cab software shall stimulate or simulate the following RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, M-ATV dashboard controls and indicators via the cab I/O subsystem:

a. Light Control Panel
b. Master Power / Start Switch
c. Driver Gauge Cluster
d. Annunciator Panel
e. Transmission Gear Selector
f. Park Brake
g. Accessory Panel
h. Fire Suppression Control Box

All controls and indicators shall operate in accordance with TM 9-2355-108-10 operator's manual.

3.4.3.1.5 Additional Driver's Compartment Components

In addition, the following components not found in the MRAP vehicle cabs but required to provide adequate training and safety shall be provided:

3.4.3.1.5.1 Emergency Lighting

The driver's compartment shall have an emergency, battery operated light that provides sufficient lighting for rapid and safe exit during emergency conditions.

3.4.3.1.5.2 Fresh Air Circulation Exchange

The driver's compartment shall have constant, fresh, forced air circulation to minimize driver stress.

3.4.3.1.5.3 Fire Detection/Warning System

A smoke detector shall be located inside the driver's compartment. The smoke detector shall interface with the CDT smoke and fire detection system to initiate proper simulator action if smoke or fire is detected. The driver's compartment shall have an audio and visual alarm (prominently visible to the driver) that interfaces with the CDT smoke and fire detection system to alert the driver to an emergency condition.

3.4.3.1.5.4 Emergency Stop and Shutdown

There shall be an emergency shutdown switch in the driver's compartment that is easily accessible by the driver. The emergency shutdown switch shall interface with the CDT emergency shutdown system.

3.4.3.1.5.5 Door & Driver's Seatbelt Interlock

There shall be a driver's compartment door and seatbelt interlock. The interlock shall inhibit any motion system response to simulation control inputs and settle the motion system to the fully lowered position in a controlled manner when the door locks are disengaged or the seatbelt not fastened correctly.

3.4.3.1.6 Optional Vehicle Equipment

None.

3.4.3.2 Vehicle Simulation

3.4.3.2.1 Vehicle Dynamics Performance

The CDT/MV shall simulate the RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV vehicle dynamics to the level of detail required to support the training tasks in paragraph 3.2.1. Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g., engine, transmission, etc.), suspension (e.g., springing, damping, range of travel, etc.), and the hull of the RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV vehicle. The parameters for these models shall be evaluated at 60 Hz to assure smooth and accurate simulation. Terrain topography and surface characteristics shall be determined and combined with control inputs from the driver compartment to provide inputs to the models of the engine, transmission, steering, brakes, suspension, and hull. The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment. The vehicle dynamic performance shall be modeled based on data provided by Government Subject Matter Experts.

The vehicle dynamics of the RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV kit shall meet the performance requirements for the critical maneuvers within +/- 10%. The critical maneuvers and the performance requirements are defined in the following tables.

a. The definitions for the critical maneuvers for vehicle dynamics are as follows:

Vehicle Parameter	Time (secs)	Trans Range	Throttle	Brake	Steering	Terrain Slope	Test Parameter		Comments
Performance Description									
OV speed at idle in surface drive on flat surface	33.0	Drive	Idle	Off	0.0	0.0	Vehicle speed		Vehicle speed after accelerating for 33 seconds
OV speed at idle in low on flat surface	33.0	Low	Idle	Off	0.0	0.0	Vehicle speed		Vehicle speed after accelerating for 33 seconds
OV speed at ½ throttle in low on flat surface	31.0	Low	0.5	Off	0.0	0.0	Vehicle speed		Vehicle speed after accelerating for 31 seconds
OV speed at full throttle in low on flat surface	31.0	Low	1.0	Off	0.0	0.0	Vehicle speed		Vehicle speed after accelerating for 31 seconds
OV braking distance from 25 MPH	-	Low	1.0	Off	0.0	0.0	Vehicle speed		Vehicle accelerates until it reaches 25 MPH
	41.0	Low	Idle	On	0.0	0.0	Braking distance		After reaching 25 MPH full brake is applied and throttle returned to idle. Braking distance is determined from vehicle position when it reaches 25 MPH until it comes to rest.
OV climbing and stopping on hill	30.0	Low	1.0	Off	0.0	(1)	Track speed	Vehicle speed	Climbing speed of vehicle after 20 seconds on a hill of slope specified in Table III.2 for the terrain type under test.
	35.0	Low	Idle	On	0.0	(1)	Vehicle speed		At 35.0 seconds does the vehicle come to rest on the specified slope with the brake fully engaged.
OV turning radius with constant throttle and steering angle	71.0	Low	0.35	Off	1.0	0.0	Turning radius		Vehicle starts from rest, after 71 seconds with vehicle at constant throttle and steering angle and on a flat surface, determine turning radius of the turn.
OV speed loss and peak lateral velocity for hard turn	33.0	Low	0.3175	Off	0.0	0.0	Vehicle speed		Vehicle speed after accelerating for 53 seconds on a flat surface.
	84.0	Low	0.3175	Off	(2)	0.0	Vehicle speed loss	Lateral velocity	Vehicle speed loss from the instant the turn was initiated (at 53 seconds) to the end of the test (84 seconds) and peak lateral velocity in turn.
OV turning radius for pivot turn on flat surface	56.0	Pivot	Idle	Off	1.0	0.0	Turning radius		Vehicle turning radius for a pivot turn on a flat surface after 56.0 seconds

NOTE:

1. The slope of the hill depends on the terrain type
2. The steering angle is not constant with time. It has been chosen to match the test driver input steering angle.

b. The vehicle dynamics performance for the critical maneuvers are as follows:

Performance Description	Idle Speed in Drive	Idle Speed in Low	Half-Throttle Speed at 31 sec.	Full-Throttle Speed at 31 sec.	Brake Distance	Hill Climbing Maximum Slope				Turn Radius	Lateral Velocity	Initial Speed	Delta Speed	Pivot Radius
	(MPH)	(MPH)	(MPH)	(MPH)	(Feet)	Max. Speed	Track Speed (MPH)	Grnd Speed (MPH)	Stop on Hill	(Feet)	(Ft/Sec)	(MPH)	(MPH)	(Feet)
Terrain Type														
Pavement	2.48	2.55	22.83	38.42	38.77	0.540	5.38	4.55	Yes	27.70	-0.53	14.02	-5.29	2.10
Dirt	1.08	2.11	19.85	34.84	42.43	0.400	7.57	5.60	Yes	24.70	-1.04	12.03	-2.67	3.59
Sand	0.60	1.96	19.05	33.96	17.27	0.110	19.85	18.60	Yes	24.49	-1.10	11.52	-2.31	4.17
Mud	0.00	1.39	16.17	30.84	46.49	0.350	8.12	4.88	Yes	29.56	-0.20	9.70	-1.28	14.79
Rock	0.60	1.88	18.95	33.54	55.34	0.280	10.04	6.48	Yes	33.74	-0.37	11.48	-1.90	2.71
Grass	0.77	2.05	19.36	34.43	39.33	0.450	6.09	4.80	Yes	27.53	-0.45	11.71	-2.93	2.53
Wet Pavement	2.45	2.51	22.71	38.15	45.30	0.430	6.80	4.12	Yes	17.53	-2.87	13.96	-4.37	2.95
Wet Dirt	0.69	1.97	19.17	34.02	43.58	0.340	8.59	6.63	Yes	27.89	-0.36	11.60	-2.37	3.42
Wet Sand	0.00	1.65	17.06	32.08	39.51	0.420	6.31	4.71	Yes	23.30	-0.50	10.22	-1.74	2.21
Wet Mud	0.00	0.00	4.90	10.60	10.43(1)	0.025	13.66	8.34	Yes	97.67	0.00	1.94	-0.30	23.63
Wet Rock	0.00	0.81	12.84	27.59	54.47	0.230	10.45	6.37	Yes	38.56	-0.18	8.37	-0.72	6.41
Wet Grass	0.00	1.69	17.50	32.36	41.73	0.230	11.16	9.80	Yes	23.43	-0.68	10.53	-1.82	2.69
Ice	2.83	2.30	22.13	32.44	178.56	0.072	32.09	5.08	Yes	14.36	-21.67	19.04	-10.06	5.33
Snow	0.08	1.53	17.84	31.57	71.56	0.140	15.72	10.64	Yes	21.23	-2.08	10.85	-2.11	2.41

NOTE:

1. Braking distance on this surface is from maximum vehicle speed attainable on this surface.

c. The vehicle dynamics performance for critical maneuvers in various desert sand types are as follows:

Terrain Type	Dry Pavement	Packed Sand	Wet Sand	Loose Sand	Soft Sand
Idle Speed in Drive (MPH)	2.48	1.53	0.44	0.0	0.0
Idle Speed in Low (MPH)	2.55	2.21	1.89	1.20	0.27
Half Throttle Speed in Low (MPH)	22.83	20.70	18.77	14.13	11.09
Full Throttle Speed in Low (MPH)	38.42	35.66	33.59	29.70	24.66
Brake Distance (Feet)	38.77	44.49	42.11	45.02	33.26
Hill Climb: Max Slope	0.54	0.400	0.42	0.37	0.16
Hill Climb: Vehicle Speed (MPH)	4.55	4.99	4.19	4.15	9.08
Hill Climb: Track Velocity (MPH)	5.38	7.59	6.66	7.64	12.20
Hill Climb: Stop on Hill (Yes/No)	Yes	Yes	Yes	Yes	Yes
Turn Radius (Feet)	27.70	27.18	28.39	37.80	46.61
Lateral Velocity (ft/sec)	-0.53	-1.03	-0.42	-0.20	-0.09
Initial Speed (MPH)	14.02	12.67	11.35	9.14	7.48
Delta Speed (MPH)	-5.29	-2.63	-2.17	-1.03	-0.56
Pivot Radius (Feet)	2.10	19.44	20.91	0.00	0.00

3.4.3.2.1.1 Engine Model

The following operational parameters of the engine shall be simulated:

a. Engine torque - The engine output torque shall be derived as a function of engine speed, load due to terrain topography and tractability, and throttle angle.

b. Engine speed - The rotational speed of the engine shall be determined as a function of throttle position, load torque, and engine/transmission inertia. The tachometer in the driver's compartment and the engine speed aural cue shall be driven by this output.

c. Fuel consumption - The fuel consumption shall be determined as a function of throttle position. The fuel level in the fuel tanks shall be determined by subtracting the fuel used from the amount of fuel remaining in the tanks. The fuel gauges in the driver compartment shall be driven by the amount of fuel remaining in the tanks. The fuel system model shall include the following fuel tank capacities:

1) Left - 40 gallons
2) Right - 40 gallons

All fuel tanks shall be full at the start of each training scenario. Activation of the low fuel malfunction shall reduce the fuel level in both fuel tanks to less than 12% of capacity.

3.4.3.2.1.2 Transmission Model

The gear selections shall be determined by the position of the transmission shift selector on the vehicle dashboard, the vehicle speed, and the throttle angle. The gear selection shall limit the range of output of the transmission dynamics model as appropriate for the selected gear.

3.4.3.2.1.3 Steering and Brake Model

The steering and brake model shall be a physics based model of the actual real world performance of the RG33L vehicle. The position of the service brake pedal and the engaged/disengaged status of the parking brake shall be input to the brake model. Appropriate real time brake force parameters shall be determined and applied to the CDT motion control software.

3.4.3.2.1.4 Suspension Model

The model of the suspension system shall include computation of the forces acting on the suspension components. The effects of the terrain, including slope and height shall be combined with the forces due to the mass and momentum of the hull to determine the suspension force acting on the hull. Pitch torque and roll torque shall be computed as inputs to the hull model by transferring the combined forces on the own vehicle through the damping and spring characteristics of the suspension.

3.4.3.2.1.5 Hull Model

The position, velocity, and acceleration of the own vehicle center of gravity shall be determined in six degrees of freedom by the hull model. Inputs from the power train, suspension, and terrain models shall be combined to resolve the updated vehicle position and derive the velocities and accelerations.

3.4.3.2.2 Malfunctions and Emergency Conditions

The CDT/MV shall meet the requirements listed in the list of malfunctions and emergency conditions for each supported MRAP vehicle. All the malfunctions and emergency conditions listed herein shall present the appropriate feedback (e.g., abnormal

vehicle dynamics, instrument readings, aural cues, etc.) to the driver trainee consistent with the operation and performance of the specific vehicle. For the RG33L Malfunction and Emergency Conditions, all relevant driver's compartment indicator's and warnings shall operate in accordance with (IAW) TM 9-2355-108-10 (Operator's Manual). All malfunctions and emergency conditions listed below shall be able to be programmed to activate at specified points in pre-programmed scenarios or initiated and cleared by the instructor in free play scenarios unless otherwise specified herein. When configured as a RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV, the CDT/MV shall include the following malfunctions and emergency conditions:

a. Engine Fire – Activation of the engine fire emergency condition shall only be possible when the engine is running. Activation of the engine fire emergency condition shall result in illumination of the ALARM indicator on the Automatic Fire Suppression System (AFSS) Control Box and activation of the fire alarm audible cue. During 50% of the engine fire emergency condition occurrences, the FAULT indicator on the AFSS Control Box shall be illuminated within 5 seconds. The engine fire emergency condition shall only be cancelled by instructor command.
b. Loss of Steering – Activation of the loss of steering emergency condition shall result in a loss of response to steering inputs. The loss of steering emergency condition shall only be cancelled by instructor command.
c. Loss of Brakes – Activation of the loss of brakes emergency condition shall result in a loss of air pressure causing the parking brake to be applied forcing the vehicle to stop. When activated, the PRIMARY BRAKE AIR PRESSURE GAUGE and the SECONDARY BRAKE AIR PRESSURE GAUGE shall both display a reading below 100.0 psi, an audible alarm shall be activated and the ANTI_LOCK BRAKING SYSTEM indicator shall illuminate. The loss of brakes emergency condition shall only be cancelled by instructor command.
d. Flat Tire – Activation of the flat tire emergency condition shall allow the instructor to select one or two particular tires to "blow out". When the tire(s) blow out, the tire blow out aural cue shall be activated, the steering wheel shall momentarily jerk to the side on which the blow out occurred, the vehicle dynamic performance shall be altered to provide the appropriate feel of a flat tire and the flat tire running aural cue shall be activated. The flat tire condition shall be cancelled by instructor command. Cancellation by instructor command shall cause the flat tire running aural cue to stop playing and the vehicle dynamic performance to be reset to normal fully operational conditions.
e. Low Fuel - Activation of the low fuel condition shall result in both fuel tanks being reduced to 12% of capacity over a period of 10 minutes. When the fuel level in both fuel tanks reaches 12% of capacity, the LOW FUEL INDICATOR shall illuminate. The low fuel condition shall be cancelled by instructor command. Cancellation by instructor command shall cause the fuel level in both fuel tanks to be reset to full.
f. Low Oil Pressure - Activation of the low engine oil pressure malfunction shall only be possible when the engine is running. When activated, the ENGINE OIL

PRESSURE GAUGE shall display a reading below 5.0 psi, an audible alarm shall be activated and the STOP ENGINE indicator shall illuminate. The malfunction shall only be canceled by instructor command.

g. High Engine Coolant Temperature - Activation of the high engine coolant temperature malfunction shall only be possible when the engine is running. When activated, the ENGINE COOLANT TEMPERATURE GAUGE shall display a reading above 235° F, an audible alarm shall be activated and the STOP ENGINE indicator shall illuminate. The malfunction shall only be canceled by instructor command.
h. High Transmission Fluid Temperature - Activation of the high transmission fluid temperature malfunction shall only be possible when the engine is running. When activated, the TRANSMISSION TEMPERATURE GAUGE shall display a reading above 200° F, an audible alarm shall be activated and the TRANSMISSION OVER TEMPERATURE indicator shall illuminate. The malfunction shall only be canceled by instructor command.
i. Transmission Locked - Activation of the transmission locked malfunction shall only be possible when the engine is running. When activated, the RANGE INHIBIT indicator shall illuminate. The malfunction shall only be canceled by instructor command.
j. Transmission Fault - Activation of the transmission fault malfunction shall only be possible when the engine is running. When activated, an audible alarm shall be activated and the CHECK TRANSMISSION indicator shall illuminate. The malfunction shall only be canceled by instructor command.
k. Non-critical Engine Fault - Activation of the non-critical engine fault malfunction shall only be possible when the engine is running. When activated, an audible alarm shall be activated and the CHECK ENGINE indicator shall illuminate. The malfunction shall only be canceled by instructor command.
l. Water in Fuel - Activation of the water in fuel malfunction shall only be possible when the engine is running. When activated, the WATER IN FUEL indicator shall illuminate. The malfunction shall only be canceled by instructor command.

When configured as a RG33L, CAT I RG33, Caiman, Caiman with ISS, Navistar MaxxPro, Navistar MaxxPro with ISS, RG31, and M-ATV, the CDT/MV shall score the student's performance in response to emergency conditions and malfunctions based on the student's ability to perform the following responses to the emergency conditions and malfunctions:

a. Engine Fire – When the engine fire emergency condition is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

    i. Check the AFSS Control Box to determine if FAULT indicator is illuminated.
    ii. If FAULT indicator is illuminated, press MANUAL ACTIVATION button within 5 seconds of the FAULT indictor being illuminated.

iii. Drive vehicle to a safe location
iv. Apply service brake to stop vehicle (if required).
v. Place gear range selector to Neutral (N).
vi. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
vii. Set communications and electrical equipment switches to OFF positions.
viii. Set engine START switch to OFF position.
ix. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
x. Set MASTER power switch to OFF position.

b. Loss of Steering – When the loss of steering emergency condition is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Apply service brake to stop vehicle (if required).
ii. Place gear range selector to Neutral (N).
iii. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
iv. Set communications and electrical equipment switches to OFF positions.
v. Set engine START switch to OFF position.
vi. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
vii. Set MASTER power switch to OFF position.

c. Loss of Brakes – When the loss of steering emergency condition is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Notify the instructor.
ii. Place gear range selector to Neutral (N).
iii. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
iv. Set communications and electrical equipment switches to OFF positions.
v. Set engine START switch to OFF position.
vi. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
vii. Set MASTER power switch to OFF position.

d. Flat Tire – When the flat tire emergency condition is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

    i. Reduce vehicle speed below 35 mph.
    ii. Continue the mission until reaching a safe location
    iii. Apply service brake to stop vehicle (if required).
    iv. Place gear range selector to Neutral (N).
    v. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
    vi. Set communications and electrical equipment switches to OFF positions.
    vii. Set engine START switch to OFF position.
    viii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
    ix. Set MASTER power switch to OFF position.

e. Low Fuel - When the low fuel malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

    i. Drive vehicle to a safe location
    ii. Apply service brake to stop vehicle (if required).
    iii. Place gear range selector to Neutral (N).
    iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
    v. Set communications and electrical equipment switches to OFF positions.
    vi. Set engine START switch to OFF position.
    vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
    viii. Set MASTER power switch to OFF position.

f. Low Oil Pressure - When the low oil pressure malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

    i. Drive vehicle to a safe location
    ii. Apply service brake to stop vehicle (if required).
    iii. Place gear range selector to Neutral (N).
    iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
    v. Set communications and electrical equipment switches to OFF positions.
    vi. Set engine START switch to OFF position.

vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

g. High Engine Coolant Temperature - When the high engine coolant temperature malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).
iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

h. High Transmission Fluid Temperature - When the high transmission fluid temperature malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).
iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

i. Transmission Locked - When the transmission locked malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).

iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

j. Transmission Fault - When the transmission fault malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).
iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

k. Non-critical Engine Fault - When the non-critical engine fault malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).
iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

l. Water in Fuel - When the water in fuel malfunction is executed during a scripted or free play scenario, the trainee shall execute the following sequence of responses, in the correct order and within 90 seconds for a satisfactory score:

i. Drive vehicle to a safe location
ii. Apply service brake to stop vehicle (if required).
iii. Place gear range selector to Neutral (N).
iv. Engage park brake and verify that PARK BRAKE (P) indicator illuminates.
v. Set communications and electrical equipment switches to OFF positions.
vi. Set engine START switch to OFF position.
vii. Allow 30 seconds after turning engine start switch to OFF before turning master power switch OFF.
viii. Set MASTER power switch to OFF position.

3.4.3.3 Visual Simulation

The CDT/MV shall utilize the visual simulation subsystem of the CDT. The visual simulation shall include the CDT image generators (standard visible environment and sensor image generators), CDT display system and CDT visual system data base.

3.4.3.3.1 Visual Scenes

The CDT/MV shall utilize the CDT visual environment data base as specified in the System Requirements Document for the Common Driver Trainer System. When configured, the CDT/MV shall have any fixed obstructions (e.g., hull or structural components) visible in the driver's field of view (FOV) displayed in the visual scene as a fixed entity. The simulated eye point height of the displayed image shall be the same as that realized by the driver in the operational vehicle.

3.4.3.3.2 Display Configuration

The CDT display system provides a 180 degree horizontal by 45 degree vertical real time image of the training environment from a defined eye point. The driver's eye point shall be located to optimize the use of the available FOV (i.e., 180 degree horizontal FOV and mid display vertical positioning).

3.4.3.3.3 Sensor Image Simulation

The visual simulation system shall provide a sensor simulation capability that replicates the DVE available in the actual vehicle. The capability to change pointing direction and image source shall be the same as in the actual vehicle. The sensor simulation modes shall be available at all times, where appropriate, during a simulation session. The sensor simulation shall utilize the visual database with additional descriptors and object data necessary to generate images with the fundamental characteristics of the sensor being simulated. The simulated sensor imagery shall include the effects of artificial illumination (e.g., headlights, flares, weapons flashes, and cultural light sources).

3.4.3.3.4 Image Display Subsystem

The Image Display Subsystem for the CDT/MV shall be in accordance with the requirements as described in the CDT Common SRD.

3.4.3.3.5 Detailed Training Environment and Model Requirements

The CDT/MV training environments, at a minimum, shall conform to the following requirements:

a. Training Postures:
   i. Normal Driving
      1) Full Day
      2) 25 Percent Ambient Light
      3) 50 Percent Ambient Light
      4) Night Using Headlights
      5) Night Using Blackout Markers (Convoy)
      6) Bright Night (Starlight and moon light)
      7) Dark Night
      8) Thermal conditions: Warm, hot, and cold in combinations of weather and visibility.
   ii. Adverse Conditions
      1) Full Day
      2) 25 Percent Ambient Light
      3) 50 Percent Ambient Light
      4) Night Using Headlights
      5) Night, Using Blackout Markers
      6) Night, Using DVE
      7) Bright Night (Starlight and moon)
      8) Dark Night
      9) Thermal conditions: Warm, hot, and cold in combinations of weather and visibility.

b. Terrain/Environmental Features and Conditions:
   i. Villages (several types, small with narrow streets, and medium size cluttered street with parked cars and other obstacles such as vendor stands and pedestrians).
   ii. Hills.
      a. The MRAP vehicle shall operate in a maximum grade of 60 degree and maximum slope 30 degrees. However, the CDT shall have hills with values greater than these.
      b. Steep hills with a variety of paved and unpaved roads.
      c. Mountainous terrain with steep winding roads, roll-outs, tunnels, and near vertical cliffs.
   iii. Obstacles:
      a. Fallen logs (trees)

b. Ditches of various widths and lengths
c. Walls of various heights
d. Steep inclines (several shall be greater than 60 degrees grade or 30 degrees slope, and including knife edge ridges).
e. Overhead obstacles (bridges, power or telephone wires).
f. Mine fields with and without markers (allows driver to negotiate around marked mines)
g. Pipes
h. Simple Obstacles (log cribs, berms, abatis)
i. Deep and shallow water fording locations.
j. Wadi
k. Farm complexes.
l. Urban complexes.
m. Dragon teeth.
n. Road craters.
o. Concertina wire..
p. Bridges.

iv. Fields
a. Plowed and grass covered.
b. Flat grassy areas.
c. Farm areas with cultivated fields.

v. Woods

vi. Vegetation (bushes, trees, rocks, etc.)

vii. Roads:
a. Major highways (high-speed autobahns).
b. Secondary roads (with sharp turns, hills, etc.).
c. Trails (narrow, unimproved, narrow roads, tank trails).
d. Road signs.
e. Narrow paved roads.
f. Canal Roads

viii. Terrain/Soil types:
a. Dirt (dry and wet).
b. Rocks.
c. Grass.
d. Mud.
e. Sand (dry and wet, packed, loose, soft, mixed).
f. Marsh.
g. Sand dunes.
h. Pavement (dry and wet).
i. Rock
j. Grass (wet and dry)
k. Ice
l. Snow

ix. Weather Conditions:
a. Snow
b. Ice.

c. Black Ice
d. Rain (slick roads, mud).
e. Low visibility (fog, haze, smoke, 25 percent ambient light,
f. 50 percent ambient light, dark).
g. Dust
h. Sandstorm
i. Wind.

i. Training Features/Environments/Conditions:
a. Desert Terrain
b. European Terrain (Winter, Winter with snow and Summer).

xi. Special training requirements:
a. Bridges (highway, tactical, assault)
b. Tunnels (one and two lane).
c. Convoys.
d. Opposing traffic.
e. Road Signs
f. Motor Pool area with rows of parked vehicles with empty spaces available.
g. Loading dock/rail load/HETS (Heavy Equipment Transport System)/ship loading
h. Ability to train with DVE
i. Appropriate trees, bushes, and shrubs for the various types of terrain and climate.
j. Appropriate buildings for the various types of terrain environment (Desert and European).

xii. Miscellaneous:
a. Drive with traffic.
b. Drive without traffic.
c. Drive in convoys.
d. Congested urban driving environment with traffic, parked vehicles, pedestrians, construction situations, detours, slow moving conditions, highway conditions, highway entrances and exit ramps, building and other constraints to movement and visibility.

xiii. Simulated Vehicle Models shall include (stationary and moving):

Model
Light Wheeled Vehicle – Civilian Examples: Chevy Caprice Taxi, Fiat Sedan, Toyota pickup truck, or similar
Medium Wheeled Vehicle – Civilian Examples: FedEx Truck, VW Van/Ambulance, or similar Heavy Wheeled Vehicle – Civilian Examples: Volvo Cargo Truck or similar Motorcycles, Bicycles, Scooters
Vehicle – Friendly Military

Examples: M1A1, Challenger, M60A3, LECLERC, AMX 30/10rc, Merkava – II, LEO I/II, Centurion, AAAV
MRAP Vehicle (Variants) Examples: Navistar MaxxPro, GDLS-RG31, Caiman, BAE RG33L, FPI Cougar, M-ATV
Vehicle – Threat Examples: T80, T72, BMP2, BRDM-2

xiv. Explosions (mines, artillery rounds, Improvised Explosive Devices).
xv. Cities.
xvi. Streams and rivers with various sizes of bridges with various weight limits and various depths of streams with fording locations.
xvii. Simulated Human Models and States shall include;

Model	**Type**	**State**
Dismounted Noncombatant – Civilian (man)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (woman)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (child)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (man - group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (woman - group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Noncombatant – Civilian (child – group)	Unarmed	Standing/Walking/Running/Falling/Dead
Dismounted Combatant – Ground Guide	Unarmed	Standing/Walking/Displaying Hand and Arm Signals
Animals	Unarmed	Standing/Walking/Running/Falling/Dead
Threat Human Models		
Dismounted – Civilian (man, woman and/or child)	Armed	Standing/Walking/Running/Falling/Dead
Dismounted	Armed	RPG Teams
Mounted	Armed	Riding in bed of civilian truck

3.4.3.3.6 Visual Effects

The visual effects produced by the CDT/MV shall occur simultaneously with the condition causing the effect. The following operating or environmental conditions listed in priority order shall produce appropriate visual effects to the driver trainee:

a. Own vehicle hit by rocket propelled grenade (RPG).
b. Own vehicle hit by an improvised explosive device (IED)
c. Own vehicle triggering a mine.
d. Nearby Explosion. Visual effect is active only when friendly and/or enemy fire is enabled and produces the visual effect of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle. When triggered, the visual effect shall appear at a random location anywhere within the driver's FOV and randomly within a range of 50 – 200 meters from the own vehicle.

3.4.3.4 Aural Cue and Communications

The CDT/MV shall utilize the aural cues and communications subsystem of the CDT to produce realistic or authentic aural cues in response to vehicle operation (movement, malfunctions, and gun fire) and interaction with the physical (terrain interaction) and tactical environment (weapons effects). The CDT/MV shall meet the general aural cue and communications requirements as specified in the System Requirements Document for the Common Driver Trainer System, PRF-PT-685.

The aural cues produced by the CDT/MV shall occur simultaneously with the condition causing the sound. The following operating or environmental conditions listed in priority order shall produce appropriate aural responses to the driver trainee:

a. Own vehicle hit by rocket propelled grenade (RPG).
b. Own vehicle hit by small arms fire
c. Own vehicle hit by an improvised explosive device (IED)
d. Own vehicle triggering a mine.
e. Hard Collision when the vehicle collides with an object. Aural cue shall be representative of the collision object.
f. Collision when own vehicle collides with another vehicle in the database. Aural cue shall be representative of the collision object.
g. Nearby Explosion. Cue is active only when friendly and/or enemy fire is enabled and produces the sound of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle.
h. Soft/Glancing Collision. Produces the sound of scraping metal. Activated when the vehicle has a Soft/ Glancing Collision with an object in the database.
i. Fire Extinguisher Shot discharge – Simulates the sound of high pressure gas escaping through a valve. Activates when the crew fire extinguisher discharges.
j. Tire Blow Out
k. Flat Tire Rolling. This sound shall continue until the driver stops the vehicle or the instructor clears the flat tire event from the Malfunctions page.
l. Engine Shutdown. Activated during the engine shutdown sequence. It produces the sound of the engine shutting down.
m. Engine Startup. It produces the whine of the starter motor and of the engine turning up. The cue activates during the engine startup sequence.
n. Engine running. Varies appropriately with engine RPM (including gear changes).

o. Road noise. A continuous sound for as long as the vehicle is moving. The noise level depends on the speed of the vehicle.
p. Parking Brake Engaging. Makes the sounds heard when setting the parking brake.
q. Starter Motor. Is activated when holding the Starter switch. It produces the whine of the starter motor.
r. Engine Noise. Is activated when the engine is running, noise varies as the RPM of the engine increases or decreases.
s. Silence. It is active on any of the audio channels that are not producing any of the other cues. Its purpose is to suppress any audio hum produced by the amplifier and other electrical components.
t. Fault alarms. Activated by the occurrence of a malfunction.
u. Scraping of dirt and rocks.
v. Braking sounds (air brakes).

3.4.3.5 Scoring Criteria

There shall be specific criteria for vehicle and trainee performance that will be monitored for evaluation against predetermined parameters. A scoring event shall occur if a specific criterion is either not met or exceeded depending on the criterion being evaluated. Scoring events shall be presented to the instructor in a scrolling log window when they occur with a time tag during both pre-programmed and free play scenarios. Scoring events shall be used to adjust the trainee's numerical score and retained in the trainee's record only during pre-programmed scenarios. Scoring events during free play scenarios shall be for instructor information and after action review and shall not be retained in the trainee's record.

a. Driver's Compartment Controls and Functions – The driver's compartment controls and functions shall be monitored continuously during scenario execution. A control or function error shall be produced in accordance with the following criteria:

i. MASTER POWER – An error shall be assigned when the MASTER POWER is turned OFF while the engine is running.
ii. Gear Shift Selector – An error shall be assigned when the gear shift selection is changed between any two positions other than LOW (L) and DRIVE (D) while own vehicle is moving at greater than 0.5 MPH.
iii. PARKING BRAKE – An error shall be assigned when the parking brake is engaged while the own vehicle is moving at greater than three MPH
iv. Startup – An error shall be assigned when the MASTER POWER is turned on and any of the following conditions are true:
    a. The SHIFT CONTROL Selector is not set to NEUTRAL (N)
    b. The PARKING BRAKE is not set.
v. Vehicle Startup – An error shall be assigned for vehicle startup if an attempt is made to start the engine and any of the following conditions are true:
    a. The LIGHTS are not turned OFF

b. Any of the vehicle electronics or communications systems are ON
c. The SHIFT CONTROL Selector is not set to NEUTRAL (N)
d. The Steering Control in not centered
e. The PARKING BRAKE is not set.

vi. Vehicle Shutdown – An error shall be assigned if the VEHICLE MASTER POWER is turned OFF and any of the following conditions are true:
a. The DVE switch is ON
b. The LIGHTS are not turned OFF
c. Any of the vehicle electronics or communications systems are ON
d. The START switch is ON
e. A 30 second cooldown period has not elapsed since the START switch was turned OFF.
f. The SHIFT CONTROL Selector is not set to NEUTRAL (N)
g. The PARKING BRAKE is not set.

b. Vehicle Control - The vehicle control criteria shall be monitored continuously during scenario execution. A vehicle control error shall be produced in accordance with the following criteria:

i. Skidding and/or sliding

a. Due to turning – An error shall be assigned due to improper turning when the own vehicle slides across the terrain for at least one second and the rate of turn commanded from the steering/throttle control at the onset of the slide exceeds six degrees per second. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.
b. Due to Braking - An error shall be assigned due to improper braking when the own vehicle slides across the terrain for at least one second, the rate of turn commanded from the steering/throttle control at the onset of the slide was six degrees per second or less and the service or parking brake was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.
c. Due to acceleration - An error shall be assigned due to improper acceleration when the own vehicle slides across the terrain for at least one second, the rate of turn commanded from the steering/throttle control at the onset of the slide was six degrees per second or less, neither the service or parking brake was applied at the onset of the slide and the throttle was applied at the onset of the slide. The own vehicle shall be considered to be

skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH.

d. Due to terrain – An error shall be assigned for skidding and/or sliding due to poor terrain selection when the own vehicle slides across the terrain for at least one second and the criteria for other causes for a slide or skid are not met. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the wheel speed is greater than two MPH. Skid scoring shall be inhibited while exiting the water during a water fording task and while any wheel is in contact with any sandy type terrain.

ii. Loss of Mobility

a. Due to a mired own vehicle – An error shall be assigned for loss of mobility due to a mired own vehicle when the terrain type on which the own vehicle is located indicates that it is impassable.
b. Due to bellied own vehicle – An error shall be assigned for loss of mobility due to a bellied own vehicle when a collision is detected on the underside of the own vehicle hull.

iii. Collisions

a. Hard Collisions – An error shall be assigned whenever a collision occurs with hard collision objects at speeds greater than 3 MPH.
b. Slow Speed Hard Collisions - An error shall be assigned whenever a collision occurs with hard collision objects at speeds less than or equal to 3 MPH.
c. Soft Collisions – An error shall be assigned whenever a collision occurs with soft collision objects at any speed.

iv. Special Action Scoring – Special action scoring shall supersede conflicting normal training criteria and be applied only during the performance of the special training actions listed below:

a. Ground Guide Control – An error shall be assigned whenever the following occurs during ground guide control:

i. Vehicle speed exceeds 5.0 MPH
ii. Failure to respond to ground guide commands within 10 seconds after the command is initially given.
iii. Turn left in response to a ground guide command to turn right for more than 6.5 seconds.
iv. Turn right in response to a ground guide command to turn left for more than 6.5 seconds.

v. Acceleration in response to the ground guide command to stop for more than 6.5 seconds.
vi. Turning in response to ground guide command to stop for more than 6.5 seconds.
vii. Forward motion in response to ground guide command to move in reverse for more than 6.5 seconds.
viii. Rearward motion in response to the ground guide command to move forward for more than 6.5 seconds.

b. Water Fording – An error shall be assigned whenever any of the following occurs during a water fording maneuver:

i. SHIFT SELECTOR not set to RANGE 1 while in the water.
ii. Bank gradient exceeds 40% on entering or exiting the water.
iii. Water depth at selected fording site exceeds 36 inches.
iv. Throttle greater than 30% while entering the water.
v. Vehicle speed exceeding 8 MPH while in the water.
vi. Failure to accelerate when exiting the water.

c. Convoy Driving

i. Vehicle Speed – An error shall be assigned if the vehicle speed during convoy driving exceeds the maximum speed specified in the scenario description.
ii. Vehicle Interval – An error shall be assigned if the distance between own vehicle and the vehicle immediately in front of own vehicle varies from the prescribed distance by +/- 25 meters or more. Vehicle interval scoring shall start 15 seconds from the initial start of the leading vehicle.
iii. Ideal path
    1. Off-Road Ideal Path - An error shall be assigned if the own vehicle deviates more than +/- 15 meters in off road scenarios.
    2. On-Road Ideal Path – An error shall be assigned if the own vehicle does not maintain the same lane as the leading vehicle. An error shall be assigned if the own vehicle does not change lanes within 10 seconds of the leading vehicle changing lanes. Standard stay in lane, lane change and turning scoring criteria shall be applied otherwise.

d. Transport Loading – An error shall be assigned whenever any of the following occurs when executing a transport loading or unloading exercise:

    i. Responses to ground guide as defined in Ground Guide Control above.
    ii. Speed in excess of 5 MPH while under Ground Guide Control.
    iii. Movement outside of the prescribed vehicle boundaries (i.e., off the edge of the trailer, contacting the inside of an aircraft transport, etc.)

e. Bridge Crossing - An error shall be assigned whenever any of the following occurs when executing a bridge crossing exercise:
    i. Responses to ground guide as defined in Ground Guide Control above.
    ii. Speed in excess of 5 MPH while under Ground Guide Control.
    iii. Movement outside of the prescribed vehicle boundaries

3.4.3.3 After Action Review Subsystem

The After Action Review system used in the CDT/MV shall be in accordance with the requirements as described in the CDT Common SRD.

3.4.3.4 Training Scenarios

The CDT/MV shall have access to all training scenarios previously developed for other CDT variant vehicles. The CDT/MV shall have 100 scenarios available for Program of Instruction (POI) population. All tasks and elements from the Training Tasks in paragraph 3.4.1 shall be included in the 100 preprogrammed scenarios.

The CDT/MV shall also provide non-preprogrammed (free-run) scenarios, which have no-predefined ideal paths or training tasks to be completed and allows the student to travel anywhere in the terrain database (within the limits of terrain traversability).

4.0 ACRONYMS LIST

AAR	After Action Review
BAE	British Aerospace Systems
CBRN	Chemical, Biological, Radiological, Nuclear
CDT	Common Driver Trainer
CVC	Combat Vehicle Crewman
D	Drive
DVE	Driver's Vision Enhancement
F	Fahrenheit
ft/sec	feet per second
FOV	Field Of View
FPII	Force Protection Industries, Inc.
HETS	Heavy Equipment Transport System
Hz	Hertz
IA	Information Assurance
iDID	Improved Driver's Integrated Display
IED	Improvised Explosive Device
IOS	Instructor Operator Station
ISS	Independent Suspension System
km	Kilometers
L	Low
m	Meters
mph	miles per hour
M-ATV	Mine Resistant Ambush Protected All Terrain Vehicle
MRAP	Mine Resistant Ambush Protected
ms	Milliseconds
N	Neutral
NBC	Nuclear, Biological, and Chemical
psi	pounds per square inch
PdM VTS	Product Manager for Virtual Training Systems
R	Reverse
RPG	rocket Propelled Grenade
rpm	revolutions per minute
SRD	System Requirement Document
TBD	to be determined
VOX	Voice Extension
USA PEO STRI	US Army Program Executive Office Simulation Training and Instrumentation

SYSTEM REQUIREMENTS DOCUMENT (SRD)
FOR THE
VISUAL SYSTEM FOR THE COMMON DRVER TRAINER (CDT)
FOR
THE COMMON DRIVER TRAINER (CDT) VIRTUAL PRODUCT LINE (VPL)
SYSTEM

COMMON SRD

VERSION 2.2

24 OCTOBER 2018

Prepared by:
U.S. Army Program Executive Office Simulation, Training and Instrumentation (PEO STRI)
Product Manager for Virtual Training Systems (PdM VTS)
12211 Science Drive
Orlando, Florida 32826-3276

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors only, due to vulnerability information, effective 30 August 2018. Other request for this document shall be referred to U.S. Army PEO STRI, ATTN: SFAE-STRI-TRADE-VTS.

Engineering

DOAN.DUNG.THU.1250396437 Digitally signed by DOAN.DUNG.THU.1250396437 Date: 2018.07.10 07:53:20 -04'00'

Prepared By:
Lead Engineer
Yung Doan

MEISTER.JEFFREY.D.1186901394 Digitally signed by MEISTER.JEFFREY.D.1186901394 Date: 2018.07.16 08:42:22 -04'00'

Approved By
PdM VTS - Chief Engineer
Jeff Meister

Acquisition Logistics

RAINE.WALTER.1114011068 Digitally signed by RAINE.WALTER.1114011068 Date: 2018.07.06 10:53:50 -04'00'

Prepared By
Logistics Management Specialist
Walter Raine

BROTHERS.MATTHEW.JR.1067535703 Digitally signed by BROTHERS.MATTHEW.JR.1067535703 Date: 2018.07.16 13:37:29 -04'00'

Approved By:
PdM VTS - TRADE PSM
Matthew Brothers Jr.

CHANGE HISTORY

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1. TRAINING SYSTEM DESCRIPTION

1.1 Scope

This System Requirements Document (SRD) describes the requirements for the Common Driver Trainer (CDT). The CDT will assist in the training of tactical vehicle drivers during Initial Entry Training (IET) and sustainment as described in this document's Appendices. The simulator(s) will enable training in the critical driver tasks that can repetitively train in a simulator and are dangerous and/or infrequently trained in the "real world" (i.e. driving on ice, fording streams, driving under blackout conditions, driving down steep embankments when coming off an improved road, etc.). The CDT will be reconfigurable to accommodate the different vehicle variants as defined in the individual SRDs included as appendices to this document. The CDT vehicle platform will be composed of common modules along with a specific module for the different vehicle variants. The components of the specific module will be the driver's compartment, instruments, controls, for the driver, and the software required operating the driver compartment and interacting with the common modules. The driver training scenarios can be "scripted" to practice driving the same tactical, terrain and traffic conditions repetitively, with random variations in traffic along the same route. The training scenarios can also be executed "unscripted," allowing instructor commanded variations of route and environmental conditions. Automated scoring of the driver during trainer scenarios ensures that training evaluation is consistent among all the students. In addition, as future vehicles define, the CDT Virtual Product Line (VPL) will grow to accommodate any new requirements that are not currently define in this document.

1.2 Background

The U.S. Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI), Product Manager for Virtual Training Systems (PdM VTS) has a requirement for driver training simulators to support the Training and Doctrine Command (TRADOC) schools with institutional drivers training and to support operational units with sustainment drivers training. The United States Marine Corps (USMC) Operator Driver Simulator (ODS) program's primary purpose is to provide both entry-level and sustainment-level training for USMC Motor Transport and incidental motor vehicle operators. USMC also has requirements for driver training simulator to support The Training Education Command (TECOM). Schools with institutional driver training will support operational units with sustainment driver training. The CDT product line is the Army's and USMC preferred solution for initial entry level and sustainment driver trainer needs. This product line encompasses driver training simulators for military wheeled, tracked and specialty vehicles, to include both tactical and non-tactical vehicles, utilizing a common platform. Each CDT system will be reconfigurable to accommodate the different vehicle variants as defined in the product system specifications.

Currently, the Army has procured 53 CDT systems (13 in the mobile system trailer training configuration and 40 in the fixed/facility configuration) and 69 specific variant cabs. This includes a Stryker Variant (SV) cab, Mine Resistance Ambush Protected (MRAP) Variant (MV) cab, Tank Variant (TV) cab that can configure as a Tank Engineering Variant (TEV) and a Tactical Wheeled Variant (TWV) cab under development. Currently, USMC PM TRASYS has procured 96 ODS systems (54 in the mobile system trailer training configuration, i.e. 19 at active

duty sites and 35 at reserve sites; along with 42 in the fixed/facility configuration, i.e. 41at active duty sites and one at a reserve site). The variants ODS currently include: the High Mobility Multipurpose Wheeled Vehicle (HMMWV) cab, the Medium Tactical Vehicle Replacement (MTVR) cab, the Mine-Resistant Ambush Protected (MRAP) Buffalo and Cougar cabs, and the MRAP All-Terrain Vehicle (M-ATV) cab. New variants include the High Mobility Artillery Rocket System (HIMARS) cab, the Logistics Vehicle System Replacement (LVSR) cab, and the Joint Light Tactical Vehicle (JLTV) cab.

The Government's intent is to maximize reuse of the existing architecture (to include software and hardware design and implementation) to preserve training capability and update this base architecture into a product line configuration providing user interoperability requirements, technical refreshes due to obsolescence and/or supportability requirements. The current driver training simulators for CDT allocate to vehicle configurations as follows:

a. SV vehicle variants consisting of an SV cab, Ten (10) software configurable instances with unique dynamics (each with slat armor option additionally) simulating equipment or components of the following:
   (1) Infantry Carrier Vehicle (ICV)
   (2) Mobile Gun System (MGS)
   (3) Reconnaissance Vehicle (RV)
   (4) Mortar Carrier (MC)
   (5) Commander Vehicle (CV)
   (6) Fire Support Vehicle (FSV)
   (7) Medical Evacuation Vehicle (MEV)
   (8) Anti-Tank Guided Missile Vehicle (ATGMV)
   (9) Nuclear, Biological and Chemical (NBC) RV (NBCRV)
   (10) Engineer Squad Vehicle (ESV) (Plow or Roller)

b. MV vehicle variants consisting of an MV cab, five (5) hardware (dash kits) and software configurable instances with unique dynamics simulating equipment or components of the following:
   (1) RG 33L
   (2) RG 31
   (3) Caiman
   (4) MaxxPro with and without Independent Suspension System (ISS)
   (5) MRAP All-Terrain Vehicle (M-ATV)

c. TV vehicle variants consisting of a M1A2 System Enhancement Package (SEP) V2 cab baseline, three (3) hardware (dash kit) and software configurable instances with unique dynamics simulating equipment or components (panels) of the following:
   (1) M1A1 (with plow or roller) (each effects dynamics)
   (2) M1A2 SEP V2 (with plow or roller) (each effects dynamics)
   (3) AutoFlug Variant (AV) cab hardware only used standalone for egress with modular AutoFlug or regular driver seat

d. TEV vehicle configuration consisting of a M1A2 SEP V2 cab baseline with M1A1 panels, two hardware and software configurable instances with unique dynamics simulating equipment or components of the following:
   (1) Joint Assault Bridge (JAB) (adding or removing bridge effects dynamics)
   (2) Assault Breacher Vehicle (ABV) (adding or removing plow effects dynamics)

e. TWV vehicle variants consisting of a TWV cab, variant specific interchangeable dashes with other equipment or components simulating the following:
   (1) M1083A1, 5-Ton Truck with M1095 Light Tactical Vehicle Trailer (LTVT)
   (2) M915 A3 Line Haul Truck with M872A4 Flatbed Trailer
   (3) M915 A5 Line Haul Truck with M872A4 Flatbed Trailer
   (4) M1120A4 Truck with M1077A1 Palletized Load System (PLS) Flatrack and M1076 Palletized Load System Trailer (PLST)

f. New TWV vehicle variants consisting of a variant specific TWV cab, and dash components are:

   (1) High Mobility Multipurpose Wheeled Vehicle (HMMWV) (i.e. M1113, M1114, M1151, M1151A1, M1152, M1152A1, M1165, M1165A1, M1167 and M997A3 utility trucks)
   (2) Medium Tactical Vehicle Replacement (MTVR) (i.e. MK/AMK-23, MK/AMK-25, MK/AMK-27, MK/AMK-28, MK/AMK-29, MK/AMK-30, MK/AMK-31 and AMK/MK36 7 -Ton trucks)
   (3) MK23 MTVR w/MAS (Marine Armor System)
   (4) Joint Light Tactical Vehicle (JLTV)
   (5) Mine-Resistant Ambush Protected (MRAP) (4x4 and 6x6 both with and without ISS) (i.e. CAT I A1, CAT 1 A1 ISS, CAT II A1, CAT II A1 ISS, CAT I A2, CAT I A2 ISS, CAT II A2, CAT II A2 ISS, CAT III Buffalo)
   (6) MRAP All-Terrain Vehicle (M-ATV) (i.e. M1240, M1240A1, M1245 and Utility Task Vehicle (UTV))
   (7) Logistics Vehicle System Replacement (LVSR) (i.e. MKR18, AMKR18, MKR16 and AMKR16)
   (8) High Mobility Artillery Rocket System (HIMARS)
   (9) M1101/M1102 Trailer, Light Tactical; M353 Trailer, General Purpose; M105, Trailer Cargo 1 ½ Ton; MK38, Trailer, Cargo Resupply, HIMARS; MK593 6Ton 4 Wheel Cargo Trailer; M149A2 Water Tank Trailer; Engineer Equipment Trailer (EET); M777 Howitzer, MK/AMK970 Aircraft Refueler

Each CDT system configuration also contains modules, consoles or workstations to facilitate training in a network system as identified below:

a. Instructor Operator Station (IOS)
b. After Action Review (AAR) / Ancillary Station (AS)
c. Scenario Generation System (SGS)
d. Semi-Automated Forces (SAF)
e. Joint Capabilities Release Logistics (JCR Log) Interface (Applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 vehicles only)
f. Local Area Network (LAN)
g. Drivers Vision Enhancer (DVE)
h. SV associated items
i. MV associated items
j. TV associated items
k. TV Rear View Sensor System (RVSS)

l. TEV associated items
m. TEV ABV Commander's station associated items

New products delivered under the CDT product line will be extensions to the existing CDT product line.

The CDT common system will employ a common mechanical, electrical and data interface for all the cabs. The CDT simulation software and variant vehicle simulation software architecture and data requirements maintained. Physically, any cab will be able to interface with any CDT common platform. In order to ensure proper vehicle variant operation, a system will require the addition of specific vehicle dynamics, vehicle operating simulation software, and variant scoring software.

All current CDT product line functionality and performance maintained unless an Engineering Change Proposal (ECP) submitted and approved by the Government.

The CDT systems will be able to connect within CDT family platforms to achieve the specific networking training objective:

Interoperation with CDT systems will meet Cybersecurity (CS) requirements.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue listed form a part of this specification to the extent specified herein. This specification designates as a first tier document. The documents referenced directly in this specification designates as second tier documents and consider part of this specification to the extent specified herein. Documents referenced in successive tiers are not part of this specification and use for guidance only.

2.1 Department of Defense Documents

MIL-STD-130N	Identification Marking of U.S. Military Property Management / Records
DA Form 348	Equipment Operator's Qualification Record
AR 600-55	The Army Driver and Operator Standardization Program
MIL-STD-1472G	Department of Defense Design Criteria Standard, Human Engineering
DoD Joint Technical Architecture (JTA)	Human-Computer Interface Standards Version 6.0
DoDI 8500.01	Cybersecurity (CS)
DoDI 8510.01	Risk Management Framework for DoD Information Technology
MIL-DTL-83511A	General Specification for Headset-Microphone and Headset-Electrical (Medium Noise Attenuation, Hearing Protective)
DoD 8570.01- M	Information Assurance Workforce Improvement Program

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions will be obtained from the procuring activity or as directed by the Procuring Contracting Officer (PCO).)

2.2 Other Government Documents

The following documents of the issue in effect on date of request for proposals, for a part of this requirements document to the extent specified herein.

PRF-PT-685	System Requirements Document (SRD) for the Common Driver Trainer (CDT): Common, Appendixes A to G
CNSSI 1253	Committee on National Security Systems Instruction (CNSSI) 1253
NIST SP 800-53	National Institute of Standards and Technology (NIST) Special Publication (SP) 800-53: Security and Privacy Controls for Federal Information Systems and Organizations
AR25-2	Information Assurance
AR 380-5	Army Information Security Program
FAR clause 52.204-9	Personal Identity Verification of Contractor Personnel
Army Directive 2014-05	Policy and Implementation Procedures for CAC Credentialing and Installation Access for Un-cleared Contractors
AR 190-13	Army Physical Security Program
PEO STRI BAM	Program Executive Office for Simulation, Training & Instrumentation Basic Accreditation Manual (BAM)
29CFR1910.1200	Occupational Safety and Health Standards Toxic and hazardous Substances
EM-385-1-1	Department of Army Manuals, US Army Corp of Engineers Safety and Health Requirements Manual 2014 (Manual is downloadable from www.usace.army.mil/CESO/Pages/EM385-1-1.aspx).
29 CFR 1910	Code of Federal Regulations (CFR), 29 CFR 1910 Occupational Safety and Health Standards (OSHA) (standards are downloadable from http://www.osha.gov)
NFPA 70	National Fire Protection Association (NFPA) 70 National Electrical Code, 2017 Edition (Copies of this document are available from http://www.nfpa.org/Catalog/ or National Fire Protection Association, 11 Tracy Drive, Avon, MA 02322)
NFPA 72	National Fire Alarm and Signaling Code
OSHA 1910	Occupational Safety and Health Administration (OSHA) Regulations OSHA 1910, Subpart S Electrical (Copies of the above regulations are available from http://www.osha.gov)

IEEE STD 12178.1a-1998	IEEE Standard for Distributed Interactive Simulation Application Protocols
IEEE 1516	IEEE Standard for Modeling and Simulation High Level Architecture (HLA)
IEEE – ANSI Y32.16	Reference Designations for Electrical and Electronics Parts and Equipment
ANSI Z53.1	Safety Color Code for Marking Physical Hazards
ANSI Z535.4	Marking Voltage Hazards
21 CFR 1040	Performance Standards for Light-Emitting Products
ANSI Z535.3	Safety Symbols
ANSI Z535.4	Product Safety Signs and Labels
NFPA 75	Standard for the Fire Protection of Information Technology Equipment
NFPA 101	Life Safety Code
CFR Title 29	Labor
ANSI/HFES 100-2007	Human Factors Engineering
GEIA-STD-0007 Rev B	Logistics Product Data
NFPA 780	Installation of Lightning Protection Systems
49 CFR 393	Parts and Accessories Necessary for Safe Operation
SAE J318	Automotive Air Brake Line Couplers
SAE J702	Brake and Electrical Connection Locations – Truck Tractor
SAE J700	Upper Coupler Kingpin – Commercial Trailers and Semitrailers
MIL-HDBK-1002/2	Loads Handbook
SAE J1292	Automobile and Motor Coach Wiring
SAE J560	Society of Automotive Engineers for Standard J560

FED-STD-595	Color Specification, Fan Decks and Paint Chips
MIL-PRF-62218 B	Corrosion Preventive Compounds

2.3 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption obtained.

3. REQUIREMENTS

3.1 System Configuration

The configuration for each CDT system derives based on the user training requirements. The configuration for each CDT system defines in the applicable CDT Variant appendices.

Each of the major subcomponents that exist within the current CDT product line shows in Figure 1, System Conceptual Diagram, and listed as follows:

a. Instructor/Operator Station (IOS)
b. Student Training Station (STS)
c. Variant Specific Cab
d. Ancillary Station (AS) / AAR
e. Common Data Server (CDS)
f. Disk Duplicator
g. Maintenance Mobile Device

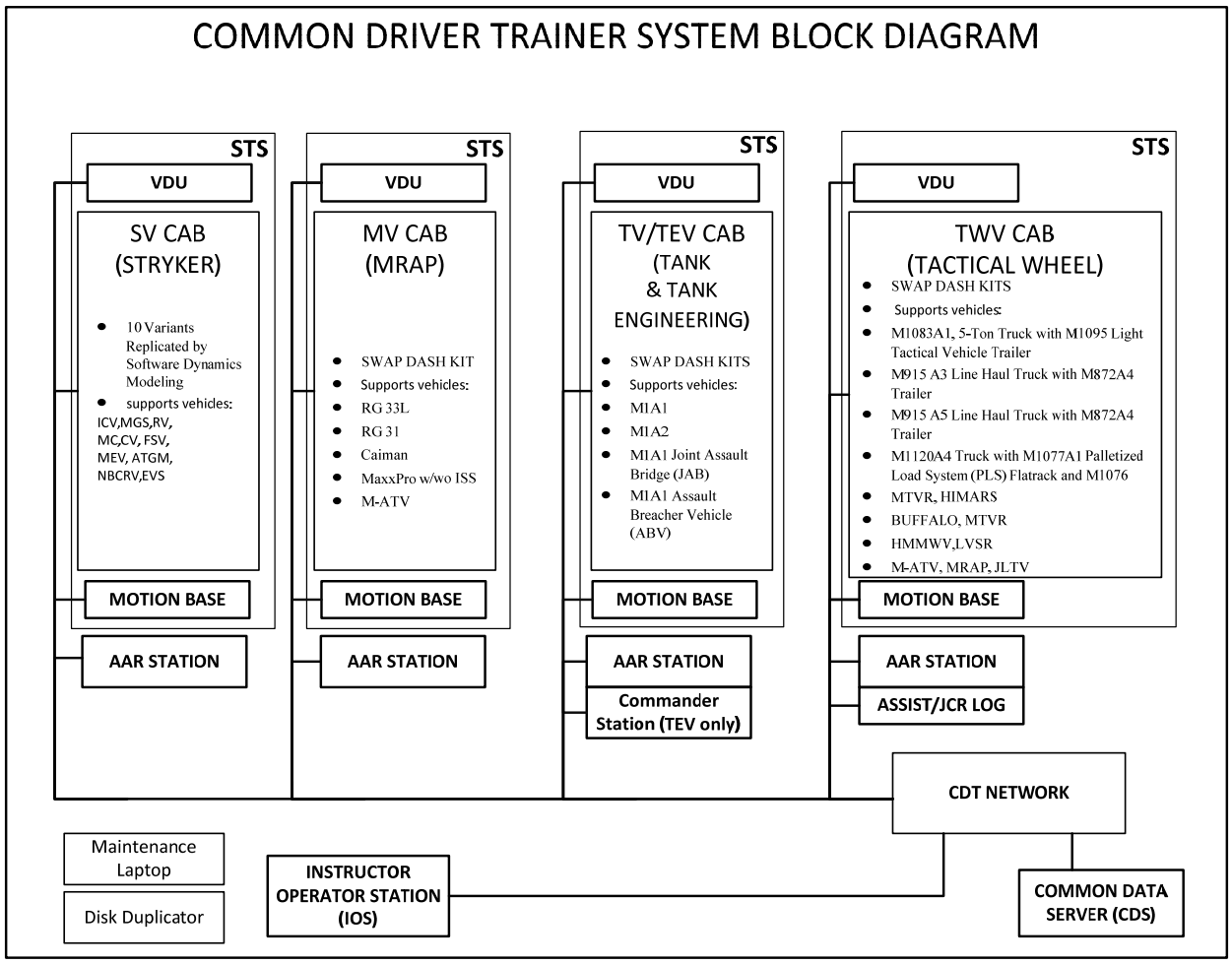


Figure 1 - CDT System Conceptual Block Diagram

3.1.1 Stand-Alone Driver Training:

The CDT shall provide initial and sustainment training of an individual's driver training requirements detailed in the variant's appendices. Figure 2 shows two modes of individual setup configurations for Independent mode operation.

a. Independent Mode (Single-Vehicle – Driver Only training).
   (1) The Driver Station shall operate in an independent mode to provide individual training.
   (2) Driver Station operating in a single scenario controlled by an IOS

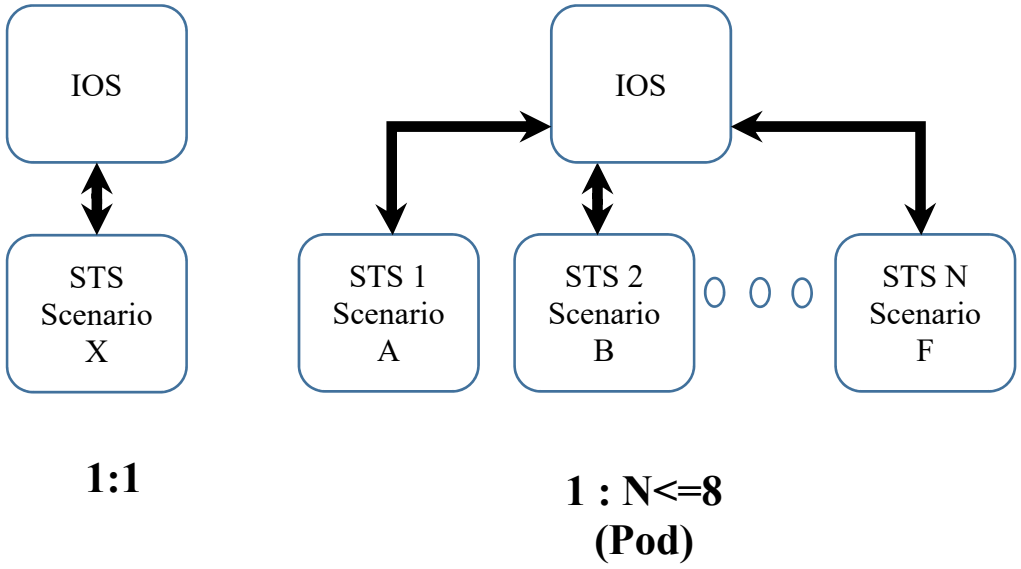


Figure 2 - CDT Independent Mode (2 Examples)

3.1.2 Crew Training:

The CDT shall provide initial and sustainment training the driver's tasks and include other crew members for that variant vehicle (Commander's Station, Gunner's Station, etc.). The set of training stations shall interoperate together as an integrated CDT training system representing a single variant vehicle type. Figure 3 shows CDT Integrated modes.

a. Integrated Mode (Single-Vehicle – Driver and Crew training)

(1) The Driver Station shall interoperate with the Ancillary Station in an integrated mode acting as one vehicle to provide crew driver training

(2) AAR/AS and Driver Station in a single scenario controlled by an IOS

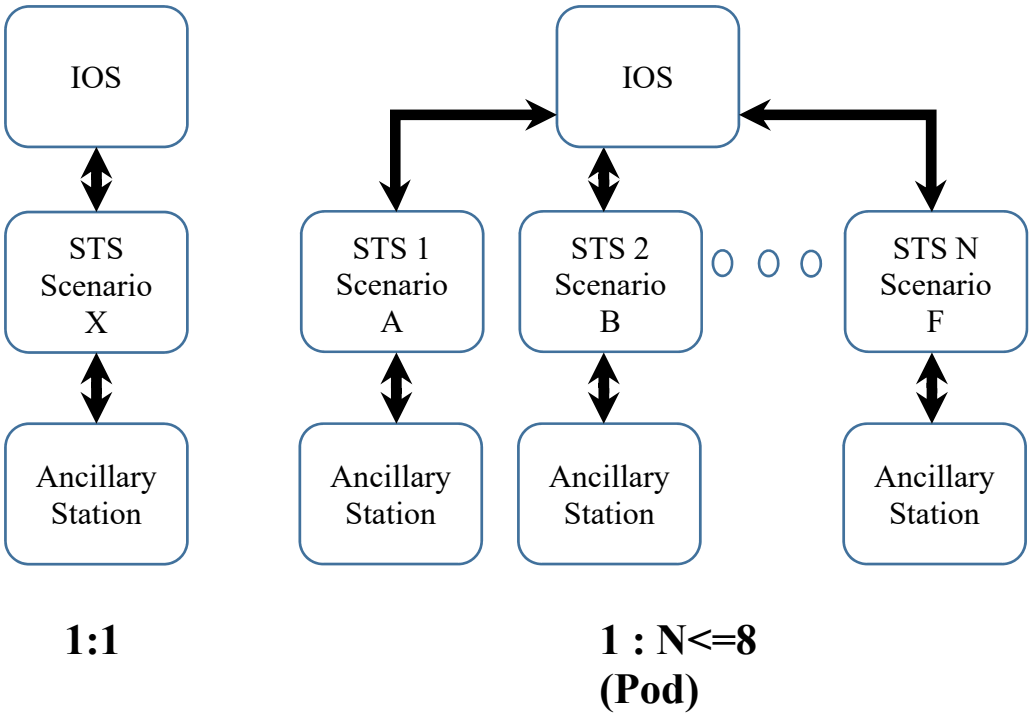


Figure 3 - CDT Integrated Mode (2 Examples)

b. Network Mode (Multiple Vehicles – Driver Only and/or Driver and Crew training). Figure 4 shows CDT Network mode operation.
   (1) Multiple STSs (up to 8) operating in the same scenario, up to the limitations of the computational systems
   (2) An IOS shall control the overall simulation including control of all STS's

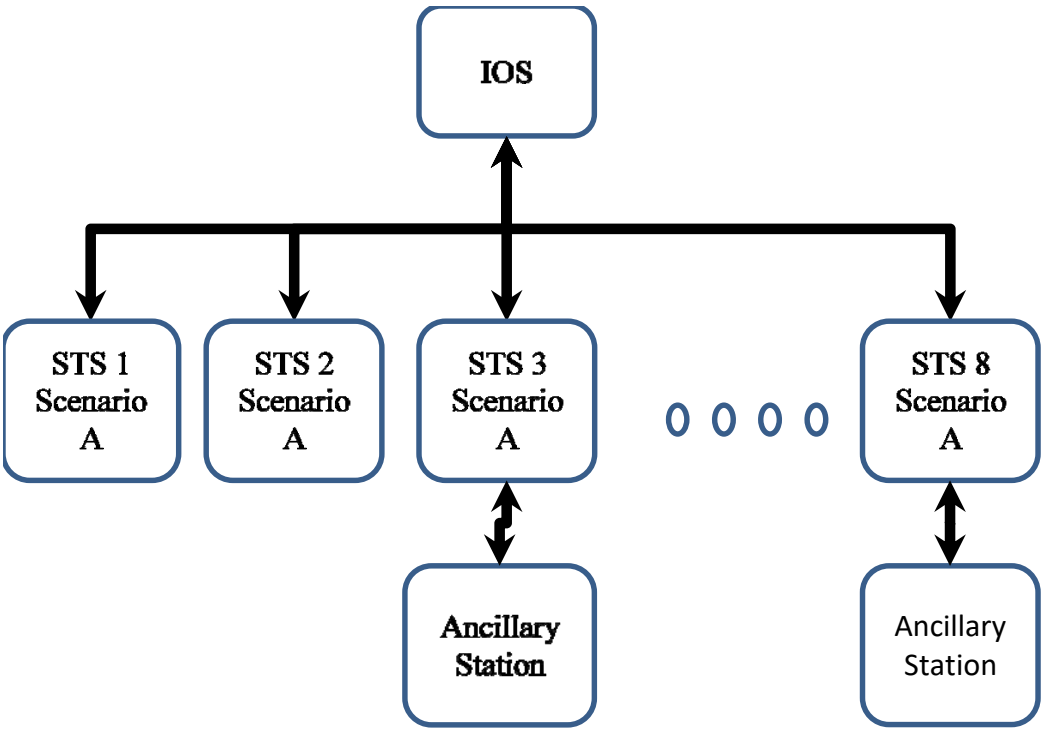


Figure 4 - CDT Network Mode

c. Hybrid Mode (Multiple Vehicles – Driver Only and/or Driver and Crew training).Figure 5 shows CDT Hybrid mode operation

(1) For a CDT base 1: N (pod – N<=8) configuration, the IOS shall allow a combination of individual and integrated modes of training

(2) Multiple STSs operating in the same scenario and other remaining STS pod operating independently, up to the limitations of the computational systems.

(3) An IOS shall control the overall simulation including control of all STS's in a pod (networked and individual training)

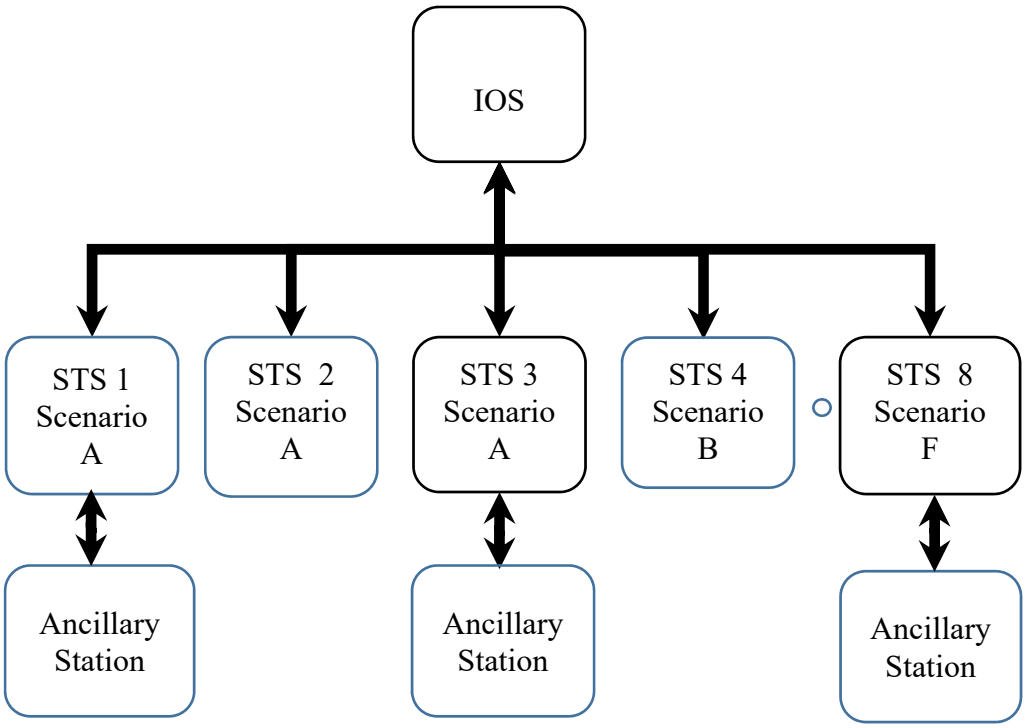


Figure 5 - CDT Hybrid Mode

3.1.3 Instructor/Operator Station (IOS)

The IOS is the instructor's primary workstation. Each IOS shall include one Common Access Card (CAC) reader capable of reading the data on the card. Information from CAC will define per Delivery Order (DO).

The IOS shall allow the instructor to select a scenario, set initial conditions, initiate the scenario, and monitor a student's progress throughout the scenario. There are two types of IOS configurations:

a. Single Configuration mode, i.e. one IOS shall be able to monitor, control, and provide real-time feedback to one STS or one STS/AAR/AS combination.
b. N-Configuration/Network mode (Pod), i.e. one IOS shall be able to monitor, control and provide real-time feedback to up to eight co-located STS/AAR/AS combinations. In network mode, all CDT systems shall be able to interact with one another on a common terrain/environmental database while executing a single scenario. In network mode, the requirement is to allow up to eight simulated vehicles to interact and allow man-in-the-loop convoy and collective training exercises.

Each IOS shall be able to monitor, control, and provide real-time feedback up to eight simultaneous scenarios and eight STS(s). In other words, an STS shall be able to run a different scenario as another STS or run a same scenario as another STS; therefore, up to eight different scenarios executed at the same time, monitored, and controlled by one IOS.

The CDT IOS shall contain hardware and software for system start-up, initialization and runtime which allows the system operators (e.g. administrators, instructors and maintainers) to perform their respective functions on the CDT. The IOS equipment set-up shall include, at a minimum:

1. A large flat work surface
2. Safety (emergency) buttons
3. Communications controls
4. Ability to manually control simulated features and applications (e.g. joystick)
5. A mouse
6. A keyboard
7. CAC smartcard reader
8. An array of color flat screen monitors to control and monitor CDT operations
9. Chairs (for an Instructor and Observer)

Figure 6 and referenced in Table 1 shows a typical station set-up.

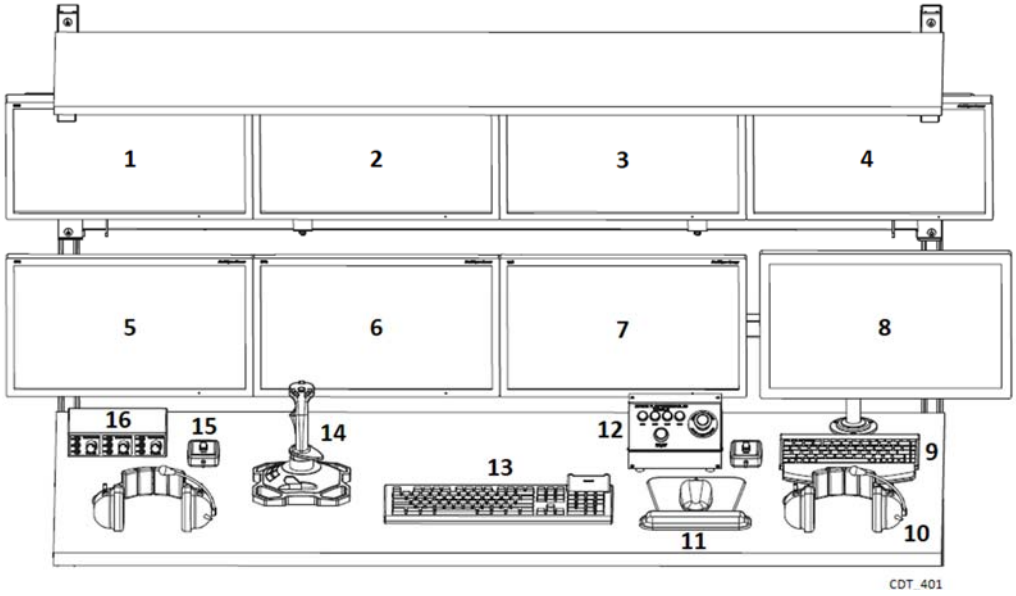


Figure 6 - Notional IOS Layout

Item	Control or Indicator	Description
1-4	Left, Center, Right and In-Cab Camera views	Reconfigurable to Left, Center, Right and In-Cab Camera views
5	Topographical map	Display scenario driver route
6	IOS Main	Primary control monitor
7	Stealth view	Bird's eye view of vehicle
8	JCR Log Monitor	Display monitor for the Instructor JCR Log (Applicable to specific TWV only)
9	JCR Log Mini Keyboard	JCR Log mini keyboard with touch pad (Applicable to specific TWV only)
10	Headset	Instructor headset (2)
11	Mouse	Mouse control
12	E-STOP	Motion-Base control
13	IOS Keyboard	Keyboard control
14	Manual input device (e.g. Joystick)	IOS override control (Ability to manually control simulated features and applications)
15	Push to Talk (PTT)	Push to talk (PTT) switch box
16	Switch Communication Amplifiers	Up to 3 Communication hookups

Item	Control or Indicator	Description
	Common Access Card (CAC) smartcard reader (On the IOS keyboard)	Common Access Card (CAC) smartcard reader

Table 1 – Notional CDT TWV IOS Layout

3.1.3.1 IOS Interfaces

The interfaces shall provide bi-directional communications between connected hardware and software features and functionalities, which as a result, shall provide access to all the control and monitoring functions of the CDT. The CDT IOS shall allow system start up and initialization; allow the system administrators to create, maintain and access student and class records; allow the instructors to control training scenarios and monitor the student's performance in real time; allow communications with students and allow maintenance personnel to access diagnostic and maintenance software.

3.1.3.2 IOS Monitors

The IOS monitors set-up shall have an array of monitors that allows the CDT operators to accomplish the various tasks such as administrator, instructor, and maintainer. All monitor displays shall be color and flat screen monitors. Each monitor shall have a minimum diagonal measurement of 22 inches for a 16:9 format (wide screen) display. The minimum native resolution shall be 1920 x 1080. The array of monitors shall include the following:

a. CDT Computer Imagery Generator (CIG) Monitors (One monitor per channel)

b. Topographical Map Monitor

c. Master Display Monitor

d. Instructor's Stealth View Monitor

e. Camera Monitor

f. Display Monitor for the Instructor JCR Log (Applicable to TWV only)

3.1.3.2.1 Topographical Map Display

The IOS shall have the capability to display a topographical map. The topographical map display shall show the simulation from a point directly above the database (perpendicular to the ground plane) at an altitude that depends on the magnification selected. The topographical map display shall have the following characteristics:

a. Regardless of the selection of magnification, the display shows all database detail (i.e. roads, structures, rivers, obstacles, and foliage). The highest magnification shall display the database detail with a resolution consistent with the native resolution of the topographical map display monitor. The topographical map display shall display without any display scintillation, flashing, or low resolution blocky artifacts.

b. The topographical map display shall provide a minimum of the following magnification selections.

(1) Zoom capability that can display any area from the entire database down to a 50 meter or closer radius around a selected map location while maintaining full resolution.

(2) Highest magnification shall show a radius of 50 meter around the selected map center.

(3) Terrain features and scenario model objects shall change detail levels automatically based on the zoom level.

c. The topographical map display shall show own vehicle position and orientation in the database by a distinctive, own vehicle icon.

d. Each icon shall distinguish by a unique color and associated code/number to distinguish each vehicle (driver/crew) in a scenario.

e. The topographical map display shall distinctively show the actual path of own vehicle progression during the scenario.

f. The topographical map display shall show all moving entity positions and orientations in the database. Each category of moving entities shall have a distinctive icon to differentiate from other moving entity categories and own vehicle.

g. The topographical map display shall show the prescribed vehicle path in scripted scenarios.

h. The topographical map display shall show the cue trigger points in scripted scenarios.

i. The topographical map display shall have the capability to selectively center the map on own vehicle or manually position the map center.

j. Each STS shall have its own dedicated topographical map view rendered.

k. The Instructor shall be able to dynamically allocate any STS's topographic map to any IOS display using its segmented and/or single view.

l. The topographical map display shall have contour lines to show elevation and pitch of grade change.

3.1.3.2.2 Master Display Monitoring

The IOS shall have a master display monitor which displays all IOS function, control and monitoring Graphical User Interface (GUI) windows and all maintenance application windows. There shall be a mouse and keyboard with the master display monitor. This shall be the input/output interface for all administrator, instructor, and maintainer functions.

All CDT control and monitor windows shall present on the master display monitor. All control and monitor GUI windows shall continuously update in real time during scenario execution. Multiple, resizable windows shall be able to be displayed simultaneously (the number of windows and the clarity of information shall be dependent on the number and size of windows selected) on the master display monitor. The control and monitor windows shall minimize (reduced to a single icon) or maximize (expanded to full screen).

The IOS shall display runtime scoring based upon Government-provided scoring standards. The IOS shall provide an embedded training course to support sustainment training. Scoring is not

required for the embedded sustainment training course. The IOS shall contain an embedded electronic operator user and maintenance manuals, Commercial Off The Shelf (COTS) and military manuals with searchable text capabilities.

3.1.3.2.3 Instructor's Stealth View Monitoring

The IOS shall have a color and flat screen monitor to display the manual input device controlled by the instructor's eye point view. The instructor's eye point view shall either tethered to the simulated training vehicle or a stealth view with free unrestricted movement throughout the training database for each simulated training vehicle. The tethered view shall present the CIG imagery of the training environment as seen from a fixed point relative to the own vehicle. The manual input device shall control the azimuth position relative to own vehicle, distance from the vehicle, elevation above own vehicle and the viewing angle of the eye point. When not being positioned by the manual input device, the attached view shall remain in a constant position and look angle relative to own vehicle throughout the training session. The stealth view shall allow unrestricted movement of the instructor's eye point view throughout the training database. The default position for the stealth view shall tethered directly above the vehicle looking forward. The CDT system shall generate an independent stealth view for each STS. A 2 Dimension (2D) on-screen text shall overlay a unique identification number next to each ownship in the exercise.

3.1.3.2.4 In-Cab Camera Monitoring

The IOS shall have an in-cab camera monitoring capability that shall display a view of the inside of the driver's compartment and student.

3.1.3.3 IOS Driving Control – Normal

When the instructor selects the own vehicle control, the manual input device shall provide control for both the normal instructor control and control with vehicle limitations override in effect. In the selection of the normal instructor control, the manual input device shall have a button that shall allow the user to set/release the parking brake. The manual input device shall have a button that shall allow the user to change transmission gear selection. The manual input device shall have a button that shall allow the user to start/shutdown the engine.

Forward deflection of the manual input device shall result in inputs to the vehicle dynamics model simulating the application of throttle to the ownship. Rearward deflection shall result in inputs to the vehicle dynamics model simulating the application of the ownship brakes. Deflection of the manual input device to the right shall provide input to the vehicle dynamics model simulating deflection of the steering mechanism that results in a right turn. Deflection of the manual input device to the left shall provide input to the vehicle dynamics model simulating deflection of the steering mechanism that results in a left turn. The simulated steering deflection shall increase as the manual input device left/right deflection angle increases.

3.1.3.4 IOS Driving Control – Vehicle Limitations Override (VLO)

The instructor shall be able to select whether the driver's compartment or the IOS has driving control over the vehicle simulation by way of the IOS manual input device. In the selection of the IOS driving control, the instructor shall be able to select normal vehicle dynamics mode or vehicle limitations override vehicle dynamics mode. When vehicle limitations override mode is

selected, the vehicle equations of motion shall be suspended so that the own vehicle can traverse any terrain that the simulated vehicle could not normally negotiate. While in vehicle limitations override mode, the own vehicle shall be capable of maneuvering on slopes too steep for normal operation and on surfaces that normally provide insufficient traction.

3.1.3.5 IOS Communications

Each CDT IOS shall include a headphone/microphone set for both the instructor/operator (I/O) and an observer in order to communicate with the STS and ancillary stations. The IOS station shall be equipped with a mixer, amplifier, and a voice communications control software using built-in sound device in the IOS computer. The IOS computer shall support up to four (4) attached headsets. Each headphone set (I/O & observer) shall have an independent jack and volume control. The headsets provided for use at the IOS shall be closed-ear headset/boom noise-cancelling mic/computer. The cab shall provide communication devices that replicate the form, fit, and function of the MIL-DTL-83511A (or most current) tactical headsets for use by the trainee. The communication devices utilized by the trainee shall replicate the form, fit, and function of the headset, communication switch with wearable inline push-to-talk adapter, and harnesses utilized in the tactical environment.

3.1.3.6 IOS Rack

The CDT IOS shall include a COTS standard roll around electronics rack for housing components necessary to support the functionality of the IOS. The IOS rack shall include:

a. Door latches with locks
b. CDT power controls,
c. Printer,
d. Computer and networking resources,
e. Cable harness space

3.1.3.7 Power Control and Initialization

The IOS shall have a simplified procedure and capability to power-on the CDT system(s) and initialize the system(s) to a state where all systems and subsystems (i.e. STSs and Ancillary Stations) power up and ready to operate. The CDT system shall be initialized and ready to operate within ten minutes of initial power-on. From the initialized, ready to operate state, operators shall be able to initiate administrator, instructor, or maintenance functions

The IOS shall also have the capability to power-down the CDT in a controlled, safe manner consistent with the CDT hardware and software (both application and operating system) requirements.

3.1.3.8 IOS Printer

The IOS rack shall have a printer to print hard copies of student reports, class reports, and student performance analysis. The IOS printer shall be able to print information from the master display monitor windows at the operator's request. The IOS printer shall also be able to print out diagnostic data from diagnostic and maintenance applications.

3.1.3.9 IOS Computer

The IOS rack shall contain computer(s) which meets the technical specifications defined in paragraph titled 'Computational Hardware'. The IOS computer shall be capable of running all of the IOS software defined in paragraph titled 'IOS Software' without noticeable lags, lockups, or system crashes.

3.1.3.10 IOS Setup Window

The IOS Setup Window shall appear on the master display monitor by default. It can move to any IOS linked monitor.

3.1.3.11 IOS Software

3.1.3.11.1 Class Manager (CM) Application

The CDT IOS shall include Class Manager Software which allows users with appropriate privileges (administrators and instructors) to perform the following functions as a minimum:

a. Group one or more scenarios into custom Program of Instructions (POIs).
b. Create student records for each student.
c. Create a database of instructors.
d. Group one or more students into a Class.
e. Assign one or more instructors to a Class.
f. Assign a POI to a Class.
g. Print student reports.
h. Print Class reports.
i. Create archives of records.
j. Export readable records/reports to external media.
k. Import records/reports in Government provided format (e.g. Excel, Word, PDF or TXT)
l. Restore all records from external media.
m. Import Resident Individual Training Management (RITM) system data from external media.
n. Retrieve all relevant personal information from an inserted CAC card automatically.

3.1.3.11.2 Administrator Capabilities

The administrator shall be able to accomplish the Class Manager functions listed herein from a single GUI administrator window. The administrator GUI window shall have radio button selections to Manage POI, Manage Scenarios, Manage Student Records, Manage Instructor Records, and Manage Class Records. The selection of the specific administrator function shall present a GUI window with data entry fields, pull down menus and radio buttons appropriate to the type of CDT training data being managed.

a. Manage POI – When selecting the Manage POI function, the administrator shall have the capability to create POIs by adding available scenarios in a specific sequence. The administrator shall also have the capability to edit POIs by changing the sequence of scenarios and deleting scenarios. The administrator shall also have the capability to delete a POI. The Manage POI function shall accomplish from a single, user friendly GUI window. Exiting the Manage POI GUI function without saving the data shall prompt an option to save the data, exit the function without saving, or cancel the operation.

b. Manage Scenarios – When selecting the Manage Scenarios function, the administrator shall have the capability to configure scenarios from the library of training scenarios available in the training database. The administrator shall be able to configure scenarios by editing the scoring limits, edit the scoring modifiers, edit the scenario configuration data, and select available configuration options. The manage scenarios function shall be accomplished from a set of selectable user friendly GUI window.

c. Manage Student Records – When selecting the Manage Student Records function, the administrator shall have the capability to manage student data in the training records database. The administrator shall be able to accomplish the following functions from the Manage Student Records GUI window:

   (1) Create a student record in the training records database. Student identification shall be loaded manually by the instructor or by scanning the student's CAC. Scanning a student's CAC card shall copy the Student's personal information into the CDT database. The student's personal information shall include at a minimum: email, rank, first and last name.

   (2) Permanently delete students and their personal information from the training records database. An appropriate warning shall present to the administrator advising of the action taken and an option to cancel the action before actual deletion.

   (3) Archive a student's record (one year or older) to an external storage media, removing the student record from the training records database.

   (4) Retrieve a student's record from an external storage media, adding the student record into the training records database.

   (5) Create student reports for viewing and printing.

d. Manage Instructor Records – When selecting the manage instructor records function; the administrator shall have the capability to manage the instructor data in the training records database. The administrator shall have the capability to perform the following functions from the manage instructor records GUI:

   (1) Add instructor's personal information to the training records database.

   (2) Permanently delete instructors and their personal information from the training records database. An appropriate warning shall present to the administrator advising of the action taken with an option to cancel the action before actual deletion.

e. Manage Class Records – When selecting the Manage Class Records function, the administrator shall have the capability to manage the training class data in the training records database. The administrator shall have the capability to perform the following functions from the Manage Class Records GUI window:

(1) The administrator shall be able to create a training class by establishing the class ID, class name, class location and the class start and end dates. The administrator shall also be able to assign an instructor or instructors to the class from a selection of instructors in the training database.

(2) The administrator shall be able to populate a training class by either manually entering student data via the keyboard or by importing student data from RITM (see section 7 RITM for a sample report) via a comma, delimited data file on digital media in accordance with DODI 8500.01 Cybersecurity guidance.

(3) The administrator shall be able to modify a training class by removing either an instructor or a student from the class and adding additional instructors or students. When deleting an instructor or student from a training class, the instructor or student data remains in the training records data base.

(4) The administrator shall be able to permanently delete a class and its associated data from the training records data base. An appropriate warning shall present to the administrator advising of the action taken and an option to cancel the action before actual deletion.

(5) The administrator shall be able to archive a class record to an external storage media, removing the class record from the training records database.

(6) The administrator shall be able to retrieve a class record from an external storage media, adding the class record into the training records database.

(7) The administrator shall be able to generate class reports for viewing or printing

f. Access Archived Operation Data – The administrator shall be able to access any cumulative archived data stored in the Class Manager, the CDS or on external media.

3.1.3.11.3 Instructor Capabilities

The instructor shall be able to accomplish the Class Manager functions listed herein from a single GUI instructor window. The instructor GUI window shall have radio button selections for each function. The selection of the specific instructor function shall present a GUI window with data entry fields, pull down menus, and radio buttons appropriate to accomplish.

a. Training Initialization – The instructor shall be able to login a student by either scanning the student's CAC or manually entering the student's identification (ID) information in the appropriate GUI field(s). If the student is not in the training records database, a warning shall generate stating a student record shall establish in the training records database before training can proceed. The instructor shall also be able to retrieve student scoring history from the student data in the training records database.

b. Create/Delete Student Record – The instructor shall be able to create or delete a student record in the training records database. Student information shall be loaded manually by

the instructor or by scanning the student's CAC. The student record shall contain all information necessary to create and print the reports and forms specified in paragraph section 'Administrator/Instructor Reports and Forms' (below).

3.1.3.11.4 Administrator/Instructor Reports and Forms

The administrator and instructor shall have the capability to print, export, modify, and save student and class reports and forms, at a minimum.

a. Student Performance Report – The student performance report shall document the analysis of the student's performance on a scenario. The Student Performance Report shall include, at a minimum, student name, date, scenario identifier, class identifier, instructor name, miles driven in scenario, time to execute scenario, simulated fuel used in scenario, final student score for scenario, final rating and any instructor comments.

b. Student Transcript Report – The student transcript report shall document the student's training on the CDT. The Student Transcript Report shall include, at a minimum, facility name, student name, current date, dates that the report covers, class identifier in the report header. The body of the report shall include an itemized list, sorted by date of the following information for each training session:

    1) CDT identifier
    2) Date of training
    3) Instructor's name
    4) Non-scripted scenario identifier (if applicable)
    5) Scripted scenario identifier (if applicable)
    6) Miles driven in scenario
    7) Time to execute scenario
    8) Simulated fuel used in the scenario
    9) Final score for scenario and the
    10) Final rating for the scenario

    The report shall also include a total of the quantitative data (number of scenarios run, miles, time, fuel, etc.) in the report.

c. Enrolled Student Class Report – The student class report shall document the data for the students in a class. The Student Class Report shall include facility name, current date, class identifier, and dates that the report covers in the report header. The body of the report shall include a list of students, sorted by name with the following information for each student:

    1) Soldier's name
    2) Number of non-scripted scenarios completed
    3) Number of scripted scenarios completed
    4) Number of scenario miles driven

5) Amount of scenario time driven
6) Amount of simulated scenario fuel consumed
7) Number of student training sessions
8) The average score of the completed scenarios

The report shall also include a total of the quantitative data (number of scenarios run, miles, time, fuel, etc.) in the report.

d. Class Status Report – The class status report shall document data for the classes at a facility. The Class Status Report shall include the facility name, current date, and the dates covered by the report in the report header. The body of the report shall include a list of classes, sorted by name with the following information for each class:

1) Number of students in the class
2) Number of non-scripted scenarios completed by the class
3) Number of scripted scenarios completed by the class
4) Total number of scenario miles run by the class
5) Total scenario time for the class
6) Number of student training sessions
7) The total simulated fuel consumed by the class

The report shall also include a total of the quantitative data (number of students, number of scenarios run, miles, time, fuel, etc.) in the report.

3.1.3.12 IOS Application

3.1.3.12.1 Simulation Control and Information Window

The Simulation Control and Information Window shall provide real-time data during scenario execution. The simulation control and information window shall allow the Instructor to control scenario execution. The simulation control and information window shall allow the Instructor to control the display mode of the Instructor stealth view monitor.

a. Simulation Information – The simulation information portion of the window shall provide to the instructor the scenario (scripted and unscripted) run time/scenario elapsed time, scenario miles driven/scenario odometer, scenario fuel consumed for the scenario being executed. The simulation portion of the window shall also present malfunction alerts and automated scenario scoring for the scenario executed. During scripted scenario execution, the program vehicle malfunctions shall alert the instructor when they activate no matter in which of the possible scenario control and monitoring windows view. The malfunction alert shall have visual display characteristics (e.g., color, flashing, font size, separate window, etc.) for timely recognition. The vehicle malfunction alert window shall provide the Instructor the capability to deactivate the malfunction and continue the scenario execution without the malfunction. During either scripted or non-scripted scenario execution, the instructor shall alert to any driver action that generates a scoring

deduction. The scoring deduction alert shall have visual display characteristics (e.g., color, flashing, font size, separate window, etc.) for timely recognition but different from the malfunction alert. Each scoring deduction alert shall also include a time tag listing the time of occurrence from the start of the scenario. The scoring deduction alert shall accumulate from the beginning to the end of the scenario with only the latest five scoring deductions shown instantaneously. There shall be the capability for the instructor to select the scoring deduction alerts with the cursor and show all scoring deduction alerts along with their time tag that have accumulated to that time. There shall also be continuous display of the current cumulative score for the scenario that updates each time a scoring deduction event is registered.

b. Simulation Control – The instructor shall be able to control the execution of the selected training scenario after the scenario begins. The instructor shall be able to start, stop, jump the scenario to the next section (instructor placed flag(s) or beginning) forwards and/or backwards, pause and resume the selected training scenario from a scenario control GUI window. The instructor shall be able to set flags during the execution of the scenario that identifies points of interest in the scenario. The instructor shall then be able to position the scenario at the flagged locations and either replay the scenario from that point or have the student re-drive the scenario from that point. The instructor shall also have the capability to jump back 30 seconds in the scenario and either replay the last 30 seconds over, or to allow the student to re-execute that section of the scenario. A separate control shall be provided that clears a hard collision (i.e. resets all visuals, states, and controls); and jumps back to either the last flagged point in the scenario or a point 30 seconds before the collision (whichever is closer to the collision point) to allow the student to continue execution of the ongoing scenario prior to the collision. The instructor shall also be able to select whether the driver's compartment or the IOS has driving control over the vehicle simulation by way of the IOS manual input device. In the selection of the IOS driving control, the instructor shall be able to select normal vehicle dynamics mode or vehicle limitations override mode. When the instructor is controlling the own vehicle, steering, throttle, service brake, and transmission control inputs from the driver compartment shall be ignored by the simulation. If normal vehicle dynamics mode is selected, all movement of the own vehicle shall be subject to the limitations of the vehicle equations of motion and terrain traversability. In normal vehicle dynamics mode, the own vehicle shall not move in a manner that would not be possible if control was exercised from the driver compartment controls. When vehicle limitations override mode is selected, the vehicle equations of motion shall be suspended so that the own vehicle can traverse terrain that the simulated vehicle could not normally negotiate. When vehicle limitations override mode is selected, the own vehicle shall be capable of maneuvering on slopes too steep for normal operation and on surfaces that normally provide insufficient traction.

c. Stealth Capability Control –The instructor shall be able to select the function and view of the IOS Stealth capability for each STS. The Stealth capability shall allow either the vehicle tethered view capability or the Stealth view capability with free unrestricted movement throughout the training database. The tethered view capability shall present the CIG of the training environment as seen from a fixed point relative to the own vehicle. The manual input device shall control the IOS Stealth view eye point as

described in azimuth position relative to own vehicle, distance from the vehicle, elevation above own vehicle and the viewing angle of the eye point. When not being positioned by the manual input device, the attached view shall remain in a constant position and look angle relative to own vehicle throughout the training session. The stealth view capability shall allow unrestricted movement of the Instructor's eye point view throughout the training database. The manual input device shall allow the instructor to move forward and reverse; turn left and right; adjusts viewpoint elevation and the viewpoint look angle.

d. Display Information – The IOS shall display the Topographical Map and the Master Display on their respective monitors, of all STSs it is controlling during the simulation. It shall also have the option to select specific STS(s) to display in full view. The remaining monitors shall be capable of dynamically allocating to the user selectable channels during initialization and execution of the scenario.

e. Ownship Position Status – The IOS shall have the capability to select the vehicle component ownship positions when in networking mode. The ownship positions shall display on the Two Dimensional (2D) map and Stealth Viewer with a unique identification number.

f. Scenario Status – The IOS shall have a scenario status graphical user interface to display the following information to the instructor:

    a. Scenario Malfunctions Status

    b. Scenario Scoring Status

        i. A GUI shall display necessary steps with go/no indicator to the instructor.

        ii. A GUI shall display the own vehicle unique identifier.

    c. Numerical Text Box to display, at a minimum, the following own vehicle information instead of the driver's GUI display:

        i. Speed

        ii. Transmission Gear Engaged

        iii. Active Indicators

        iv. Other vehicle specific data shall define in the vehicle variant appendices.

        v. Scenario Status

    d. Scenario Scoring Control – The IOS shall have a scenario control interface to allow the instructor to perform the following functions:

        i. Scoring

            1. On or Off

            2. If On, then a waypoint shall trigger the ownship before the instructor cues the scoring event and the steps necessary to pass the scored event.

        ii. Automated Cueing and Scoring Assistant Subsystems – On or Off.

        iii. At the end of the GUI selection screen, a table of selected options shall show the instructor their selections.

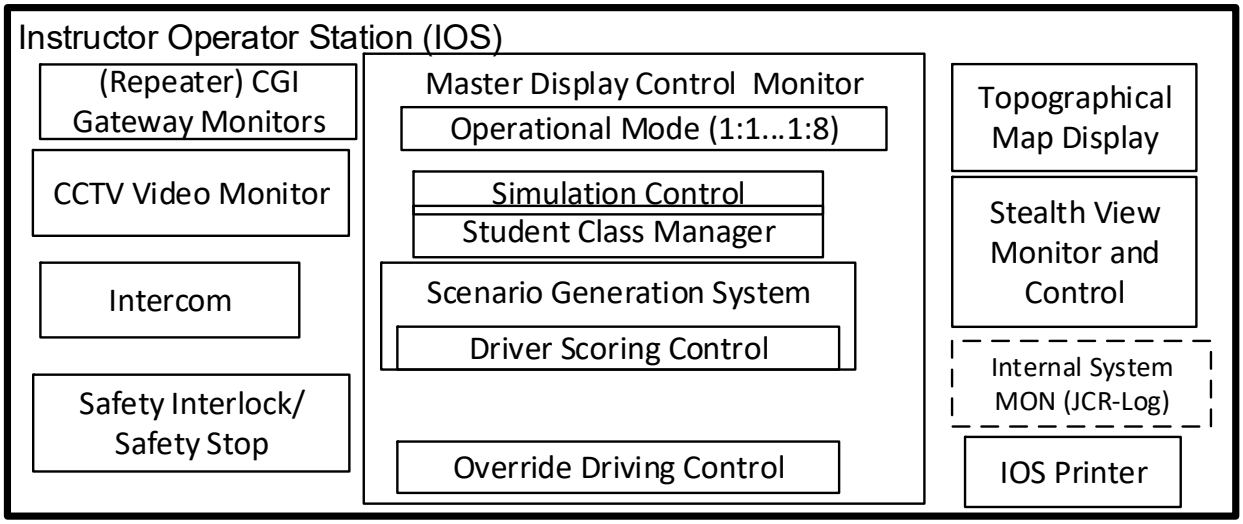


Figure 7 - IOS

3.1.3.12.2 Multiple and Cross-Pod Control Capability

Each IOS shall have the capability to control multiple STSs from multiple pods in any training mode (stand-alone, hybrid, or network). The IOS shall be able to add or remove STS(s) in the network and/or hybrid mode during simulation (i.e. in training session).

The IOS shall display the Topographical Map and the Master Display on their respective monitors (refer to Figure 7). The remaining monitors shall be capable of dynamically allocating to the user selectable channels during initialization and execution of scenario.

The IOS shall have the capability to select the vehicle component ownship positions when in networking mode. The ownship positions shall display on the Two Dimensional (2D) map and Stealth Viewer with a unique identification number.

3.1.3.12.3 Vehicle Instrument and Control Window

The vehicle instrument and control window shall graphically represent all monitored driver's compartment controls, indicators, switches, instruments, and displays of the vehicle simulated. The graphical representations of the vehicle controls, indicators, switches, instruments and displays shall either represent the status due to student actions (e.g., flip a switch, turn a knob, brake pedal position, etc.) or the status or value resulting from the vehicle simulation (e.g., speedometer readings, fuel level, etc.). The graphical representation of the monitored driver's compartment controls, indicators, switches, instruments, and displays shall update in real time during scenario execution.

3.1.3.12.4 Scenario Selection Window

The IOS shall have a scenario selection window. The scenario selection window shall allow an Instructor to search for a scenario, select a scenario, adjust selected scenarios parameters, and

initialize execution of the scenario. A scenario shall be selectable from a training scenario library. The IOS shall have a method for initializing scenarios using on-screen menus. The IOS shall provide an option for the instructor to place a student anywhere within the scenario progression matrix by selecting a particular scenario. The GUI interface shall provide a selection of training scenarios to the instructor. The GUI interface shall provide a high level overview of the training scenario description to include if appended systems are necessary and whether the scenario can utilize as a network scenario. The IOS shall allow the instructor to assign ownship positions based on the systems availability given the selection of the network mode training scenario. The IOS shall allow the instructor to assign appended systems based on the systems availability given the selection of the integrated mode scenario. The IOS shall also allow the Instructor to configure the scenarios as an unscripted scenario selection. When the instructor selects the unscripted scenario, a scenario setup window shall display to the Instructor on the master display monitor. The scenario setup window shall present vehicle and scenario setup options that are specific to the simulated vehicle and the training categories, e.g. POI/scenario libraries, terrain types, training tasks, environmental conditions and variant-specific conditions, selected by the instructor. The IOS shall have a method to select and change, at a minimum, the following scenario parameters:

a. Relocatable objects
b. Visibility in varying degrees from continuous values of 0 to 100%
c. Meteorological effects: haze, dust, cloud, lightning, storm, thunder, fog, rain, snow, ice, wind with all variable density, direction and velocity
d. Continuous and progressing time of day including sun and moon angle effect
e. Nighttime visibility based upon moon phase (full moon, no moon, and half-moon)
f. Time of day (morning, afternoon, dusk, night, dawn)
g. Vehicle malfunctions
h. Automated cues On/off (see Automated Cueing Subsystem)
i. Scripted scoring communication On/Off
j. Vehicle variants
k. Loads Capacity/Types (half, full, empty, solid and liquid)
l. Trailer and Towing (half, full, empty, solid and liquid) options
m. Other vehicle variables required to meet training requirements for that vehicle
n. Pedestrian and vehicular traffic
o. Motion active (setting shall enable or disable movement of the motion platform during a scenario.
p. Continuous time of day including sun angle effect
q. Nighttime visibility based upon moon phase (full moon, no moon and half-moon)

The scenario setup window shall not be available to the instructor when selecting scripted scenarios. The IOS shall display the scenario configuration selections to the instructor for

approval prior to beginning execution of the training scenario. The IOS shall provide the capability to unselect any previously selected options before execution of the training scenario.

3.1.3.12.5 Scenario Runtime

The IOS shall have real time controls capabilities, i.e. environments, SAF entities, and malfunctions, while scenarios are running. The IOS shall have the capability to re-configure the stealth and Out the Window (OTW) displays while in integrated or network mode during scenario execution. This means, when a single IOS connects to more than one STS in either integrated or networked mode, the instructor shall have the ability to allocate any combination of OTW and stealth views to any monitors not dedicated to scenario control. For example, in the seven monitor configuration shown in Figure 6 – Notional IOS Layout, if the IOS was controlling four STS in integrated mode, the instructor could allocate displays 1, 2, 3, and 6 to stealth views at the start of a session. Whenever a student has trouble, the IOS operator shall be able to select and switch the monitors to show that student's OTW views on monitors 1, 2 and 3 and a stealth view on monitor 6.

3.1.3.12.6 Vehicle Malfunction Window

The vehicle malfunction window shall display all the possible malfunctions and vehicle failures simulated for the selected vehicle. During scripted and unscripted scenario executions, the vehicle malfunction window shall allow the instructor to select any of the available malfunctions for that vehicle by a radio button associated with that malfunction. The vehicle malfunction window shall indicate the activation of the malfunction. Upon activation, the vehicle simulation then provides the proper operating characteristics for the selected malfunction. The vehicle malfunction window shall allow any active malfunction to clear by selecting the associated radio button changing the malfunction to a deactivated state. Upon deactivation, the simulation shall return to normal vehicle operating characteristics. During scripted scenario execution, the vehicle malfunction window shall not allow the instructor activation of a vehicle malfunction or failure. When an activated vehicle malfunction or failure occurs by the scripted scenario, the vehicle malfunction window shall automatically display the malfunction as activated. The vehicle malfunction window shall allow the automatically activated malfunction to clear by selecting the associated radio button changing the malfunction to a deactivated state or by the predetermined vehicle malfunction course of action programmed into the host system. Upon deactivation, the simulation shall return to normal vehicle operating characteristics. If the instructor deactivates the malfunction from an alert on the simulation control and information window, the malfunction shall have a deactivated indication on the vehicle malfunction window.

3.1.3.12.7 IOS Gauges Window

The CDT vehicle specific software shall include an IOS gauges window for each simulated vehicle by the CDT. The IOS gauges window for each vehicle assigned to the IOS shall be selectable and displayable on the IOS during scenario runtime. The IOS gauges window shall display all gauges, lights, indicators and other controls available on the cab dashboard. When the STS dashboard compares to the corresponding IOS window displays in real time, the following tolerances shall be meet:

a. Analog gauges/indicators within 10% difference

b. Digital gauges/indicators to within 1% difference

c. Boolean (on/off) indicators 100% accurate

3.1.3.12.8 Own Vehicle Weapons Firing Window

The Own Vehicle Weapons Firing Window shall display the own vehicle weapons controls for the vehicle being simulated. During scripted and unscripted scenarios, the instructor shall have the capability to control own vehicle weapons. The instructor shall have the capability to select the weapon for firing and to direct the pointing of the selected weapon in azimuth and elevation relative to the own vehicle main body if the weapon has that capability. The instructor shall have the capability to fire the selected weapon as if someone else in the vehicle (other than the driver) was firing the weapon. The activation of selected weapon firing by the instructor shall initiate an aural cue and visual cue that represents the firing of the weapon. The aural cue shall be a single shot or a burst of shots when activated depending on the simulated weapon. The visual cue shall present in the driver's field of view when activated depending on the weapon's position relative to the driver's compartment. The vehicle dynamics shall react appropriately to the type of the firing of the weapon and the direction of the fire.

3.1.3.12.9 Incoming Fire Window

The Incoming Fire Window shall display possible weapon attacks on the ownship. During scripted and unscripted scenarios, the instructor shall have the capability to trigger selected incoming weapon attacks. The effect shall be random within +/- 70 degrees from the ownship's front center and within 100 meters of the vehicle ownship. The activation of the selected weapon by the instructor shall initiate an aural, motion and visual cues representing the particular weapon selected. The aural cue shall be a single shot or a burst of shots when activated depending on the simulated weapon. The motion cue shall represent a shockwave the variant cab would experience where the random weapon detonates. The visual cue shall present in the driver's field of view when activated depending on the weapon's position relative to the driver's compartment. The visual weapons effects shall be representative of the selected weapon used. The visual weapons effects shall include the launch signature (e.g. RPG, ATGM, main gun weapons systems and small arms), if applicable. The weapon selected shall be able to modify the terrain database (dynamic terrain) after detonation. The vehicle dynamics shall react appropriately to the type of incoming direction of fire and dynamic terrain changes. The following operating or environmental conditions listed in priority order shall produce appropriate aural, motion, dynamic terrain, and visual effects to the driver trainee:

a. Own vehicle hit by Rocket Propelled Grenade (RPG)
b. Own vehicle hit by an Improvised Explosive Device (IED) buried, exposed, etc.
c. Own vehicle triggering a mine
d. Own vehicle taking on small arms fire

3.1.3.12.10 Environmental Control System

CDT shall include the simulation Environmental Control System (ECS). The ECS shall allow an instructor operator to alter the environmental conditions of a scenario during runtime via an interactive GUI window at the IOS such as rain, snow, day and night (ref. Sec. Scenario

Selection Window). When in network mode, only the IOS shall be able to alter the environmental conditions for the scenario. Modified environment condition shall produce the correct response from scripted entities, SAF entities, and ownships which encounter the altered environment condition.

3.1.4 Student Training Station (STS)

Each STS or STS/AAR/AS combination, the student's primary workstation, can simulate a different vehicle configuration (i.e. Variant); operate in a different terrain/environmental database; and execute a different or same training scenario from the other STSs.

The IOS shall control each system and CDT exercises. The exercises shall record and play back at the After Action Review Console.

At a minimum, each STS shall have a cab mounted on a motion platform with a Visual Display Unit (VDU). Each STS shall include the computational and Image Generation (IG) components necessary to simulate the vehicle and its environment. Each STS shall include one or more AAR/AS(s) to support an AAR or variant crew training.

3.1.4.1 STS Components

The STS components shall consist of a motion platform with interfaces for mounting CDT compatible cabs. The STS components shall consist of one or more standard roll around electronics rack(s) for fixed configuration, and mounted to the floor for mobile configuration. The STS components shall consist of a VDU and ancillary station(s), if required. The maximum height of a computer rack shall be 42U. Computers, circuit cards and electronic components which shall be subjected to displacement or loosening of connections during normal motion platform operation shall not place within the cabs, dashboards or other components normally placed on the motion platform during operation. Each STS shall include one CAC reader capable of reading the data on the card. Each driver station, assistant driver station, vehicle commander station or other ancillary station in an STS shall require a student to log in via IOS manually, IOS CAC reader or the AAR CAC reader.

3.1.4.2 STS Rack

The CDT STS shall include a standard equipment rack for housing components necessary to support the functionality of the STS. The STS rack shall include, at a minimum:

a. Power controls
b. Computers
c. Networking resources, i.e. switches, routers
d. Equipment cable areas

3.1.4.3 Simulation Host Computational System

The STS computational system shall contain computer(s) which meets the technical specifications defined in section titled 'Trainer Computer Systems'. The simulation host computer(s) shall be capable of running all of the CDT simulation control software without noticeable lags, lockups, or system crashes. The current CDT architecture utilizes separate

computers for computational system processes, but multi-core processors and multi-thread systems shall consider providing the functional modularity of the maintained CDT software architecture.

3.1.4.4 IG System

The CDT IG system provides simulated imagery for out the window and sensor displays. The CDT IG system shall be Personal Computer (PC) based with commercially available hardware that can separately procured. The IG shall be able to use modern PC and video card hardware as replacements, when original hardware becomes unavailable. The replacements shall be backwards compatible with the original hardware delivered with the system.

3.1.4.5 Motion Platform

The CDT motion platform shall install on the motion system of section 'Motion System'. The motion platform shall provide the support structure for the VDU and the common physical/mechanical interface for the installation of the vehicle variant driver's cab. The motion platform shall have an interlock system that prevents motion activation unless the vehicle variant cab securely installs.

3.1.4.6 Visual Display Unit

The CDT host software shall include a STS Visual Display Application. The application shall allow a user seated at the IOS to control the visual display(s) on the STS. The application shall have an icon available on the IOS Desktop.

The visual display system shall portray the simulated training environment to the trainee utilizing the visual interface (e.g. windshield/windows, vision blocks, periscopes, direct view through open hatch, and sensors) with applicable obscurations/restrictions of the specific operational simulated vehicle. The visual display system configuration shall be scalable in terms of dimension and number of channels to optimize the displays for the specific driver's compartment configuration and the training requirements.

The VDU shall use a Commercial Off-the-Shelf (COTS) solution and the display resolution of each VDU shall be a minimum of 1440h x 1080v for the Field-Of-View (FOV) of 60 degrees horizontal by 45 degrees vertical.

3.1.4.7 Luminance

Luminance shall provide no less than 250 lumens of light output onto a VDU of 21 square feet and deliver 14.4 foot-Lambert (ft.-L) at the center of each display channel.

3.1.4.8 Contrast Ratio

The minimum contrast ratio for all displayed images shall be 150:1 for each display channel.

3.1.4.9 Total Geometric Accuracy

The total geometric distortion for each display shall minimize the error in apparent location for any point in the scene relative to the true projected position.

3.1.4.10 Adjacent Channel Matching

Variations in color, brightness, contrast, and resolution between adjacent channels shall minimize for the full range of simulated conditions. Gaps between displays shall less than two degrees and shall not impact training effectiveness.

3.1.4.11 Image Stability

The displayed image shall not drift more than two pixels per eight hours of continuous operation. The displayed image shall not have any perceptible movement relative to the CDT VDU (i.e. jitter in response to system motion) during scenario execution. Normal operation of the CDT system shall not adversely affect the alignment, focus, or stability of the visual display system or the displayed images.

3.1.4.12 Field-Of-View (FOV)

The CDT shall have the capability to accommodate the FOV of the vehicle variants. Specific FOV parameters define in the Visual SRD.

3.1.4.13 STS Interfaces

Figure 8 – Internal STS Interfaces shows the internal interfaces between host processor and the components that comprise a workstation, console, or manned module. Not all components shall be supported in any single workstation, console or manned module. The following paragraphs describe the functions provided by the interfaces between these components.

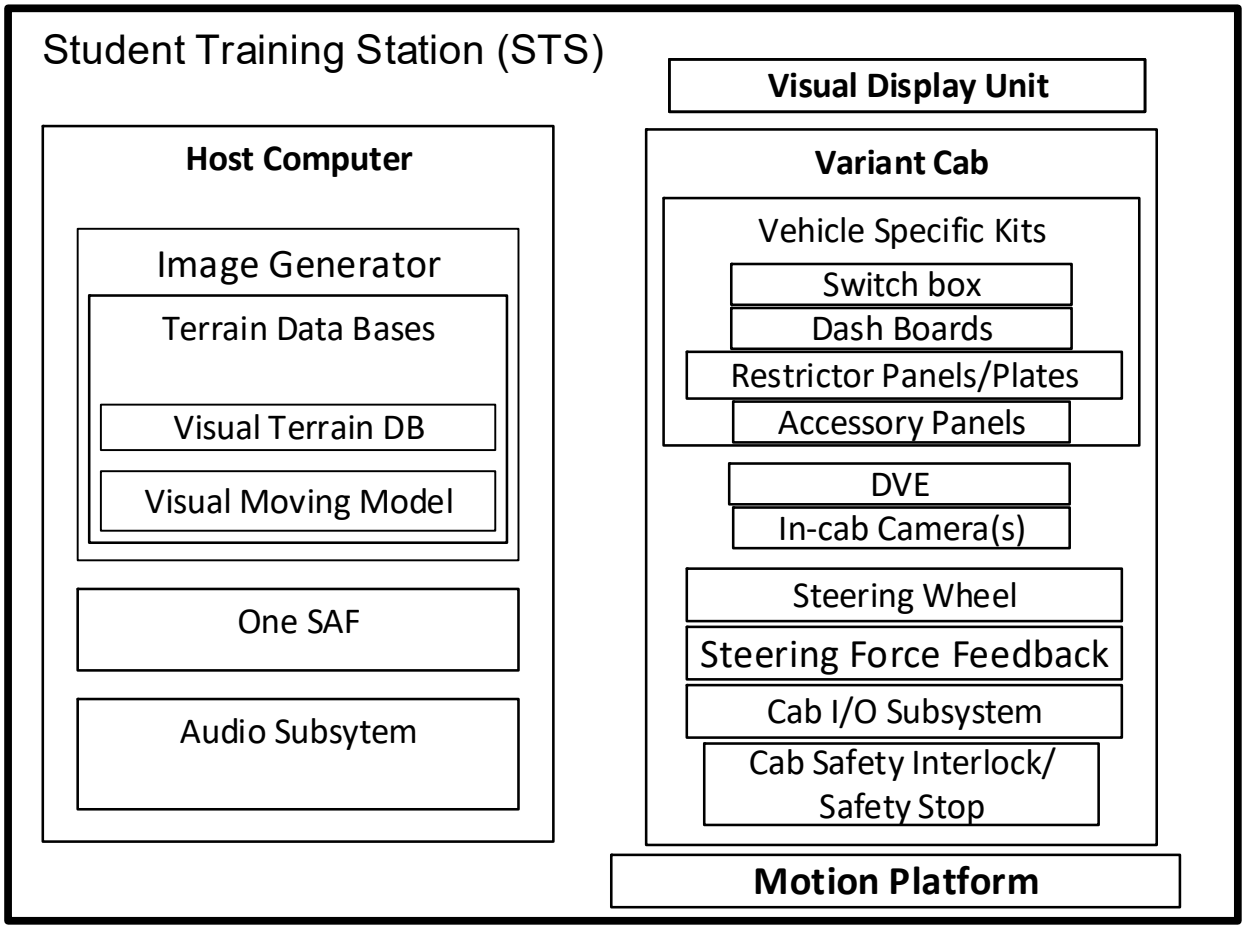


Figure 8 - Internal STS Interfaces

3.1.4.14 Host Computer

The Host Computer software used to operate the driver's compartment shall interact and control the common and variant modules. The Host Computer shall be capable of installation in the common modules with no loss of functional capabilities per common or existing variant modules. The Host Computer shall reuse the existing software interfaces to the greatest extent possible and modified to meet the new variant requirement interfaces.

3.1.4.15 Variant Vehicle Cab

The cab shall be a structure which houses the replication of a vehicle's driver's station. The cab shall design to be reconfigurable to support training of multiple vehicle types using a single cab. The cab shall contain all of the controls, switches, lamps, indicators and other equipment or components necessary to train the student in the driver's training tasks defined in each CDT Variant's appendices.

Each CDT current and new cab shall be capable of mating with the existing CDT common component interfaces (detailed in provided CDT Technical Data Package). Each CDT cab shall provide an Ethernet interface to allow connection of the maintenance mobile device for

calibration and diagnostic purposes. Reconfiguration from one CDT variant cab to another shall be achievable in less than 1.0 hour by a two person crew.

3.1.4.15.1 Cab Input/Output (I/O) Subsystem

Each CDT cab shall include an electrical/electronic Input/Output subsystem. The CDT architecture currently supports the following COTS items: WAGO and United Electronics Industries (UEI) I/O systems. All future CDT cab variants shall utilize anon-proprietary or COTS I/O.

3.1.4.15.2 Cab Safety Interlocks

Each CDT cab shall include safety interlocks on all doors, seat belts, hatches, and crewmember's safety harnesses. Whenever an interlock is opened [i.e. door opened, seat belt (shoulder/lap belt and 3-point harness) or harness unbuckled], the CDT system shall display a warning message at the IOS and the motion platform shall settle to the fully lowered position known as the 'Parked' position.

3.1.4.15.3 In-Cab Camera(s)

Each CDT cab shall include one or more cameras. The placement of the primary camera shall optimize to capture the student's interaction with the controls of the simulated vehicle. The placement of an additional camera shall optimize to capture the student's facial expressions and reactions to allow the Instructor to monitor the student for the onset of motion sickness. Each vehicle variant cab shall have the camera locations determined during preliminary design review.

3.1.4.15.4 In-Cab Communication Subsystem

Each CDT cab shall include an in-cab audio subsystem. The in-cab audio subsystem shall allow verbal communications between the student and the instructor. Two-way communication between the instructor and student shall provide at all times when the system is initialized. Either communication shall accomplish through headsets, the student's appropriate helmet, or a speaker and microphone located in the driver compartment. The instructor shall be able to select the headset/helmet, in-cab speaker/microphone subsystem or both for student communication audio in the driver's compartment. The instructor shall be able to control overall voice communications volumes for the entire system.

Each CDT cab shall allow students to utilize the Combat Vehicle Crew (CVC) helmet that utilizes in the actual vehicle or the appropriate gear used for communications in the actual vehicle. If headsets are used, each headset shall have an independent jack and volume control. The headsets provided for use in the cab shall be David Clark computer compatible headsets part number 40642G-01 or concurrent.

Any speakers and microphones utilized for the in-cab communication subsystem shall be separate and distinct from the speakers utilized in the in-cab sound subsystem described below.

3.1.4.15.5 In-Cab Audio Subsystem

Each CDT cab shall include an in-cab audio subsystem. The in-cab directional audio subsystem shall be capable of providing automated verbal cues, corrective instructions, environmental

sounds, realistic vehicular operational sounds, and aural cues to the student. The in-cab audio subsystem shall provide realistic sounds, typically experience by a driver operating a military vehicle singly and in convoy with other military vehicles in Continental United States (CONUS) and Outside the Continental United States (OCONUS); urban; city; rural; wooded; desert; seaport; airport; and motor pool areas in all types of weather conditions. The in-cab audio subsystem shall represent vehicle weapon firing and incoming weapon sounds the driver would experience.

Per Delivery Order (DO), each CDT cab shall contain at least four full range speakers and a larger woofer. The in-cab audio subsystem shall be capable of providing sounds to all speakers in the cab.

All nonverbal sounds and aural cues shall play through the in-cab audio subsystem. This includes all vehicle caution, warning, alert and malfunction alarms except when the sound generates by and played from a speaker within a COTS dashboard or Government Furnished Equipment (GFE) vehicle panel as specified in each DO.

The audio subsystem shall have the capability of playing at least one hundred twenty eight aural cues simultaneously (or 64 simultaneous if all require stereo playback) when required by the training conditions. The audio subsystem shall support prioritization of cues according to the simulated vehicle as specified in the cab requirements document. The instructor shall be able to adjust a master volume control for all aural cue volumes sound using the audio subsystem software interface at the IOS.

The audio subsystem shall be capable of generating and storing sound libraries for each CDT cab and vehicle variant. Each sound library shall contain the set of sounds listed in the specific requirements document. The priority for each sound contained in a sound library shall determine by the specific requirements document. A volume level for each individual sound shall be stored in the sound library. The audio subsystem shall include a GUI based sound library editing application. The sound library editing application shall allow an instructor to create new sound libraries, edit and delete existing libraries, add new sound files to a library, delete sound files from the library, adjust volumes for each sound file in the library, set and change priority for each sound file within a library, and organize sound files within the library. Each sound library shall be capable of storing at least 128 sound files. The audio subsystem shall allow the user to use standard sound files, user-configurable one shot sound files, user-configurable looping sound files and user-configurable complex (start – loop – stop) sound files.

3.1.4.15.6 Vehicle Specific Kit(s)

Each CDT cab shall include one or more vehicle specific kits. When provided with a cab, each vehicle specific kit shall contain the components and accessories necessary to transform the generic cab into a cab which replicates the form, fit and function of the driver's station inside the cab of a specific vehicle or family of vehicles. Installation of a vehicle specific kit shall not require removal of the cab from the motion platform. Reconfiguration from one vehicle specific kit to another shall be achievable in less than 30 minutes by a one person crew, with a desired objective time of 15 minutes.

Specific driver seat dynamics and seat pan characteristics to replicate realistic ergonomic conditions of each vehicle variant provided.

3.1.4.15.6.1 Dashboard(s)

Each vehicle specific kit shall include one or more alternate dashboards. When provided as part of a vehicle specific kit, each alternate dashboard shall contain the components, gauges, indicators, alarms, switches and other components necessary to replicate the form, fit and function of the driver's station inside the cab of a specific vehicle or family of vehicles. All dashboards provided with a cab shall mate to a single set of physical, electrical, electronic and data interfaces in the generic cab. All electrical, electronic and data connectors shall be uniquely sized and keyed to prevent accidental mismatches. Actual vehicle dashboards, or portions thereof, shall use whenever possible.

3.1.4.15.6.2 Accessory Panels

Each vehicle specific kit shall include all necessary components required to replicate the specific vehicle variants form, fit and function. All accessory panels provided with a cab shall mate to the same physical, electrical, electronic and data interfaces in the generic cab. All electrical, electronic and data connectors shall be uniquely sized and keyed to prevent accidental mismatches. Actual vehicle panels, or portions thereof, shall use whenever possible.

3.1.4.15.6.3 Switchboxes

Each vehicle specific kit shall include one or more switchboxes. When provided as part of a vehicle specific kit, each switchbox shall contain the components, gauges, indicators, alarms, switches and other components necessary to replicate the form, fit and function of the driver's station inside the cab of a specific vehicle or family of vehicles. All switchboxes provided with a cab shall mate to the same physical, electrical, electronic and data interfaces in the generic cab. All electrical, electronic and data connectors shall be uniquely sized and keyed to prevent accidental mismatches. Actual vehicle switchboxes, or portions thereof, shall use whenever possible.

3.1.4.15.6.4 Vision Restriction

Each vehicle variant shall replicate the actual visual restrictions and driver vantage points. Whenever a cab intends to simulate more than one vehicle or family of vehicles, the cab shall design to match the largest field of view provided by any of the vehicles and vision restrictor shall use to reduce the field of view to match other vehicles. All vision restriction provided with a cab shall mate to the same physical interfaces on the generic cab.

3.1.4.15.6.5 Space Restrictor(s)

Each vehicle specific kit shall include one or more space restrictors. Whenever a cab intends to simulate more than one vehicle or family of vehicles, the cab shall design to match the largest interior space provided by any of the vehicles. Space restrictors shall use to reduce the interior space to match other vehicles.

3.1.4.15.6.6 Driver Vision Enhancer (DVE)

Whenever an actual simulated vehicle by the CDT allows a driver to use a DVE, then the CDT cab shall contain all of the mounting hardware and simulation software to allow the student driver to use a DVE within CDT scenarios. The DVE mounting hardware in the CDT cab shall replicate the form, fit and function of the DVE mounting hardware found in the actual vehicle.

3.1.4.15.6.7 Storage Container(s)

Each vehicle specific kit shall include one or more ruggedized storage containers for storing accessory panels, switchboxes, vision restriction, and space restrictors. When required, all components simulating a particular vehicle or family of vehicles shall be stored in single storage container. All storage containers shall meet the requirements for a two-man lift.

3.1.4.15.6.8 Dash Rack(s)

Each vehicle specific kit shall include one or more dash racks for storing. When required, all components simulating a particular vehicle or family of vehicles shall be stored within a single dash rack. All dash racks shall meet the requirements for a two-man lift.

3.1.4.16 Vehicle Dynamics

The CDT software architecture shall include a standardized interface to facilitate data exchanges with vehicle dynamic model software. Each vehicle variant cab shall include vehicle dynamic model software. The CDT system shall load the appropriate vehicle dynamic model software during the system power up and initialization process.

The CDT vehicle specific software shall include Vehicle Dynamics Models for each simulated vehicle by the CDT. The initial Vehicle Dynamics Model software shall simulate actual vehicle performance within 10% of the values of all vehicle tests performed during vehicle testing at accredited testing facilities. Final vehicle dynamics model performance shall tune and verify by a Government sponsored vehicle expert and approved by Government Lead Engineer.

3.1.4.16.1 Terrain Traction

The Coefficient of Traction for each terrain type and weather condition (ref. Scenario Selection Window) shall be input to the vehicle dynamics model software and affect the simulated vehicle performance during scenario runtime.

3.1.4.16.2 Terrain Roughness

The roughness factor for each terrain type and weather condition shall be input to the vehicle dynamics model software and Steering Force Feedback system, aural, visual and motion feedback and shall affect the simulated vehicle performance during scenario runtime.

3.1.5 After Action Review (AAR) / Ancillary Station (AS)

The AAR/AS is a floor-mounted workstation. One or more AAR/AS's shall append to each STS. For example, AAR #1 can view video and audio playback from any of the STSs connected on the network. Typically, the primary use for an AAR/AS is an AAR station used by both instructors and students to review a student's performance, but an AAR/AS could also have a dual function as a Commander's Station, Gunner's Station, Equipment Operator's Station, or an Assistant Driver. A single AAR/AS can dedicate solely to one function or can use for multiple functions, i.e. a single AAR/AS can use as both an AAR and a Commander's Station.

Unless otherwise specified in a Variant Appendix, vehicle ancillary stations shall consist of floor-mounted sets of optional workstations, components, and equipment with associated

applications. The purpose of a vehicle AAR/AS is to facilitate training additional crewmembers whenever training of crew coordination tasks is required.

Ancillary components are optional components, equipment, and software items. These items shall be included in a CDT system variant kit.

A work surface shall be provide with sturdy construction and shall be finished with high pressure laminate and a chair.

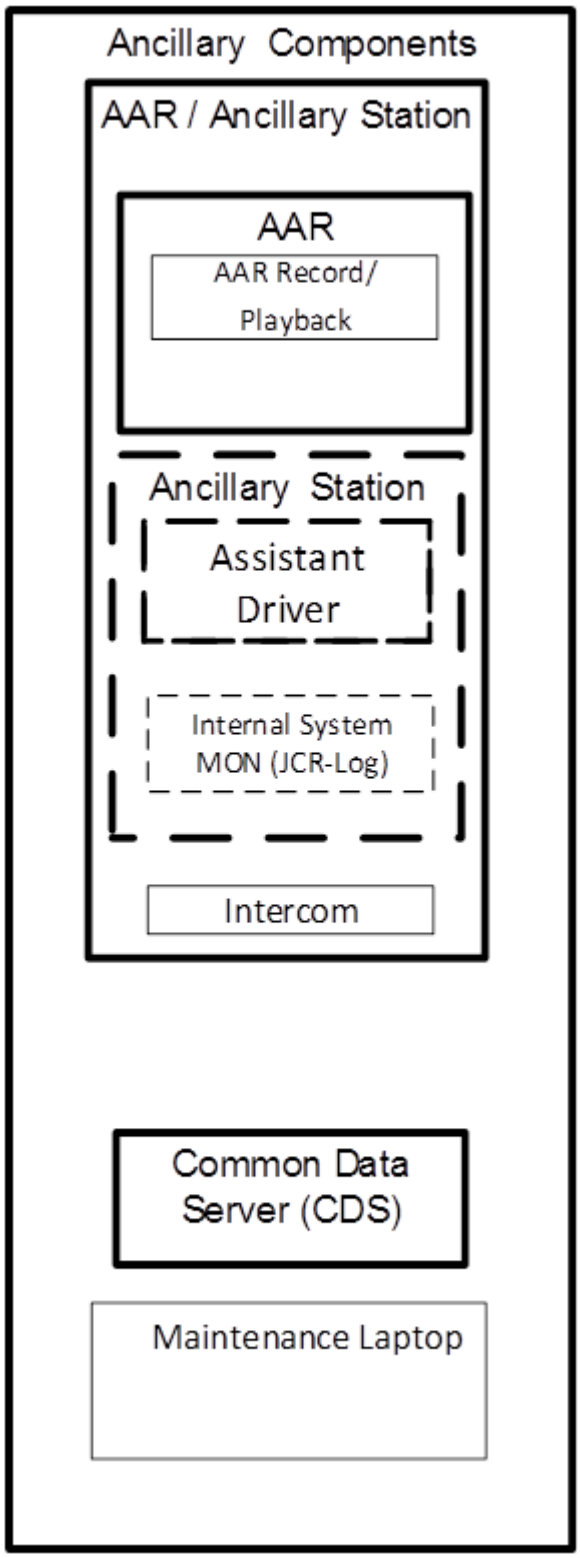


Figure 9 - Ancillary Components Diagram

3.1.6 Common Data Server (CDS)

The CDS contains the centralized data repository for each fielded site.

3.1.6.1 Functions

The CDT architecture shall support a CDS capability. The CDS shall serve as a centralized data repository at each fielded site where more than one CDT system deploys. The CDS shall use a client-server architecture with an object-relational Database Management System (DBMS) to allow data to store and retrieve from a central location with multiple IOSs. The CDS shall store student records, class records, scenarios, terrain databases, and instructor data. When connected to a CDS, each IOS shall use the CDS as the default source for all data available on the CDS. The CDS shall include a separate COTS server (multi-core CPU) with a single monitor, keyboard, and mouse. The CDS shall include a mass storage device(s) with a minimum capacity of one Terabyte (TB). The CDS shall have a desktop workstation (i.e. desk and chair) with the CDT Scenario Generation System (SGS) software.

3.1.6.2 Master Electronic Maintenance Log (M-EML)

Each CDT CDS shall include a Master Electronic Maintenance Log (M-EML) software application. The M-EML shall be capable of configuring to match the overall site configuration as fielded, i.e. a system can consist of 1 IOS, 1 to n STSs and 0 to n ASs (i.e. Commander's Stations, Gunner's Stations, etc.). The M-EML shall host on the CDS. The M-EML shall access via a separate desktop icon. The M-EML shall be capable of accepting entries for each IOS, STS, and AAR/AS separately and for each CDT system as a whole. The M-EML shall automatically record the date, time and log-in data of the user making each entry into the M-EML as part of each entry. The M-EML shall periodically and automatically update based on the data received.

The M-EML shall allow a user with Maintainer privileges to make entries consisting of the date and type of all Preventive Maintenance Check & Services performed. The following types of PMCS services shall allow Daily Readiness Checks (DRC), Weekly (W), Bi-weekly (BW), Monthly (M), Bi-monthly (BM), Quarterly (Q), Semi-annual (S), and Annual (A).

The M-EML shall allow a user with Maintainer privileges to make entries for any hardware replacement activities performed. The entry shall include the manufacturer, model number, part number, serial number, and Item Unique Identification (IUID), if applicable, for both the original item and the replacement item.

The M-EML shall allow a user with maintainer privileges to schedule and make entries for any perishable item replacement activities performed. Perishable items shall include but not be limited to such items as batteries, bulbs, printer cartridges and other items which consume during the normal course of operations. The entry shall include the manufacturer, model number, and part number for each perishable item. The scheduling function shall allow a Maintainer to enter a frequency or scheduled date for replacement of each perishable item. The scheduling function shall allow the Maintainer to set up to two reminders for each scheduled replacement activity.

The M-EML shall allow a user with Maintainer privileges to make entries for any hardware update activities performed. The entry shall include a text field for entering a brief description of any hardware added to or removed from the system.

The M-EML shall allow a user with Maintainer privileges to make entries for any software update activities performed. The entry shall include the software version number and patch number, if applicable. The entry shall include a text field for entering a brief description of the software installed.

The M-EML shall automatically record an entry in the M-EML each time the system password is changed. The entry shall indicate if the automated password change procedure or the manual method used. The entry shall include a masked entry for the new password which shall only unmask by a user with administrator privileges. The entry shall automatically record the date, time and log-in data of the user changing or attempting to change the password as soon as the attempt begins.

The M-EML shall include a Master System Usage Monitor (M-SUM) function. The M-SUM shall be capable of interfacing with each IOS SUM. The M-SUM shall be capable of collecting and storing the SUM data for each IOS separately. The M-SUM shall also be capable of consolidating the individual SUM data into overall facility usage reports. The facility usage reports shall include, but not be limited to, weekly, monthly, quarterly, semi-annual, and annual effective training time and effective mileage reports.

3.1.6.2.1 Records For Each STS Session

The SUM shall be capable of recording the following data for each STS session:

a. STS number
b. Cab type mounted on the STS
c. Power on time
d. System mode, i.e. the system mode shall be Training (T), Maintenance (M) or Demo (D)
e. Session elapsed time, i.e. the running total of time from STS power up to STS power down
b. Session driving time, i.e. the running total of time spent in actual scenarios
c. Session miles, i.e. the running total of miles driven in scenarios
d. Fuel consumption
e. Shall not be resettable, even on software updates
f. Dates
g. Base location
h. Number of trainees trained per system
i. Type of exercise
j. Units trained
k. Miles driven per simulated vehicle
l. Scenarios trained (identify quantity for each scenario used for training)
m. Mission Essential Tasks (METs) and Training & Readiness (T&R) events trained
n. Scenarios failed by trainees

3.1.6.2.2 Records For Each AAR/AS Session

The SUM shall be capable of recording the following data for each AAR/AS session:

a. STS number
b. Cab type mounted on the STS

c. System mode, i.e. the system mode shall be Training (T), Maintenance (M) or Demo (D)
d. AAR/AS number
e. Session elapsed time, i.e. the running total of time from AAR/AS power up to AAR/AS power down
f. Session training time, i.e. the running total of time spent in actual scenarios
g. Session miles, i.e. the running total of miles driven in scenarios
h. Shall not be resettable, even on software updates
i. Dates
j. Base location
k. Number of trainees trained per system
l. Type of exercise
m. Units trained
n. Miles driven per simulated vehicle
o. Scenarios trained
p. METs and T&R events trained
q. Scenarios failed by trainees

3.1.6.2.3 Records For Each IOS Session

The SUM shall be capable of recording the following data for each IOS session:

a. IOS number, if more than one IOS is located at a facility
b. System mode, i.e. the system mode shall be Training (T), Maintenance (M) or Demo (D)
c. Session elapsed time, i.e. the running total of time from IOS power up to IOS power down
d. Session effective training time, i.e. the summed total of time spent in actual scenarios by all STS and Ancillary Stations connected to the IOS during the session
e. Session effective miles, i.e. the summed total of miles driven in scenarios by all STS and Ancillary Stations connected to the IOS during the session
f. Cab type mounted on each STS during the session
g. AAR/AS type for each AAR/AS used during the session
h. Shall not be resettable, even on software updates
i. Dates
j. Base location
k. Number of trainees trained per system
l. Type of exercise
m. Units trained
n. Miles driven per simulated vehicle
o. Scenarios trained
p. METs and T&R events trained
q. Scenarios failed by trainees

3.1.6.3 Password Change Application

The CDT host software shall include a Password Change Application. The Password Change Application shall allow an authorized Maintainer to individually or collectively change the system password on all password protected computers.

3.1.6.4 Shutdown Application

The IOS shall provide a Shutdown Application, accessible via an icon on the IOS Desktop, for the instructor to power down the CDT training system and all associated CDT subsystems. The Shutdown Application shall be a one-step selection to execute by the instructor. The Shutdown Application shall halt and/or stop the simulation application and COTS applications that are executing on the CDT training systems. The Shutdown Application shall power down each CDT system to its operating system power off mode.

3.1.6.5 Power Up Application (CDT System Mode Manager)

The CDT System shall initialize into individual training upon power up. The CDT System Mode Manager shall automatically display after initialization has completed. The CDT System Mode Manager shall identify and give the training status of its own CDT system and up to seven (7) other integrated CDT systems. The IOS shall have a CDT System Mode Manager window to configure the CDT System(s) into the other training modes (integrated or network).

3.1.6.6 IOS Statistics Application

There shall be an information application titled CDT Statistics that provides both real time information and cumulative statistics for the CDT system (per STS, per dash and per student). The Statistics page shall display the following information:

a. Time Statistics
    (1) Time Current Scenario – The elapsed time since the start of the current scenario.
    (2) Total Simulated Time – The total time the system has been actively running scenarios since the last system statistics reset, usually monthly. Idle time does not include in the Total Simulated Time.
    (3) Total Networked Time – The total time the system has been actively running scenarios in Network Mode since the last system statistics reset, usually monthly. Idle time does not include in the Total Networked Time.
b. Distance Statistics
    (1) Miles Driven Current Scenario – The total distance the student has driven since the start of the current scenario.
    (2) Total Simulated Miles – The total simulated miles the system has driven since the last system statistics reset, usually monthly. The Total Simulated Miles shall include miles driven in both scripted and unscripted modes of operation including free play. In other words, if it moves, it counts.
c. Fuel Statistics
    (1) Fuel Consumed Current Scenario – An estimate of the fuel consumed (based on a vehicle specific average miles per gallon estimate) since the start of the current scenario.
    (2) Fuel Consumed Per Vehicle Variant – an estimate of the fuel consumed (based on dynamic modeling of fuel consumption rates/calculations based on driving) for the system since the last system statistics reset.
    (3) Total Fuel Consumed – The total estimated fuel for the system since the last system statistics reset.
d. Metrics Window

(1) Previous Seven Days – This line within the Metrics window shall display the Total Simulated Time, Total Networked Time, Total Miles Driven and Total Fuel Consumed for the last seven calendar days. This metric shall span more than a single week or month.
(2) Previous 90 Days – This line within the Metrics window shall display the Total Simulated Time, Total Networked Time, Total Miles Driven and Total Fuel Consumed for the last 90 calendar days. This metric shall span more than a single month.

e. Monthly Statistics window
(1) This window shall be a scrollable window with a single line of data for each month of system operation. Each line shall display the Year, the Month, the Total Simulated Time, Total Networked Time, Total Miles Driven and Total Fuel Consumed for that month.

f. Last Reset – This metric shall display the date of the last reset.

The Statistics page shall also contain a button labeled "Reset" with a warning message to ensure reset. Activating the "Reset" shall cause the Total Simulated Time, Total Networked Time, Total Simulated Miles, and Total Fuel Consumed statistics to reset to zero; update the Last Reset metric to the current date; close the current line in the Monthly Statistic window; and initialize a new line in the Monthly Statistics window.

3.1.6.7 Cab Calibration Software

Each CDT cab shall include firmware or software which interfaces with the CDT Calibration Tool to allow maintenance personnel to calibrate individual vehicle dashboard components and cab controls as needed. Software shall be able to store calibration parameters and shall be accessible from the CDS to any available resources (e.g. maintenance mobile device, IOS or AAR/AS). Calibration functions shall perform on both the IOS and maintenance mobile device.

3.1.6.8 Cab Diagnostic Software

Each CDT cab shall include firmware or software which interfaces with the CDT Diagnostic Tool to allow maintenance personnel to diagnose and troubleshoot individual vehicle cab and dashboard components down to the Lowest Replaceable Unit (LRU) level.

3.1.6.9 Maintenance

All maintenance functions shall execute at the CDS, ref. Sec. 3.1.4.2 – Master Electronic Maintenance Log and Sec. 3.3.5.3 – Maintainability / Built-In-Test.

3.1.6.10 Software CM Controls

The CDT software shall implement an automated configuration management function to perform configuration control, configuration identification, audits, and status accounting in a system-engineering environment. The contractor shall follow the Product Line (PL) procedures and processes for control of all data, hardware, and software baselines.

3.1.7 Disk Duplicators

N/A.

3.1.8 Maintenance Mobile Device

A mobile device computer shall be included at each CDT location to support diagnosis and calibration of CDT cabs. A CDT fielding with multiple CDTs in a common area shall receive one maintenance mobile device (rounded up) per twelve to sixteen STSs. All CDT maintenance mobile devices shall be capable to support all the maintenance activities.

3.1.8.1 Calibration Tool – Maintenance Mobile Device

The CDT software shall include a Calibration Tool application. The Calibration Tool shall support the calibration of gauges and equipment within each CDT cab. The Calibration Tool application shall install on the maintenance mobile device. Each CDT cab shall provide an Ethernet interface to allow connection of the maintenance mobile device for calibration and diagnostic purposes.

3.1.8.2 Diagnostic Tool – Maintenance Mobile Device

The CDT software shall include a Diagnostic Tool application. The Diagnostic Tool shall support the diagnosis and fault isolation of equipment within the CDT system. The Diagnostic Tool application shall install on the maintenance mobile device. Each CDT system shall provide multiple Ethernet interfaces to allow connection of the maintenance mobile device for diagnostic purposes.

3.1.9 Interoperability

The CDT architecture shall base on Government and industry standards which promote the interoperability of components and systems. Open system standards shall be used to the maximum extent to define interfaces between components and between systems.

Internal components are those components which are integral to the operation of the CDT training system and include actual or simulated components used in actual vehicles that are the basis for CDT variants. Components include, but are not limited to:

a. Dashboard gauges, indicators and data bus systems
b. Position tracking systems (JCR Log – Applicable to TWV M1083A1, M915A3, M915A5 and M1120A4 only)
c. Radios and other communication systems

The CDT system shall employ a common mechanical, electrical and data interfaces for the cabs and cab components. The CDT simulation software and variant vehicle simulation software architecture and data requirements shall maintain in the common product line. Physically, any cab shall be able to interface with any CDT common platform. In order to ensure proper vehicle variant operation, a system shall require the addition of specific vehicle dynamics, training specific vehicle operating simulation software, and scoring requirements as identified in the appendices.

External systems are those systems which are not part of normal CDT operations, but which the CDT shall be required to interoperate with another CDT system to achieve a specific training objective. CDT system shall follow Distributed Interactive Simulation/High-Level Architecture (DIS, HLA), and Virtual Distributed Interactive Simulation (VDIS) standards.

3.1.10 Software

Figure 10 illustrates the conceptual software modules expected to control the CDT operation.

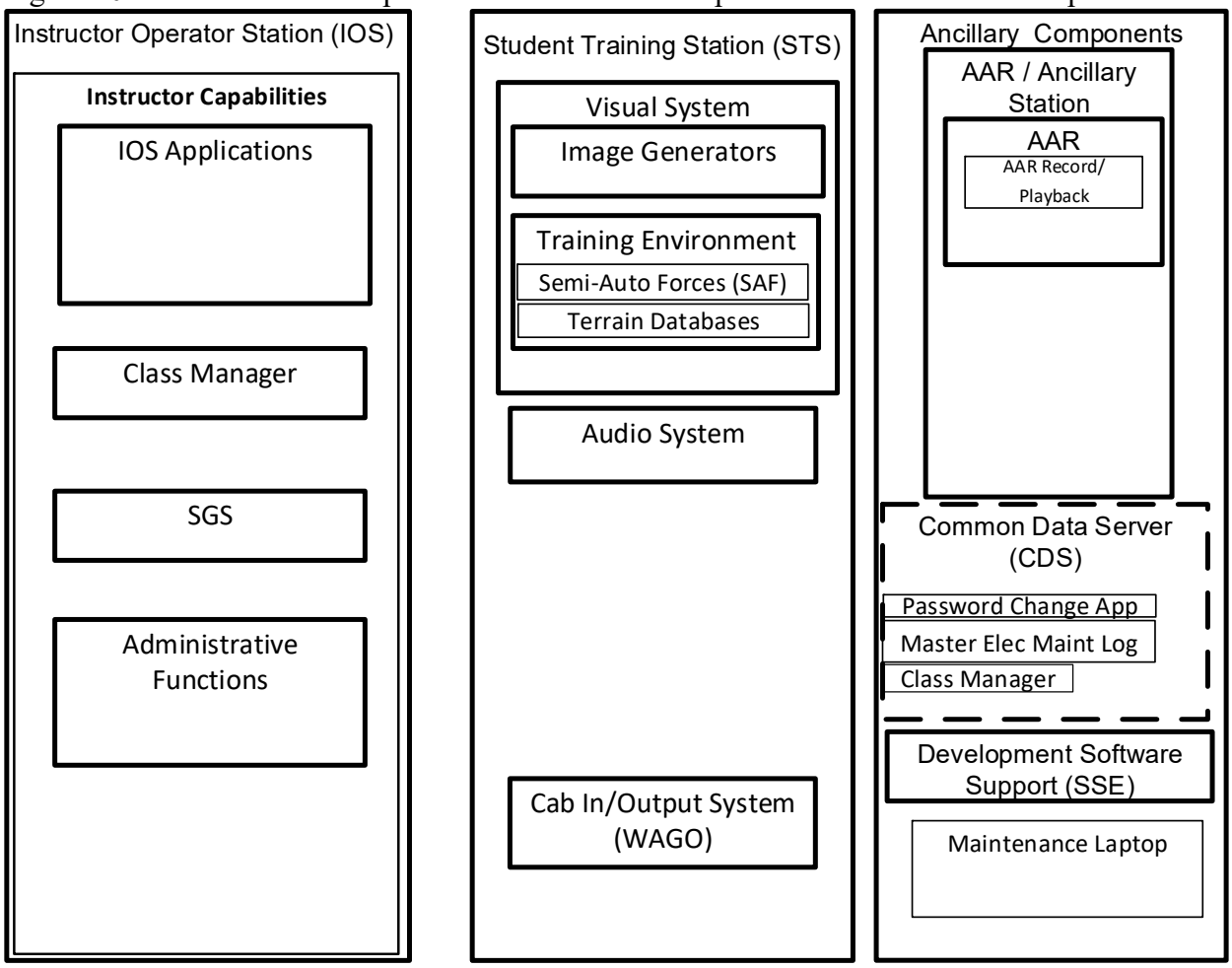


Figure 10 - Software Conceptual Diagram

3.1.10.1 Programming Language

All non-Commercial Item software shall provide in American Standard Code for Information Interchange (ASCII) source form. All source code that is compiled and used in generating executable code shall be written in a high-level language, such as C++, chosen to provide performance fidelity, supportability and the lowest life-cycle cost for the Army. All source code shall be in conformance with the applicable industry standard for the language used.

3.1.10.2 Integrity in Handling Calendar Dates

The handling of calendar dates shall not cause erroneous results regardless of the date or dates processed. All computational hardware and software subsystems shall be synched automatically in time and date for system readiness, operation, and maintenance functions.

3.1.10.3 Application Software

The application software shall include:

a. Software necessary to operate the trainer in accordance with the functional requirements of this specification,

b. Software used to perform testing, to monitor trainer operations, and to demonstrate compliance of the trainer with this specification.

3.1.10.4 Diagnostic Software

Diagnostic software shall test the operation of the computers, peripheral equipment and other trainer hardware, and shall identify malfunctioning components to the lowest replaceable unit. The diagnostic software shall include, but is not limited to, the programs described in the following subordinate paragraphs.

3.1.10.5 Computer and Peripheral Diagnostic Programs

Diagnostic programs for the computers, network, and peripherals shall make maximum use of COTS software. The use of any Non-COTS software for diagnostic programs requires prior Government approval.

3.1.10.6 System Daily Readiness Check Program

Daily readiness check programs shall enable operating personnel to determine that the trainer is ready for operation. Provisions shall make the automatic sequencing through the daily readiness check program, or portions thereof, to verify the desired output at each step. The operator shall have the option of either proceeding, after noting the discrepancies, or stopping the execution. Identification of errors shall display. The system daily readiness check shall require less than ten minutes completing.

3.1.11 Hardware

The CDT systems shall be comprised of a hardware configuration that supports all functional equipment required for the operation of the IOS, STS, and AAR/AS components for providing each of the specific vehicle platform training capabilities. Figure 11 shows the hardware conceptual diagram.

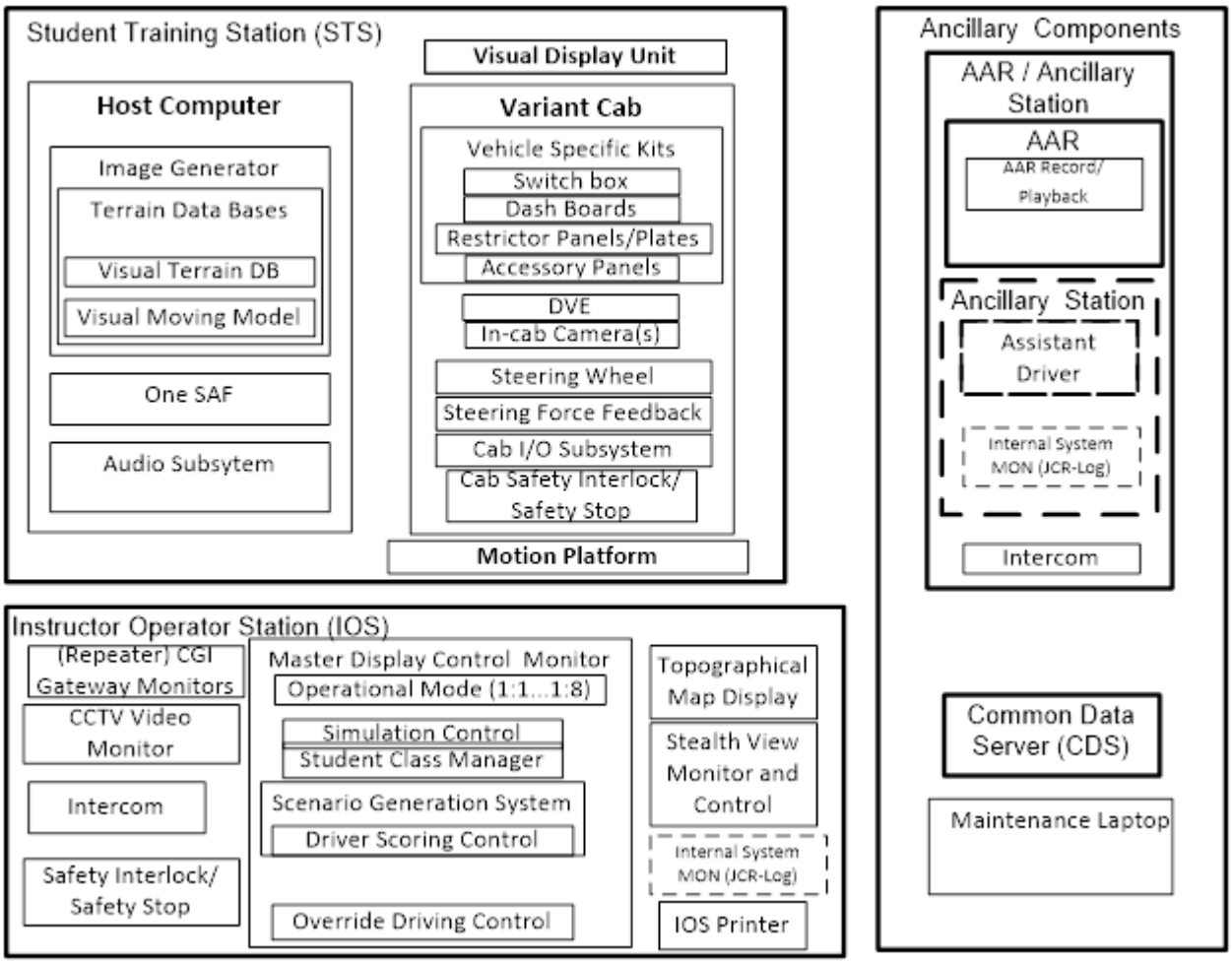


Figure 11 - Hardware Conceptual Diagram

3.1.11.1 Compatibility

The CDT common system shall employ a common mechanical, electrical and data interface for the cabs. The CDT simulation software and variant vehicle simulation software architecture and data requirements shall maintain. Physically, any cab shall be able to interface with any CDT common platform. In order to ensure proper vehicle variant operation, a system shall require the addition of specific vehicle dynamics, vehicle operating simulation software, and variant scoring software.

All CDT product line functionality and performance shall maintain unless the Government approves an ECP.

3.1.11.2 Storage, Backup and Updates

The CDT systems shall provide removable storage for system backup and updates. The backup hard drives per CDT system shall enclose in a marked, Electrostatic discharge (ESD) closable case.

3.1.11.3 Internal System Interfaces

The principal internal interfaces within the CDT systems are:

a. the interfaces between the major system components (STS, IOS and Vehicle cab)
b. the interfaces within the major system components

3.1.11.4 JCR Log Monitor

The JCR Log monitor/keyboard is use to communicate to each IOS and AAR/AS JCR Log station for JCR Log equipped variants. JCR Log shall include touch pad keyboard.

3.1.11.5 Manual Input Device

The IOS shall have a manual input device. The manual input device shall be used to control the eye point positioning and movement in the stealth display or to control own vehicle movement when the instructor takes control of the vehicle's operation. The manual input device shall have full 360 degree axis movement (fore, aft, left, right, and intermediate axis in between) with the manual input device. Manual input device buttons and operation shall be the same for all vehicles.

3.1.11.6 Stealth View Eye Point Control

When the tethered eye point mode selects for the stealth view monitor, the manual input device shall control the azimuth position relative to each own vehicle, distance from each vehicle, elevation above each own vehicle and the viewing angle of the eye point. When unrestricted eye point movement selects for the stealth view monitor, the manual input device shall allow the instructor to move the eye point forward and reverse, turn left and right, adjust viewpoint elevation and the viewpoint look angle. Stealth view eye point control shall be active any time a scenario is active whether running or paused. The manual input device shall have a control that provides the ability to adjust the speed of the eye point movement when in Stealth Mode.

3.1.11.7 Controls and Indicators Interface

An interface shall provide between the host processor, controls and indicators system of a manned module. The controls and indicators system shall sample the state of the operator controls of a manned module and then provide that state information to the host processor when requested. The host processor shall analyze the controls and generate any required Protocol Data Units (PDUs) (ref. IEEE Standard 1278.1a-1998) on the network or updates to the other component systems. The controls and indicators system shall provide status information to the host processor to support Built-In-Test (BIT). The controls and indicators system shall be able to send indicator and control state updates to the controls and indicators in the manned module. The host processor shall send updates to the state of the controls and indicators; and the controls and indicators system shall process those updates to turn indicator lamps on or off, change the reading of gauges, modify the reaction of operator controls, etc.

3.1.11.8 Sound System Interface

The sound system shall receive commands and data from the host processor in order to generate sound cues and effects. The sound system shall interface with speakers contained within the manned module, workstation, or console. The sound system shall send status information back to the host processor in order to support BIT.

3.1.11.9 Host Processor Interface

In addition to the interfaces with the other component systems, the host processor shall interface with computer peripherals, controls, and displays. The controls and displays interfaces shall support operator control of the host processor for BIT, performance of workstation and console functions, and performance of virtual manned module tasks.

3.1.11.10 Headset

The AAR/AS shall have audio communications between the IOS (instructor & observer) and the driver. All communications shall be via the headset. Section titled 'Communication System' shall accomplish via headsets with boom microphones for the student at the AAR/AS. The AAR/AS headset shall be adjustable for head size with cushioned, closed ear (surrounds the ear) headset speaker enclosures with noise canceling speakers and adjustable, noise canceling microphones. The AAR/AS shall have controls to adjust the volume levels of the headset audio individually. IOS communications to the student at the AAR/AS shall be active anytime the AAR/AS and IOS are both powered-up.

3.1.12 Facilities and Facility Equipment

3.1.12.1 System Power Requirements

All components, except the motion platform, of each CDT system (regardless of configuration) shall be able to operate at, 120 Volts Alternating Current (VAC), 60 Hz, single phase power with a tolerance of ± 10 percent in voltage and ± 1 percent in frequency. The equipment shall protect from power fluctuations, sags, surges, and transients. Each computer shall have a supplemental non-interruptible power supply to allow time to shut down the computers normally in case of a power failure. The electrical system design and installation shall be in accordance with ANSI NFPA 70.

The power for the motion system shall be 208/240 VAC or 480 VAC, 3 phase, 60Hz with a tolerance of ± 10 percent in voltage and ± 1 percent in frequency with current available power sources and shall be compatible with site current power status. For example, Ft. Leonard Wood CDT facility supports 480V VAC 3 phase, 60 Hz. Ft Benning CDT facility supports 208/240 VAC, 3 phase, 60Hz. OCONUS sites support 208/240 VAC, 3 phase, 60Hz/50Hz. The existing facility requirement for the mobile system trailer configuration sites is support for 208/240 VAC, 1 phase, 60Hz power.

3.1.12.2 Grounding System

The CDT system shall require a site approved grounding system to handle grounding of the system for:

a. Earth electrode ground
b. Signal reference ground
c. Fault protection
d. Lightning protection (mobile system trailer configuration only)

Digital electronic simulation equipment shall require a low impedance earth electrode subsystem for acceptable performance. This equipment shall require a direct path to earth without the possibility of reflective noise generated voltage and current being picked up. The electrical bonding resistance at each tie point and from the central tie point to earth shall be 10 milliohms or less. Simulator equipment grounds shall bring to a similar or central ground point tie point which reference to the earth electrode subsystem.

3.1.12.3 Safety System

The equipment design shall include the emergency power disconnect(s) required by Section 645 of NFPA 70. The safety system shall include a physical Emergency Power Off (EPO) button that when activated shall remove power from the system. The IOS shall include a physical Emergency Stop (E-STOP) button. The section labeled 'Emergency Buttons' shall explain each button in greater details.

E-STOP and EPO buttons shall provide at the IOS(s) and STS(s). The E-STOP and EPO buttons shall be located in their positions to minimize accidental and/or unwanted activations. Activation of an E-STOP button shall cause only the associated STS to halt all motion, slowly lower the motion platform to its parked position, and pause the simulation. Activation of an EPO shall immediately remove all power from the CDT system (except the motion platform(s) which shall retain battery power) regardless of the system's configuration, halt all motion, and slowly lower the motion platform(s) to the parked position. The EPO switch shall be capable of connecting to a facility power off shunt trip. Each of the emergency buttons shall legibly and permanently marks to indicate its purpose.

3.1.12.4 Phase Balance

The equipment power distribution shall design so that the normal load on any one phase does not vary from the average load of the three phases by more than 7.5 percent.

3.1.12.5 Utility Power

Utility electrical power receptacles shall provide as part of the equipment installation. The receptacles shall place so that a W-C-596 approved duplex receptacle shall be within six feet of any area where maintenance performs.

3.1.12.6 Equipment Station Cooling

Air flow shall provide with sufficient flow that the temperature inside the station shall not exceed 80°F when operated at full capacity with full personnel loading, given a maximum ambient temperature of 75°F.

3.1.12.7 Cabling

Facility power, CDT system major component interconnecting cables, and grounding cables shall install in facility provided overhead cable trays. Cabling within any CDT major component shall place such that the cabling does not present a trip hazard to operating personnel.

3.2 System Performance

CDT systems shall use a parameter-driven open architecture in the implementation of the modules, consoles, workstations, and network system components of the CDT systems. Each major component shall design to operate autonomously and shall be able to transmit and receive changes in the state of entity variables or when events occur. All components shall conform to non-proprietary standards. The computer system architecture shall allow addition and replacement of modular hardware items, specifically mass storage devices, memory, processing units, I/O equipment, and network components, without requiring changes to trainer computer system software that is other than commercial item software. If the trainer computer system contains multiple processors, to the extent practicable, failure of a single processor shall not cause degradation of trainer operation in subsystems not controlled by the failed processor.

3.2.1 Components Requirements

3.2.1.1 Computer Processing Requirements

The CDT system shall have processing capacity to meet the performance requirements and the spare processing requirements described in this specification. Iteration rates, data structures, and algorithms shall provide mathematically consistent and stable simulations. The CDT system shall provide processor capacity, memory capacity, input/output device capacity, mass storage capacity, and communications/network equipment capacity to satisfy the performance requirements in this specification.

Each computer shall have a minimum of 10% spare processing capacity, with a total average across all computers of a minimum of 50% under worst case conditions. At least 50% of the total Random Access Memory (RAM) available in each computer shall be spare capacity. The total mass storage (i.e. hard disk) shall have a minimum of 70% spare capacity unless further detailed in this specification.

3.2.1.2 Computer Operations Control Function

The computer control function shall provide control of the CDT system, including start-up from a powered-down condition, loading the trainer operational programs, bringing the trainer system to operating status, shutdown, trapping unexpected system transient events, operation and management of network system components, and control of system diagnostics. The computer control function shall provide the means to enter commands interactively at the operating system level and observe and record responses to the entered commands. The use of the computer control function shall not require more than one operator.

3.2.1.3 Computational System Network

If a network provides as part of the CDT system, it shall have the following performance characteristics:

a. Network protocols shall conform to recognized industry standards.

b. Analysis tools shall be provided for determination of:

   i. network faults

   ii. packet losses

   iii. bit error rate

   iv. peak and average network traffic loading rates sampled at periods less than or equal to one second.

   v. all packet, cell contents and all header

c. The network shall sustain the removal and addition of nodes without adversely affecting communications among the remaining nodes of the network. If a node incurs an error condition, the error condition shall not adversely affect the operation of the network.

d. Peak network traffic (when the sample period is less than or equal to one second) shall not exceed 50% of capacity.

e. The network shall be equipped with high level language support (for example, sockets).

f. The network shall support the bi-directional transfer of files and messages among nodes.

3.2.1.4 Distributed Interactive Simulation/High Level Architecture (DIS/HLA)

Each CDT system shall utilize DIS PDUs as defined in IEEE Standard 1278.1a-1998 to exchange simulation related data between components of a system (i.e. between the STS and an AAR/AS) and with other systems when networked.

Each CDT system shall utilize DIS or HLA as defined in IEEE Standard 1516 to exchange simulation data between other external systems when networked.

3.2.1.5 Virtual - Distributed Interactive Simulation (V-DIS)

CDT system shall utilize V-DIS PDUs as defined in the Synthetic Environment Core (SE Core) specification to exchange simulation related data between components of a system (i.e. between the STS and an AAR/AS) and with other systems when networked.

3.2.2 Scenarios Control

CDT shall be able to train individual and collective tasks by executing scenarios in the individual, networked and hybrid modes. The contractor can find specific scenario requirements in the variant specific requirements documents. The CDT shall provide one IOS that can monitor up to eight scenarios concurrently eight different STSs. For each facility, the CDT shall be required to execute no more than 56 scenarios concurrently.

3.2.3 Latency

3.2.3.1 Transport Delay

The trainer transport delay shall not exceed 105 milliseconds for visual, motion, aural and/or instrument cues, nor shall exceed 35 milliseconds between any two cues. Transport delay (synchronization) shall define as the time from when an input initiates at the vehicle controls, sampled, processed through the cueing systems, output to the visual display, motion actuators, and vehicle instruments, and these respective cueing systems provide a detectable output change in response to the input.

3.2.3.2 Update Rates & Channel Synchronization

The displayed scene shall generate from updated position and attitude data for the viewpoint and all moving entities at a rate not less than 60 Hertz (Hz). All channels shall update and the updated image shall display synchronously.

The CDT shall simulate vehicle crashes and collisions. All collisions of own-vehicle with moving models, cultural features and other database features shall detect at the point of collision. The collision object type, vehicle speed, and direction shall sense and process at a rate to meet the system transport delay/synchronization requirements. The CDT system shall provide an appropriate aural, vehicle dynamic simulation, motion, and visual response to all crashes and collisions depending on the object type and vehicle speed.

The displayed visual image and the driver compartment/motion platform movement shall synchronize to produce a realistic simulation of the vehicle in motion over roads or terrain. In addition, the driver compartment, its enclosure, and the motion platform shall allow for the reconfiguration/removal/replacement of the specific module for future updates/reuse. Performance of the aural cues and visual display scenes shall be coordinated with movement of the motion platform. The physical movement of the motion platform shall be determined by computations based upon the actual vehicle variant driver compartment motion (pitch, roll, yaw, heave, surge, and sway), and shall correspond in real-time to driver actions and terrain/environment/vehicle interaction.

The sensation of motion shall be representative of the sensations experienced in the actual vehicle. The acceleration of the CDT's driver compartment in any axis shall correspond to the actual vehicle acceleration experienced under similar ride and configuration conditions. Representative vibrations shall simulate by the CDTs. Vibration cues shall generate at frequencies approximating those experienced in the vehicle variant. Such vibrations shall represent normal and abnormal vehicle vibration, control-induced changes of the vehicle, oscillations, rough/smooth terrain characteristics, vehicle impact, and brake application/release. The CDT motion simulation shall minimize the effect of the students to experience vertigo, motion sickness, or simulator sickness. The motion platform shall electrically actuate.

3.2.3.3 Dead Reckoning Algorithms (DRAs)

Every STS shall utilize a methodology which shall avoid anomalous entity movement. A look-ahead mechanism shall employ to maintain entity position and orientation in the database between receipt of actual entity position and orientation data. When a position correction

performs on a visual model, the resulting visual update shall not exceed the time latencies for individual STSs.

3.3 Physical Characteristics

The CDT basic designs shall have the following physical characteristics as outlined in this specification. The system design shall be modular to allow for future product upgrades, modifications, and technology insertion.

3.3.1 Weight

The weight of the CDT equipment, in operation, shall not exceed a uniformly distributed maximum load of 100 pounds (lbs.) per square foot or a concentrated load of 1,000 pounds applied on one square inch.

3.3.2 Height

The CDT shall be able to fit and operate in a room with a 12 foot ceiling. When the motion platform is at maximum extent of motion with full mechanical actuator extension, the highest point of the STS shall not extend beyond 11 feet 6 inches (11' – 6") from the floor.

3.3.3 Equipment Dimensions

In an uninstalled configuration, CDT modules shall be capable of passage through a ten feet wide by ten feet high opening and all other equipment shall be capable of passage through a six feet wide by seven feet high opening. The maximum size footprint of each STS AAR/AS module, in its installed configuration, including electronic cabinets, shall satisfy the current fielded mobile requirements.

3.3.4 CDT System Area Clearances / Trainer Maintenance Access

When floor-mounted in a facility, each CDT STS shall have 3 feet of clearance as a safety buffer from adjacent CDT STSs at their maximum motion envelope extents, adjacent walls or adjacent permanent building structures (not ceilings) when it moves thru its full range of motion (maximum extent of motion), for passageways, maintenance and air circulation.

3.3.5 Reliability, Availability and Maintainability (RAM) Requirements

3.3.5.1 Reliability

The CDT shall be designed with a Mean Time Between Failure (MTBF) of 500 hours per trainer.

3.3.5.2 Availability

The CDT shall have an Operational Availability goal (Ao) of 90%. The trainers shall be used eight hours/day, five days/week, and 50 weeks/year equaling 2,000 hours per year. The availability rate of 90% translates that the trainers shall be available for operation of at least 1,800 hours/year.

3.3.5.3 Maintainability / Built-In-Test (BIT)

The CDT shall design a Mean Time to Repair (MTTR) of 1.0 hour. The CDT BIT shall be composed of three components: (1) daily readiness check, (2) performance monitoring (PM), and (3) fault detection and fault localization (FL) and shall apply to all the equipment in the systems. The design of controls and readout devices shall be such that they can use and interpret by maintenance personnel. The BIT shall have the capability exercised by a single operator. The circuits and devices providing the BIT shall design in such a manner that failure of these circuits or devices shall not cause failure of the training device. The system shall provide an assessment of the overall device integrity in not more than five minutes upon command. The IOS, CDS, and maintenance mobile device shall also have the capability to perform any of the BIT functions.

3.3.5.3.1 Daily Readiness Check

Daily readiness check programs shall enable operating personnel to determine that the trainer is ready for operation. Provisions shall make the automatic sequencing through the daily readiness check program, or portions thereof, to verify the desired output at each step. The operator shall have the option of either proceeding, after noting the discrepancies, or stopping the execution. Identification of errors shall display. The system daily readiness check shall require less than ten minutes completing.

3.3.5.3.2 Performance Monitoring

The performance monitoring component shall function on-line, be entirely self-contained, and shall require no external stimuli nor measurement equipment. Normal operation of the performance monitoring capability of the host processor shall be in an energized mode continuously monitoring all circuitry with no warm-up period required. Performance monitoring in the host processor shall have the capability to continuously monitor operating system anomalies and record them to an error log. Host processors whose BIT includes parity checking and memory error detection, shall have the capability to monitor those errors continuously and record them in an error log. The operator shall have the capability to readily query the error log.

The status of communication within each network node shall provide to the network manager. When performance monitoring BIT tests detect a fault and if no network fault exists, then the tests shall provide enough information to isolate to the faulty workstation, console, or manned module. If a fault detects in the network, the network manager shall use to isolate the fault to the failing system components.

3.3.5.3.3 Fault Localization (FL)

The FL component shall function off-line, and shall require manual initiation. Upon indication of failures of commercial equipment, diagnostic routines, procedures, test units, and other procedures from the vendor shall use to isolate the faulty hardware to the Lowest Replaceable Unit (LRU). For prime and subcontractor newly designed equipment and the image generator, fault locating BIT shall provide.

The status and results shall display in an easily readable format on the screen and printed hard copy (selectable by the user) and shall include identification of the error and necessary corrective

action. The results shall be stored in computer files which shall be accessible via display or hardcopy printout later. The diagnostic operator interface formats shall be the same for every station in the CDT configuration. The operator shall have the capability to run FL on all hardware in the station or choose to check out individual components of the station. Provisions shall make for automatic sequencing through the tests, or portions thereof, incrementally to verify the desired output at each step. The operator shall have the option of either proceeding after s/he has noted the errors or stopping the computers to determine the type and nature of the failure with the maintenance mobile device computer. The software and user interfaces for running local diagnostics shall be the same as for running from the IOS or CDS itself. The locally executed diagnostics shall have no impact to the network, as they shall be capable of running in parallel to CDT simulations. The FL shall provide the capability for the operator to run checkout diagnostics on any unused IOS or CDS at any time. The FL shall provide the capability for any particular console, at the discretion of the CDS or IOS, removes from the active simulation configuration, and perform FL on its own hardware.

3.3.6 Lamps / Light Bulbs

All lamps and/or light bulbs shall be easily replaceable in less than ten minutes.

3.3.7 Accessibility

3.3.7.1 Cable Slack

Cable slack and cable bending features shall provide to assure full extension access to multiple equipment extensions during maintenance. Cable slack shall provide in the cables behind equipment panels to permit removal of each instrument, display, or control panel and disconnection from associated cables in one maintenance operation from the equipment.

3.3.7.2 Assemblies

Units, assemblies, subassemblies, and parts shall provide with accessibility and removability for ease of maintenance. If tracks, slides, or roller provides, automatically operated locking devices shall provide to lock the assembly in the servicing position as well as in the fully opened (except for the equipment rack shelf) and fully closed positions. The design of each major assembly, subassembly, and unit of the systems, shall permit access to its interior components and parts for maintenance. It shall not be necessary to displace or remove wires, cables, subassemblies, or assemblies in order to gain access to mounting screws, test points, adjustment points, lubricating points, and the like. Where visual inspection is necessary, and open access is not feasible, transparent access panels shall use. The placement of parts shall be such as to provide space for the use of test probes. Assemblies subject to replacement or service shall not permanently secure.

3.3.7.3 Covers, Panels and Doors

Hinged covers and doors shall provide with a means to retain them in an open position; and when opened, shall not cause the equipment to become unbalanced. A retention device fastened to the equipment shall use on removable covers for which no convenient location for depositing the cover is available during maintenance. Front panels containing parts, which require

maintenance such as instruments, switches, potentiometers, and the like, shall provide accessibility and removability for ease of maintenance. Where parts or assemblies mount on hinged doors, panels, or covers, electrical ground return shall not depend on the hinge contact for electrical continuity. A separate grounding means shall provide for the electrical ground return. Locking devices shall install on the hinged covers and doors to retain them in the open position to permit accessibility and to prevent injury to personnel performing maintenance.

3.3.7.4 Handles

Handles and hand grips shall provide for removing units or chassis from enclosures. Handles on enclosures shall recess.

3.3.7.5 Replacement of Modular Assemblies

Plug-in techniques shall use to permit replacement of modular assemblies. All modular assemblies shall design so that they insert into the equipment in one position only. Sockets shall be oriented in the same direction and positioned so that the sockets are visible. Modular circuits shall group in functional units.

3.3.7.6 Cabinet Door Locks

All equipment cabinet doors equipped with key operated locks shall utilize a common key for all locks.

3.3.7.7 Circuit Card Connectors, Power, and Ground

Inadvertent insertion of a card in the wrong slot shall not result in damage to the circuit card or to other parts of the system.

3.3.8 Environmental Conditions

Component parts, units, assemblies, and subassemblies of the CDT fixed site system shall meet the environmental performance requirements that follow. Requirements for mobile system trailer CDT systems specify in Sec. 3.15 ‘Mobile Systems’.

3.3.8.1 Operational Climatic Environment

The CDT shall design for operation within a climatically controlled environment. The CDT shall operate without degraded performance within the following ambient environmental conditions:

a. Temperature: 5° to 35° C (40° to 95° F).

b. Relative Humidity: 8 to 85 percent, non-condensing.

3.3.8.2 Non-Operational Climatic Environment

During transit and storage of the trainer and associated components, the systems shall accept ambient environmental conditions within the following extremes without degradation:

a. Temperature: -40° to 65° C (-40° to 149° F).

b. Relative Humidity: 20 percent to 80 percent, non-condensing.

3.3.9 Shock and Vibration

All parts of the CDT shall be designed to prevent performance degradation and damage (e.g. loosening of fasteners, disturbance of adjustable settings, etc.) during shock and vibration environments normally encountered during shipment/transportation (by ground or air) and for shock and vibration encountered during training operations. Displays and optics shall not suffer permanent damage due to excursions within the design limits of the motion system.

3.3.10 Transportability

The CDT shall be transportable (air, ground and sea) by standard commercial or military transportation means. The CDT shall be able to withstand, without damage, normal stresses incident to movement, handling in transit, hoisting, and tie-down aboard transporting vehicles. Major units (components, assemblies, and subassemblies) shall construct such that the installation, assembly, and disassembly can accomplish with no special equipment or tools and without the necessity of soldering, cutting, welding, or other destruction of material. All major units requiring more than a two-man lift shall have provision for movement by forklifts. The systems shall be constructed such that relocation of the training system can be accomplished without physical modification (e.g. soldering, welding, unsoldering, cutting, crimping, or destruction) of material. System components, when disassembled for relocation, shall be capable of packaging in containers with door openings of 7 feet 5 inches in height and 8 feet 6 inches in width, and internal dimensions of 19 feet 4¼ inches in length, 7 feet 9 inches in height, and 8 feet 6 inches in width.

3.4 Qualitative Maintainability Requirements

General maintainability characteristics of the trainer equipment shall be as specified in the following paragraphs.

3.4.1 Special Tools

There shall be no need to use special tools for equipment maintenance. Any special tools shall require Government approval.

3.4.2 Accessibility

All CDT equipment racks, stairs, steps, handles, and major assemblies shall assemble in compliance with best commercial practices for accessibility to components to facilitate maintenance operations.

3.4.3 Configuration Management of Internet Protocol (IP) Address

The Password Change Application shall also allow an authorized maintainer to individually or collectively change the system password and IP address on the CDS computer if connected to the system. The Password Change Application shall allow an authorized maintainer to individually

or collectively change the system password and IP Addresses on any computers connected to the system.

3.5 Design and Construction

3.5.1 Wiring

Wires and cables shall position or protect to avoid contact with rough surfaces, irregular surfaces and sharp edges, and to avoid damage to conductors and adjacent parts. Harnesses and cable form containment means shall be neat in appearance, uniformly applied, and positioned to retain critical form factors and breakout locations. The containment means (lacing, ties, and tie down straps) shall not cause the insulation to deform to the point where performance is adversely affected. There shall be no evidence of burns, of abrading, or of pinch marks in the insulation which could cause short circuits or leakage. Clearance shall provide between wires or cables and heat generating parts to avoid deterioration of the wires and cables.

3.5.2 Shielding

Shielding on wires and cables shall secure in a manner that shall prevent it from contacting or shorting exposed current-carrying parts. The ends of the shielding or braid shall secure to prevent fraying.

3.5.3 Cable and Wire Markings

Serviceable interconnect cables and wires shall mark permanently and legibly in accordance with the following requirements, which shall apply to all equipment categories. These types of serviceable interconnect items include plugs, jacks, lugged terminals, push-on captivated wires. Jumpers or links located on terminal boards, jacks or plugs are exempt from such marking. Soldered connections are also exempt from such marking. Markings shall not damage the wires or cables attached to and shall be located within approximately eight cm from the connector, terminal, or plug, oriented in such a manner as to be readable without removal of the wire or cable or support clamps.

3.5.3.1 Cable Marking Method

The following methods shall be used to mark cables and wires and IAW Standard Reference Designations for Electrical and Electronics Parts and Equipment (ANSI/IEEE Y32.16) on all serviceable interconnect cables:

a. Molded on the cable
b. Stamped on the cable
c. Securely attached, appropriately marked plastic bands (no less than 0.25 mm thickness)
d. Bands of appropriately marked heat shrinkable tubing
e. COTS items internally are not required to be marked
f. COTS interface cable(s) with a CDT system shall be marked

3.5.3.1.1 "W" and "P" Cable Designations

A "W" designation (W1, W2, etc.) shall assign to uniquely identify cables and wires. The numerical portion of the "W" designations shall be consecutive throughout the trainer. In addition, each connector within the same cable shall identify with a "P" designation (P1, P2, etc.). The numerical portion of the "P" designations shall be consecutive for a given cable. The "W" and "P" designations shall be marked on cables in accordance with Figure 12 - Examples of Cable Markings.

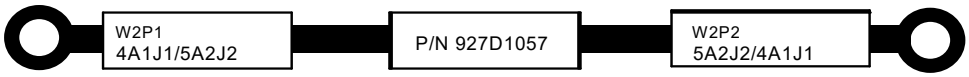
3.5.3.1.2 To and From Designators

In addition to the "W" and "P" designations, cable and wire markings shall include "to-from" reference designators to identify the locations where they are connected. Cables and wires internal to subassemblies are not required to be marked with the "from" designator. The "to-from" designators shall be marked on cables in accordance with Figure 12- Examples of Cable Markings.

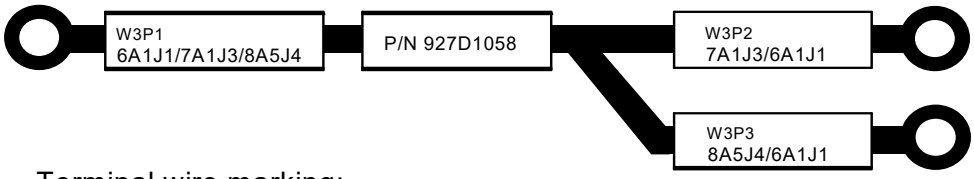
3.5.3.1.3 Assembly/Part Number

Trainer-peculiar wires, cables, and harnesses shall identify and mark with the applicable assembly or part number. The number shall be included with other required cable markings where space permits; otherwise, a separate marking shall be made adjacent to the "W", "P", and "to-from" designator markings.

Basic inter-cabinet cable:

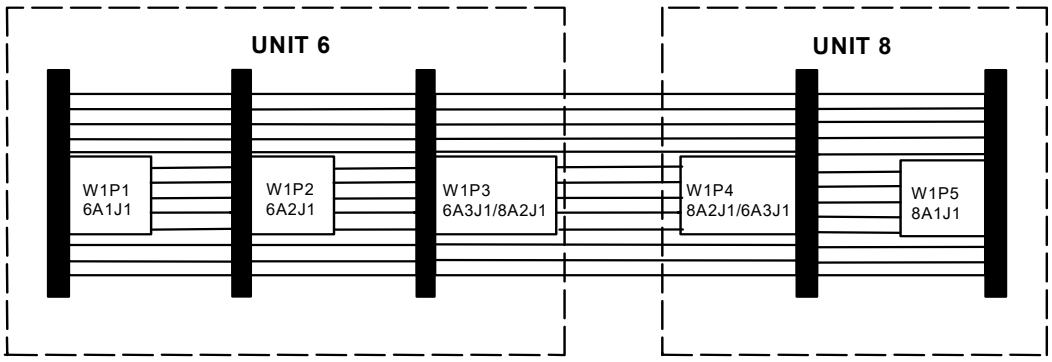


Multiple destination cable:



Terminal wire marking:

Daisy chain, continuous ribbon cable with clamp on connectors:



NOTE (1) PREFIX MAY BE OMITTED FOR WIRES OR CABLES LOCATED ENTIRELY WITHIN THE SAME CABINET.

NOTE (2) FOR PURPOSES OF THESE MARKING REQUIREMENTS, UNITS COMPRISED OF MULTIPLE CABINETS OR BAYS PERMANENTLY WELDED OR BOLTED TOGETHER SHALL BE CONSIDERED AS HAVING SEPARATE CABINETS.

NOTE (3) THE UNDERLYING CRITERIA FOR WIRE AND CABLE MARKING SHALL BE EASE OF MAINTENANCE AND REDUCTION OF CHANCES FOR MISCONNECTION.

Figure 12 - Examples of Cable Markings

3.5.4 Materials and Processes

Materials and processes shall be in accordance with the following requirements. Commercial and Non-Developmental Items (CaNDI) and GFE are exempt from these requirements, unless otherwise specified in this section. CaNDI must comply with the Government's definitions in order to be exempt.

3.5.4.1 Materials

Materials selected for the trainer hardware shall meet the primary design requirements of their application and the following additional performance requirements:

a. Except in the case of consumable items, materials used in the construction of nonexempt equipment shall preclude deterioration in performance and appearance over the design service life of the equipment.

b. When it is commercially practicable, materials selected shall allow trainer-peculiar parts to be repairable by commonly applied commercial processes. Materials selected shall withstand, without deterioration, the effects of the environment in which the equipment shall be operated, stored, and transported.

c. Materials selected shall preclude exposure of personnel, facilities, and the environment to toxic, explosive, electrical and fire hazards throughout the life cycle of the equipment.

3.5.4.2 Hazardous Materials

The trainer shall not expose personnel or the environment to any level of toxic, carcinogenic, teratogenic, and otherwise hazardous materials as defined by OSHA and the Environmental Protection Agency (EPA). If hazardous materials must be used in order to meet the performance requirements of this specification, only Government-authorized materials shall be used, the hazardous items shall be suitably marked, and all due precautions shall be taken to prevent whatever harm the hazardous material could cause. Any batteries used in the COTS motion base, smoke detectors, or uninterruptable power supplies shall be appropriately marked and listed in the CDT System Maintenance Manual (SMM). The SMM shall provide the Material Safety Data Sheets (MSDS) and instructions for proper disposal for each hazardous material.

3.5.4.3 Metals

Metals shall be corrosion-resistant, coat, or metallurgically process to resist corrosion. The environmental conditions to which the equipment shall expose shall not cause corrosion and shall not cause deterioration of metal parts.

3.5.4.4 Parts

The trainer hardware shall be comprised of CaNDI to the maximum extent practicable. Trainer Peculiar Equipment shall keep to a minimum.

3.5.4.5 Power Supplies

All power supplies used in the trainer shall be commercial items to the maximum extent practicable. The use of trainer-peculiar and Non-Developmental Item (NDI) power supplies shall require specific written authorization by the Government.

3.5.4.6 Recycled, Recovered, or Environmentally Preferable Materials

Recycled, recovered, or environmentally preferable materials shall use to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.5.5 Electromagnetic Radiation

No wireless radio frequency communications shall use within the systems.

3.5.6 Safety and Health Hazards

3.5.6.1 Smoke Detectors

All enclosed areas where personnel are working or training shall be equipped with smoke detectors, which shall be capable of integrating into a fire alarm system. In the mobile system trailer configuration, at least one smoke detector shall be located in each cab, each STS area, and each IOS area.

3.5.6.2 Safety Markings

Danger, caution, and warning signs, labels, and markings shall use to warn of specific hazards such as voltage, current, thermal, or physical hazards. Method, permanency, and legibility of equipment safety markings shall be as specified in applicable Government and industry standard safety documents. Guards, barriers, and access doors or covers shall be marked to indicate the hazard which shall be present upon removal of such devices. These markings shall place in a manner, so they are still visible when the barrier or access door removed. Additionally, hazards internal to units shall be marked adjacent to hazards if they are significantly different from those surrounding items.

a. Physical hazards shall be marked in accordance with ANSI Z53.1.

b. Voltage hazards shall be marked in accordance with ANSI Z35.4.

c. Laser labels shall be in accordance with 21 CFR 1040.

3.5.6.4 Personnel Safety

The design of the systems shall be such as to provide maximum safety to personnel and system equipment when installing, operating, transporting, adjusting and maintaining the equipment. In the end-item configuration, materials shall be non-combustible or fire retardant. Parts and assembled equipment shall clean of smudges, loose, spattered or excess solder; weld metal; metal chips and mold release agents; or any other foreign material which might detract from the intended operation, function, or appearance of the equipment. Screws, nuts and bolts shall show no evidence of cross threading, mutilation, or detrimental or hazardous burrs, and shall firmly

secure. Bearing assemblies shall be free of rust, discoloration, and significant surface imperfections. Wires and cables shall position or protect to avoid contact with rough or irregular surfaces and sharp edges and to avoid damage to conductors or adjacent parts. Shielding on wires and cables shall secure in a manner that shall prevent it from contacting or shorting exposed current-carrying parts. The ends of the shielding or braid shall secure to prevent fraying. The design of the systems shall comply with NFPA 101 for ingress, egress and other life safety issues. Ventilation shall ensure by introducing fresh air into any personnel enclosure. If the enclosure volume is 4.25 m^3 (150 ft^3) or less per person, a minimum of 0.85 m^3 (30 ft^3) of ventilation air per minute shall be introduced into the enclosure; approximately two-thirds should be outdoor air. Air shall not move past personnel at a velocity of 60 m (200 ft.) per minute. Where manuals or loose papers are used, airspeed past these items shall not be more than 30 m (100 ft) per minute. Unless wiring ducts or conduits are used, mechanically mounted cable clamps shall provide to ensure correct routing of electrical cables within and between equipment items. Cables shall route or protect in such a way that they shall not pinch by doors, walked on, used for hand holds, or bent or twisted sharply or repeatedly. Cables shall label to indicate the equipment to which they belong and the connectors with which they mate. Where commercial equipment uses, if commercial (e.g., UL) safety standards meet, then the commercial equipment do not need to modify, except by labeling to meet the additional safety requirements stated in this section. Fire extinguishers shall provide for all confined space areas as well as be easily accessible within the facility as described within CFR Title 29. Fire extinguishers for mobile system trailer shall fix in position with a bracket to be secure during transit and vibration while providing ease of removal during an emergency. Emergency power off switches shall provide that can reach by all operator personnel in the event of an emergency.

3.5.6.5 Hazardous Materials

The systems shall not incorporate any asbestos. Glass fiber materials shall not use as the outer surface or covering on cables, wire or other items where they shall cause skin irritation to operating personnel. When maintenance procedures require access to glass fibers, such as insulation, a proper caution note shall provide. Polyvinyl Chloride (PVC) materials shall not use in the crew compartment. The systems shall preclude exposure of personnel or the environment to excessive levels of toxic, carcinogenic, or otherwise hazardous materials as defined by Occupational Safety and Health Agency (OSHA), Environmental Protection Agency (EPA), and Department of Transportation (DOT).

3.5.6.6 Mechanical Safety

Moving parts shall guard or provide with safety devices to prevent mechanical injury to operator and maintenance personnel. Edges and corners shall be rounded and free from burrs. Center of gravity shall be such that the system is easy to handle; the system shall be stable. A means shall provide to lock or disengage the wheels of applicable equipment, so the system cannot inadvertently move.

3.5.6.7 Acoustical Noise

The control of acoustical noise generation and penetration shall be in accordance with 29 CFR 1910.95. In addition, the acoustical noise level in operational areas of the trainer shall not exceed the requirements of sound generation system paragraphs provided throughout this

specification for the various components of systems. The acoustical noise level in CDT simulator bay aisles shall be less than 81dB.

3.5.6.3 Electrical Safety

Electrical circuitry shall comply with the requirements of the National Electric Code. Equipment shall be listed or certified by a Nationally Recognized Test Laboratory (NRTL) (e.g. Underwriters Laboratories) or be shown to comply with appropriate consensus standards. The design and development of electronic equipment shall: provide fail safe features; incorporate methods to protect personnel from inadvertent contact with voltages capable of producing shock hazards: and ensure that all external electrically conductive parts, surfaces, and shields are at ground potential at all times during normal operation. The main power switch shall be located in front of the system, clearly labeled, and shall cut off power to the complete system. Danger, caution, and warning signs shall design and use in accordance with ANSI Z535.3 and ANSI Z535.4 to warn user personnel of specific hazards such as voltage, current, and thermal. For GFE or existing vehicles used within the systems, warning signs already designed and approved for such vehicles shall use. For potentials between 70 and 500 volts, warning shields and sign labels shall read "CAUTION (insert maximum voltage) VOLTS." Circuit breakers shall be on the equipment side of the power switch and shall be capable of manual reset only. Computer equipment shall meet the requirements of Chapter 4 of NFPA 75, except that flexible alternating current (AC) power cords shall not exceed 25 feet in length. Batteries shall separate from electronic components to prevent damage from corrosion. In addition, grounding wands shall provide and install in each equipment rack where an interlock circuit installs because of residual electrical charges. The wands shall permanently wire to the equipment ground system.

3.5.6.8 Nonskid Surfaces

Surfaces where personnel normally step during trainer use and maintenance shall be inherently nonskid surfaces, or shall cover with nonskid paint or material.

3.5.7 Human Performance and Human Factors Engineering (MANPRINT)

The design of the systems, exclusive of simulated feature fidelity, shall be in conformance to applicable provisions of the human factor engineering criteria and requirements of ANSI/HFS 100-1988. All aspects of the systems, except those portions which replicate actual military hardware, shall govern by the dimensional range from the 5th percentile female to the 95th percentile male soldiers working with the system. Design, selection, and arrangement of equipment shall ensure ease, efficiency, and safety of operation in the performance of all necessary functions by the crew and other personnel in fulfilling the intended use of the systems. Factors causing simulation sickness and fatigue shall reduce to a minimum. Crew station fidelity design developed under the concept of providing only what is necessary and essential for the task shall assure limitations and fidelity are not contributing factors in crew fatigue.

The CDT shall design to enhance operational efficiency, interaction, and realism; while meeting all applicable Human Factors Engineering (HFE) requirements for training devices. The CDT shall comprehensively integrate human characteristics into system definition, design, development, and evaluation to optimize human performance in accordance with the HFE

guidelines of MIL-STD-1472G. The detail design and functionality of the CDT system shall be in agreement with the following sections of MIL-STD-1472G:

a. Control
b. Control/display integration
c. Visual displays
d. Speech &Audio
e. Labeling
f. Warnings, hazards & safety
g. Workspace design
h. Physical Environment
i. Virtual Environment

The CDT design shall provide an interface that eases mental and physical tasks, as well as minimizes the chance of operator /maintainer error or accident.

The CDT shall ensure personnel safety of the instructor operator, trainee, and maintainer by identifying and eliminating program risks associated with critical human factors that can have a significant impact on safety, performance, schedule, or operational readiness.

The systems shall design and construct for safe operation and maintenance. The risks due to human error under routine, non-routine, and emergency conditions shall minimize. A fail-safe design shall provide in those areas where failure can cause death, severe injury, severe occupational illness, or major system damage. The design shall satisfy the requirements herein and the conditions of Appendix B - System Safety Design Checklist provided by the Government.

3.6 Identification and Marking

Markings for components and assemblies shall be as permanent as the normal life expectancy of the item. Markings shall be capable of withstanding the environment in which they are utilized and any necessary cleaning procedures. Legibility shall be as required to ensure ready readability. Markings shall not adversely affect the life and utility of the item. Location of identification and reference designator markings shall ensure visibility and allow differentiation from other items during normal operational use.

3.6.1 Identification Markings

Identification markings shall minimally consist of the design agency Contractor and Government Entity (CAGE) code, a dash (or slant), and the identifying part number. Commercial items which are already marked, as well as parts within an assembly or subassembly which are not normally subject to removal, replacement, or repair do not require identification markings.

3.6.1.1 Item Unique Identification

Each upper level assembly shall have a Department of Defense human and machine readable Item Unique Identification (IUID) with bar code label as defined in MIL-STD-130N.

3.6.1.2 Nameplates or Product Markings

Trainer equipment and cables shall identify and mark in accordance with the following requirements. Markings shall be permanent, securely fastened, and shall withstand the operational and storage environment of the trainer. Legibility shall be as required for ready readability. Markings shall be of a color which is in contrast to the color of the background surface. Markings of items shall not adversely affect the life and utility of the item. Letters shall be without serifs (sans-serifs) such as Gothic or Futura capitals, and the numerals shall be Arabic, except when Roman numerals use type designations.

3.6.1.3 Trainer Nameplate

A nameplate shall permanently affix to the trainer in a prominent location designated by the contracting officer. The trainer nameplate shall include a 2-D Data Matrix bar code that meets the IUID requirements of the contract. Methods of applying, type of lettering, permanency, and legibility of this nameplate shall be in accordance with MIL-STD-130N.

3.6.2 Reference Designator Markings

All serviceable interconnect cables and wires shall be marked with reference designator markings consisting of the reference designation of the item (minimally the "W" and "P" designation) as well as assembly designations as required to readily differentiate the part. The marking shall also contain the reference designation of the item it connected. Circuit cards and terminal boards receiving cables or wires shall be marked in order to facilitate connections. Ground wires and cables and wires within a commercial assembly do not require reference designator markings.

3.6.3 Electrostatic Discharge (ESD) Markings

Electrostatic discharge sensitive assemblies shall be identified as such utilizing standard, commercial markings.

3.6.4 Major Assembly Markings

Major assemblies such as equipment racks, manned module compartments, workstations, and mobile system trailers shall have identifying labels consisting of black marking on a white or silver background. Identification shall include name of the procuring agency, name of the assembly, part number, contract number, manufacturer and CAGE, serial number, and year of manufacture.

3.6.5 Simulated and Modified Tactical Equipment

Modified operational/tactical equipment for system use only, as well as simulated equipment which could be mistaken for operational/tactical equipment shall be marked "WARNING: FOR SIMULATION TRAINER USE ONLY" if the equipment can be removed without the use of tools.

3.6.5.1 Warning Marking for Simulated and Modified Equipment

The following types of trainer equipment shall identify and marked IAW applicable Government and industry standards MIL-STD-130N:

a. Government-furnished or Contractor-acquired operational/tactical equipment which has been modified for use in the trainer

b. Unmodified Contractor-acquired operational/tactical equipment that has not been fully tested and certified for military use

c. Simulated equipment which has overall outward appearance which is substantially identical to the operational/tactical equipment for which it could be mistaken

3.6.5.2 Trainer-use-only Identification

The trainer-use-only identification shall consist of a sticker or nameplate with yellow background and the legend shown below in black. The sticker or nameplate shall not obscure other identification or labeling. Method of applying, permanency, legibility, and lettering shall be as specified in applicable Government and industry standards. See Figure 13.

WARNING: FOR CDT USE ONLY

Figure 13 - Trainer-User-Only Identification Sticker

3.7 Logistics

The systems shall support a maintenance concept of Life Cycle Contractor Support (LCCS).

The Government requires the rights in technical data and computer software, per FAR 252.227-7015, that permits the Government to fully support, maintain and modify the CDT system software and technical data throughout the program life cycle. Specifically, the Government intends to have training programs and devices operated, maintained, and supported throughout its life cycle by competitively-awarded contracts, at least in part.

Logistics for the CDT shall modify throughout the life cycle of the system and shall utilize ANSI GEIA-STD-0007-B for Logistics Product Data. This standard defines logistics product data generated during the requirements definition and design of an industry or government system, end item or product. The standard provides users with a set of data tags for all or portions of logistics product data and customer defined sub-sets of logistics product data. The data tags shall be specific to;

a. Initial Spares/Repair Parts List

b. Common and Bulk List

c. Tools and Test Equipment List

d. Provisioning Parts List

e. Materiel Component List

3.8 Module Common Performance Requirements

3.8.1 Interactive Human Models / Semi-Automated Forces (SAF)

The CDT shall use Interactive Human Models selected from the SE Core Common Moving Models (CM2). If a specific model is not available in the SE Core library, a new model shall develop in accordance with SE Core CM2 Process. At a minimum, a Vehicle Description Document (VDD) and an OpenFlight specification IAW the latest SE Core model specification which the Government will provide. Any new model shall submit back into SE Core CM2 for future use.

The CDT shall use the SE Core Virtual OneSAF baseline to meet system requirements. The design shall support and be functional with the capabilities of OneSAF. For those requirements not met by OneSAF, the contractor shall develop these enhanced features to satisfy the CDT requirements.

SAF entities shall follow the road network to include paved and unpaved roads with roads varying in size from simple trails to a four lane freeway/autobahn. SAF entities shall obey vehicle traffic regulations for the terrain specified. SAF entities shall include pedestrians (friendly, threat, and neutral forces). These entities shall support additional distractions for the crew, such as, weapons effects (including firing on the own vehicle to include hits and near misses or firing weapons into the air), pedestrians or children walking or running into the street, and aggressive driving (speeding, weaving in and out of traffic, cutting in front of the own vehicle).

The CDT shall provide real-time color computer generated visual images supported by OneSAF and SE Core. The visual simulation shall provide essential cues required by the crew member(s) to assess simulated vehicle position and velocity, characteristics of the terrain, and other information necessary to operate the module(s)/appended subsystem(s) in training scenarios.

SAF entities shall include static and dynamic models, and any associated software required to simulate the SAF entity appended subsystem(s) visual/sensor scene environment. Critical SAF entities include but are not limited to SE Core CM2 moving models, realistic high resolution animation, dismounted human models, particle based special effects, and animation shall render in high level of detail to facilitate Warfighter's immersion in the synthetic environment and maximize training objectives.

3.8.1.1 Ground Guide

A host controlled, animated, interactive human model(s) shall be provided that gives visual hand and arm signals to direct vehicle movement or vehicle equipment configuration. The animated, interactive human model(s) shall have the capability of executing a minimum of 30 animated, smooth, human like, realistic hand, and arm signals that correspond to real-world directions when performing vehicle maneuvering or configuration tasks. Interactive human model(s)

positioning relative to the vehicle and signals execution shall be associated with the simulated vehicle. The signals shall include both day and night (military flashlight in hand) military hand and arm signals.

The interactive human model(s) signals shall interactively control by evaluating the simulated vehicle's movement and position relative to a pre-defined desired path and the position relative to the interactive human model. The pre-defined path that the vehicle is supposed to follow shall have a tolerance depending on the location of the vehicle in the database. In areas that have other objects such as a motor pool stall openings, a row of vehicles, a tight passage between objects, etc., the actual vehicle location compared to the pre-defined path shall have a tolerance of +/- 6 inches. In less dense, open areas, the deviation of the vehicle from the pre-defined path shall have a tolerance of +/- 3 feet. The interactive human model(s) to vehicle positioning shall evaluate for distance and offset (position in the field of view). Parameters for distance and offset shall be configurable for the simulated vehicle. The frequency of interactive human model halts and repositions shall minimize in order to maintain realistic progress for vehicle movements. When the simulated vehicle moves outside the acceptable tolerance or the interactive human model is outside the acceptable field of view, the interactive human model shall halt the movement and refer the student to the instructor. The interactive human model movement animations such as walking and turning shall be realistic. The interactive human model path shall not go through any database object. When directing a vehicle to back up, the front (visible) interactive human model shall act as if receiving signals from a second, rear ground guide. The simulated interactive human model(s) shall conduct safe, procedurally correct actions.

For vehicle configuration tasks, the interactive human model(s) shall correctly position in front of the vehicle and shall provide hand and arm signal configuration commands consistent with the vehicle, vehicle equipment, and equipment status. When multiple steps are required for equipment configuration, the interactive human model shall provide commands only when prerequisite actions are accomplish.

For convoy commands, the animated human model(s) shall portray a lead vehicle commander, typically from the waist up in the lead vehicle hatch or waving out the passenger window. The lead vehicle commander shall be able to give hand signal to vehicles following the lead vehicle. The lead vehicle commander's hand signals or mounted signals shall be in response to scenario requirements and triggered at specific points on the lead vehicle path.

3.8.1.2 Moveable Objects

The CDT architecture shall support the inclusion of moveable objects within CDT training scenarios. Moveable objects shall define as any object which can move, push, lift, place, or transport during runtime by another entity which has the capability to perform that action of that object. The CDT Scenario Generation System shall support the initial placement of moveable objects within a scenario during scenario development.

3.8.1.3 Relocatable Objects

The CDT architecture shall support the insertion of relocatable objects within CDT training scenarios during scenario runtime. Relocatable objects shall define as any object or feature which can create, place, modify, or remove in a scenario during runtime. Examples of relocatable objects include but are not limited to jersey barriers, shipping containers, barricades,

buildings, static vehicles, craters, fighting positions and debris piles. The CDT Scenario Generation System shall support the initial placement of relocatable objects within a scenario during scenario development. The CDT IOS software shall support the creation, placement, modification, or removal of relocatable objects during scenario runtime.

3.8.1.4 Common Moving Models / Other Entities

The CDT shall achieve interoperability and fair fight with Current Force, Future Force, and future virtual simulators by providing a common synthetic environment, common virtual coordinate system, CM2, and common SAF/Computer Generated Force (CGF) provided by SE Core.

The CDT shall use visual models selected from the SE Core CM2. If a specific model is not available in the SE Core library, a new model shall develop in accordance with SE Core CM2 process. At a minimum, a VDD and an OpenFlight specification IAW the latest SE Core model specification provided by the government.

3.8.1.5 Moving/Repositionable/Switchable Models, Animations & Special Effects

N/A.

3.8.1.6 Traffic Models

Urban traffic on highways and secondary roads shall provide to aid in training convoy tasks and defensive driving tasks.

3.8.1.7 Terrain Following

The attitude of all visible land vehicles shall reflect the terrain surface shape and orientation based on the elevation at a minimum of three support points. For own vehicle, contact point elevations and underlying soil types shall be provided to meet the vehicle dynamics requirements and the terrain and object interaction requirements for the type of vehicle. Own-vehicle attitude shall reflect the surface orientation.

3.8.1.8 Weapon Impact Detection

All weapon impact points on the own vehicle shall be detected. Other incoming weapons effects scripted and/or IOS triggered such as artillery explosions, IED (buried or exposed), cannon fire and missiles shall be random in location, size, effect, and number (i.e., single or multiple depending on weapon) and shall design as distractions to the student with visual, motion, and aural cues.

3.8.1.9 Training Environment Data Communications

When in stand-alone mode, the CDT system shall use a combination of DIS, V-DIS and internal Application Programming Interface (API) function calls to communicate simulation and entity data between entities, objects, and ownships.

When in network mode, each CDT system shall use a combination of DIS and V-DIS to communicate simulation and entity data between CDT systems.

3.8.1.10 Environmental Runtime Component (ERC)

The CDT software shall include the SE Core Virtual OneSAF ERC.

The ERC Earth Skin State Application Programming Interface (API) shall use to provide information about the terrain at a particular location including but not limited to the unit normal, trafficability code, and height of terrain.

The ERC Line of Sight API shall use to determine whether a clear, unobstructed line of sight exists between a viewpoint and a target point. Data from the ERC Line of Sight API shall use to provide input to SAF entities (including autonomous traffic and all human models) to determine if an entity can "see" other entities or terrain features and react appropriately to them.

The ERC Routing API shall use to determine routes for SAF entities including autonomous traffic. Routes for SAF entities shall be recalculated using the routing API whenever a dynamic change to the environment occurs including but not limited to explosions which create craters, setting roadblocks or barricades, digging or creation of fighting positions and building damage which results in creation of rubble piles.

The ERC Ultra-High Resolution Building (UHRB) Route API shall use to determine routes through UHRBs for autonomous human models, interactive human models, and ground guides. For ground guides, the ERC UHRB Building Route API shall use to determine the ground guide path when guiding a vehicle through a motor pool maintenance bay.

The ERC Features API shall use to retrieve features in a particular area and also to create, commit, modify, or remove features during runtime. The Environment Data Model (EDM) shall use to define all of the features and feature attributes the ERC supports. If additional features develop to meet CDT training objectives, the new features shall integrate into the EDM and features API. Then provide these features back to PM OneSAF with full Government rights. The features API shall use to support both static and dynamic features.

The ERC Air Ocean Space (AOS) API shall use to provide weather, illumination, sun/moon/stars state, and transmittance data to the IG systems. The AOS API shall support both static and dynamic weather. For dynamic control of weather during runtime, the AOS API shall integrate with the existing CDT weather, visibility, and illumination controls.

The ERC Transmittance API, a subsystem of the AOS API, shall use to determine the effects of weather and other obscurants on the capabilities of vehicle sensor systems including but not limited to the DVE and the Rear View Sensor System (RVSS).

3.9 Major Component Characteristics

Each CDT's computer system, which consists of the computer hardware and software of the trainer, shall program with algorithms and iteration rates that provide mathematically consistent and stable solutions. Iteration rates for time-critical aspects of real-time dynamics shall be no less than 60 Hertz (Hz). Instructor station and student station displays and indications shall be free of discernible stepping, oscillating, jittering, or other erratic behavior.

Each CDT system, regardless of configuration, shall be capable of simulating, stimulating, and emulating all operations necessary to train students to perform the training tasks defined by the requirements listed in the Appendices for each of the vehicle variants.

All GFIs provided are for references only and there is no mandate to use/reuse, as long as all CDT VPL requirements are satisfied, ref. Figure 14, CDT Software Functional Modules.

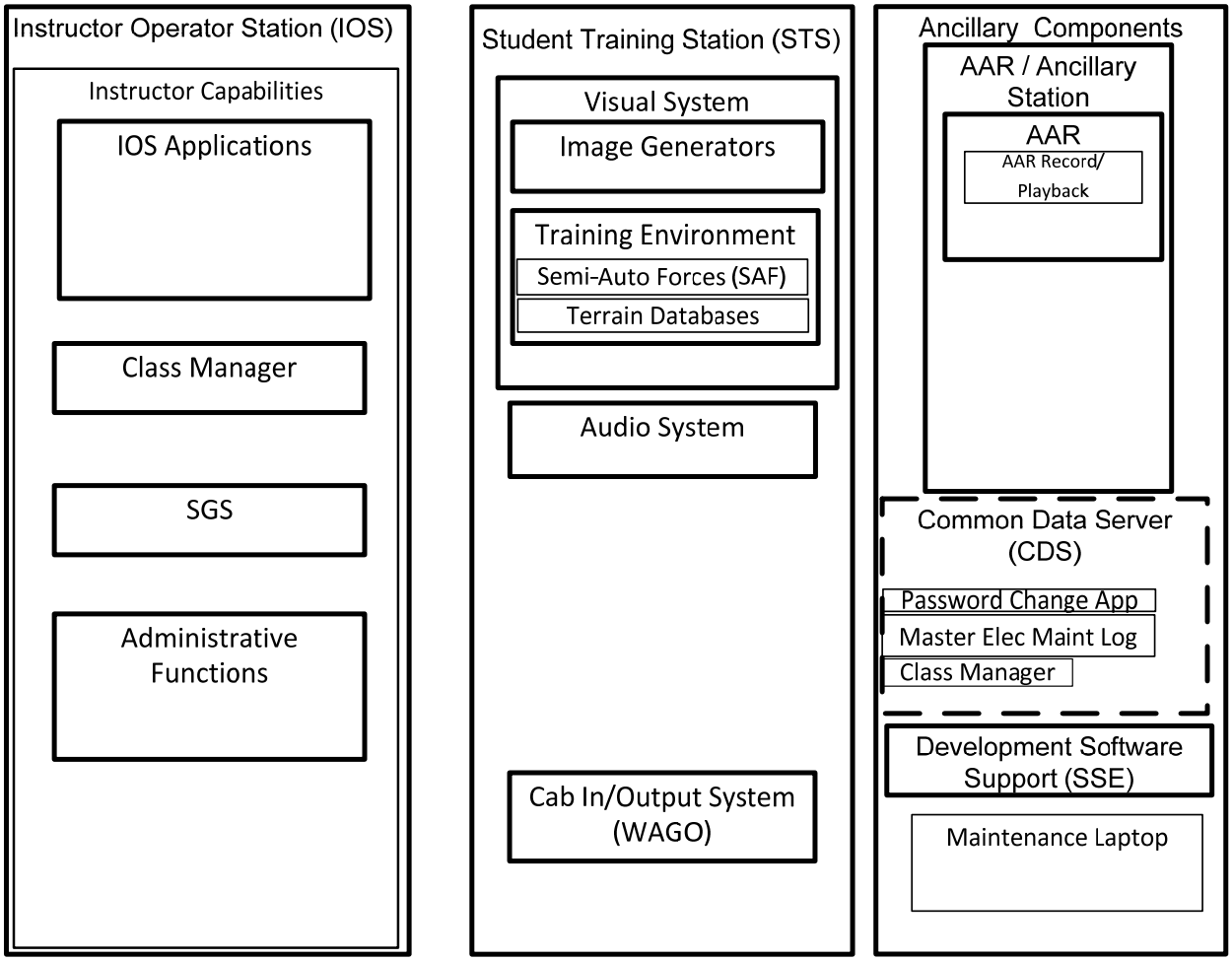


Figure 14 – CDT Software Functional Modules

The contractor shall evolve the CDT design and product baseline that was developed and fielded; and then provided to the Government for development of future baselines.

3.9.1 Trainer Computer Systems

Each CDT's computer system, which consists of the computer hardware and software of the trainer, shall program with algorithms and iteration rates that provide mathematically consistent and stable solutions. Iteration rates for time-critical aspects of real-time dynamics shall be no less than 60 Hz. Instructor station and student station displays and indications shall be free of discernible stepping, oscillating, jittering, or other erratic behavior.

3.9.2 Computer Hardware Requirements

3.9.2.1 Computational Hardware

Computer hardware and network components shall select in a manner that minimizes the number of different types of spare parts, maximizes the commonality of software components, and minimizes associated logistics support costs. Any contractor has proposed deviation to the requirements shall requires Government's review and approval before implementation.

Computer hardware and electronic parts design to place on the motion platform shall specifically rate and design to tolerate the maximum motion and forces the motion device can produce. Placement of these parts on the motion platform shall be limited as much as possible to increase the use of common components between vehicle variants.

For all Engineering Change and/or Technical Refreshes to existing CDT systems, if either changes or additions to the existing computer system hardware, or both, exist, such equipment shall meet the requirements above. In addition, new hardware must be compatible with the remaining legacy hardware.

3.9.2.2 Peripherals

Peripherals shall provide to support the following functions:

a. Printing of hard copy output of information necessary to support the operation, maintenance and testing of the trainer in accordance with the requirements of this specification and the intended use of the trainer

b. Storage of software and databases used for operation, maintenance and testing of the trainer

c. Backup of all Class Manager Databases up to a combined maximum of 4 gigabytes (GB) of information to electronic media shall accomplish within 60 minutes. Recovery of all Class Manager databases up to a combined maximum of 4 GB of information from electronic media shall be accomplished within 60 minutes

d. Reading to, and writing from, data storage and transmission digital media in accordance with DODI 8500.01 Cybersecurity guidance

3.9.2.3 Hardware Failure

Adverse effects from failure of a hardware element shall be limited to the subsystem containing that hardware element

3.10 Network System

The network system shall cover the utilization of the systems Local Area Network (LAN) for the fixed and mobile system trailer sites. The systems LAN shall be composed of commercial hardware and software.

3.11 Communication System

3.11.1 Communication Subsystem

The CDT communication subsystem shall use Voice Over Internet Protocol (VoIP) or other open system standard protocol to emulate inter-vehicle and intra-vehicle communication systems. The CDT communication subsystem shall have a dedicated channel for each simulated radio connection. The CDT communication subsystem shall be configurable to match the performance requirements for each vehicle variant radio communication system defined in a variant appendix. The CDT communication subsystem shall emulate a dedicated internal radio connection (intercom) based on the vehicle configuration defined in the variant appendix. The intercom shall connect the driver, instructor, and any ancillary crewmembers operating a single vehicle simulator. The CDT communication subsystem shall have the capability to emulate Push to Talk (PTT) if a radio connection is selected other than the intercom. The CDT communication subsystem shall have an emergency radio connection that can override all existing radio connections to communicate an emergency from any training position in the CDT system regardless of configuration or mode. The CDT communication subsystem shall provide an indicator on the main IOS screen to notify the instructor of incoming VoIP data.

3.11.2 IOS Communications

The CDT shall have audio communications between the IOS (instructor & observer) and the student stations (STS and AAR/AS). Communications shall accomplish via headsets with boom microphones for the instructor and observer. The communications in the STS and included ancillary stations shall be via operational CVC helmets or headsets as defined in the particular variant annex. The IOS headset shall be adjustable for head size with cushioned, closed ear (surrounds the ear) headset speaker enclosures with noise canceling speakers and adjustable, noise canceling microphones. The IOS shall have controls to adjust the volume levels of the instructor and observer headset audio individually. When the CDT configuration is multiple STSs-controlled by one IOS, communications from the instructor to the student at any STS or ancillary station shall individually selectable or to all students at once. Communications between the students and the instructor shall be available at all times when the student station (STS or ancillary station) and IOS are powered-up. IOS communications shall be available anytime the IOS is powered-up.

3.11.3 Automated Cueing Subsystem (ACS)

Each CDT system shall include an Automated Cueing Subsystem (ACS). The ACS shall be capable of providing verbal or nonverbal instructions and cues, or both, to the student driver. The instructor shall have the ability to select the ACS operating mode (verbal, nonverbal or both) at the IOS whenever the CDT is powered on. When in verbal mode, the ACS shall play pre-generated or pre-recorded sound files to provide the student driver with scenario instructions, route, and driving directions, and other verbal messages via the communications system. When in verbal mode the ACS shall also provide corrective input to the student driver (e.g. excessive speed warning, deviating from prescribed course, and incorrect Central Tire Inflation System (CTIS) mode by playing pre-generated or pre-recorded verbal messages through the communications system. When in nonverbal mode, the ACS shall provide route and driving directions, corrective input, and other messages to the student driver by displaying transparent

messages on the center screen of the VDU. When in nonverbal mode, the ACS shall not be capable of delivering pre-generated or pre-recorded verbal scenario instructions to the student driver. When in both mode, the ACS shall provide both verbal and nonverbal cues, instructions and messages to the student driver as described above. The instructor shall have the ability enable/disable the entire ACS or just the corrective messages at any time from the IOS.

When in either verbal or both mode, the ACS shall not stack duplicative cues in any type of queue or list. If a scenario instruction, route cue, driving direction, or other waypoint triggered cue is playing and a new cue triggers, the current cue shall cease playing and the newly triggered cue shall begin playing immediately. If a corrective cue is playing when a new corrective cue for the same corrective action triggers, the current cue shall continue playing and the new cue shall ignore or drop. If a corrective cue is playing when a new corrective cue for a different corrective action triggers, the current cue shall continue playing to the end, and then the new cue shall begin playing.

3.12 Motion System

3.12.1 Motion System Safety

The area under and around the CDT motion platform shall be marked as safety zone and confine this area. The motion platform shall include a visual indicator that activates when the motion platform is in use. This visual indicator shall be visible from the IOS and safety zone area. The system shall provide an emergency exit for the student to exit the driver compartment in case the motion platform freezes in an elevated position. A constant electric (trickle charger) battery backup shall be provided for the motion system hardware. If main power is lost, the backup motion system battery shall park the motion system to the parked position for student egress, and not to induce any damage to the equipment. The system then shall not require recalibration of the training equipment. If the E-STOP activates, the motion system shall settle to the parked position.

The motion system for the CDT Tank Variant (TV) cabs shall modify to allow instructor support and aid to the student ingress and egress using the AUTOFLUG seat system.

3.12.2 Interlocks

The CDT architecture and motion system shall support the use of interlocks to prevent motion under unsafe conditions. Recommended locations for safety interlocks shall include, but are not limited to, all doors, seat belts and crewmember's safety harnesses, and hardware fixtures for the cab. Whenever an interlock opens (i.e. door opened, seat belt or harness unbuckled), the CDT system shall immediately display a warning message at the IOS and shall cause the associated STS to halt all motion, slowly lower the motion platform to its parked position and pause the simulation.

3.12.3 Warning Visuals

The CDT motion platform shall include two hard panel drop-down visual warning flags which shall be clearly visible and interlocks shall trigger whenever the two rearmost cab mounting bolts are not properly install and tighten.

3.12.4 Vehicle Simulation

At a minimum, the CDT shall simulate the vehicle variant dynamically to the level of detail required to support the training tasks for the specific variant. The CDT shall replicate the performance and handling of the actual vehicle and shall include any differences in performance/handling of the vehicle variations. Vehicle simulation shall include at a minimum the following vehicle components:

a. Engine
b. Fuel system
c. Dynamic modeling of fuel consumption rates (calculations based on driving of vehicle variants)
d. Power Train/Transmission Gearbox
e. Electrical system
f. Brakes – Hydraulic and Air
g. Steering
h. Accelerator
i. Suspension System
j. Hull
k. Communication system
l. Driving optics and field of view restrictions
m. Fire suppression system for applicable variants
n. Clutch/Transmission Selector
o. Tires/track systems

3.12.5 Vehicle Dynamics

The CDT shall simulate the dynamics of the actual vehicle variant with fidelity to train students for the training requirements contained in the specific vehicle variant annex. The vehicle dynamics shall be based on simulations of the physical characteristics of the above vehicle components, and the interaction with the terrain topography, terrain obstacles (all natural and man-made), surface, and soil characteristics surrounding the simulated vehicle variant. The effects of the terrain shall combine with the forces due to the mass and momentum of the hull to determine the vehicle performance using multiple points per vehicle ownship (wheels and tracks) interaction with the terrain database.

Vehicle dynamics shall include steering feel, steering response, acceleration, deceleration, braking, and suspension response. The vehicle dynamics simulation shall provide models of the power train (e.g. engine and transmission), suspension (e.g. springing, damping and range of travel), and moments of inertia of each vehicle. The parameters for these models shall evaluate at 60 Hz to assure smooth and accurate simulation. The system shall provide the sensor information and feel to the student when operating a plow or any other earth moving device. The

simulated modes shall include normal operation, malfunctions, emergency conditions, vehicle motion along and about all axis, rate of turn, acceleration, speed, angular velocity, transmission selection, and terrain surface/conditions.

The vehicle dynamics model shall also respond to nearby explosions. The magnitude of the response shall be a function of explosion size and location (distance and azimuth). The vehicle dynamics simulation results shall drive the visual displays, motion cues, aural cues, and instrumentation in the driver compartment. The vehicle dynamic performance shall model based on data provided by Government Subject Matter Experts.

3.12.6 Motion Simulation

The motion capability provided shall simulate the motion (pitch, roll, yaw, heave, surge and sway) associated with the operation of the actual vehicle variant with fidelity to train students. In addition and at a minimum, the CDT shall also provide simulated motion associated with the following when applicable to a variant resulting from terrain surface conditions (e.g. hard, gravel, mud, sand, ice, snow, and water).

a. acceleration;
b. deceleration;
c. braking;
d. rate of turn;
e. collisions;
f. skids;
g. banks;
h. turns;
i. sluggish steering;
j. pivot steering;
k. loose or thrown tracks;
l. tire blowout;
m. loss of steering;
n. loss of brakes;
o. brakes locked;
p. transmission lock-up;
q. engine overspeed;
r. clogged filters (oil, air, fuel);
s. terrain following;
t. speed;

u. traction;

v. suspension;

w. motion;

In addition, interactions with the environment and appended equipment (e.g., mud, snow, ice, rain, collisions, plows, and rollers) shall appropriately simulate.

3.12.7 Steering Force Feedback Subsystem

The CDT shall include a high-bandwidth torque loop steering force feedback subsystem. The model for the steering force feedback shall simulate the vehicle and the interaction of the terrain force feedback applied.

3.13 After Action Review (AAR) / Ancillary Station (AS)

The CDT architecture shall support an AAR/AS capability per STS. When specified as part of a CDT system, there shall be one AAR/AS system per Driver's Station. The AAR/AS subsystem shall allow off-line review of training results. The AAR/AS system shall record and playback all of the scenario as a single file and include the capability to pause, rewind, and fast forward (2x, 4x and 8x) the playback scenario. The AAR/AS shall be functionally available at any time after the completion of a scenario and shall not preclude the concurrent use of any other CDT system modules (i.e. IOS and STS) for training purposes. The AAR/AS user shall be able to browse and select scenarios for playback by student name and scenario identification (ID). The AAR/AS shall offer vehicle ownship center, right, left, and DVE computer generated imagery and the camera video feeds. The playback of a training scenario, shall recreate the visual image selected (vehicle ownship CIG) and have all of the aural communications and instrumentation cues of the original scenario execution. The AAR/AS shall design to allow the recorded imagery to archive on Compact Disk- Read only (CD-R) disks that can play on standard PC workstations.

3.14 Development Software Support Environment (SSE)

The Government will provide the latest SSE as part of the GFE and GFI. The contractor shall be responsible to maintain the SSE throughout the life of the contract. The SSE shall incorporate in the LT2 Portal when required.

3.15 Mobile Systems

3.15.1 Environmental Conditions

Mobile systems shall withstand the following environmental conditions without deformation, cracking, damage, and unusual wear of internal and external components.

3.15.1.1 Non-Operational Climatic Environment

During transit, site nonuse and storage, the trailer structures, equipment exterior of the structures and other mobile system trailer system equipment located on the exterior and capable of being

environmentally-controlled by the environmental control system (ECS) shall accept ambient temperatures within the following ranges:

a. Temperature: -40° to 65° C (-40° to 149° F)
b. Relative Humidity: 20 percent to 80 percent, non-condensing.

3.15.1.2 Operational Climatic Environment

Training shall take place, without degradation, within the mobile system trailer when outside ambient temperatures and humidity are within the following extremes: The CDT shall design for operation within a climatically controlled facility. The CDT shall operate without degraded performance within the following ambient environmental conditions:

a. Temperature: 5° to 35° C (40° to 95° F).
b. Relative Humidity: 8 to 85 percent, non-condensing

3.15.1.3 Lightning Protection

Lightning protection for all equipment components in all semi-trailers shall provide by surge protection at the trailer electrical power input and down conductors on opposite sides of the trailer, and shall conform to NFPA 780.

3.15.1.4 Environmental Kits

Environmental kits shall aid in the protection of semi-trailers during the environmental conditions described in Sec. 3.15.1.5 – Extreme Environmental.

3.15.1.5 Extreme Environmental

3.15.1.5.1 Sand and Dust

CDT mobile system trailers, with the aid of supplementary environmental kits, shall design to operate in environments with sand and dust particle concentration of 0.18 g/m^3 (grams per cubic meter) with wind speeds of 18 m/s. The air inlet for the Heating, Ventilation, and Air Conditioning (HVAC) system shall filter particles as small as 74 micrometers.

3.15.1.5.2 Rain

CDT mobile system trailers shall design to operate in the intended location and withstand the effects of rain in that location without leaks and seepage.

3.15.1.5.3 Snow

CDT mobile system trailers shall design to withstand the snow load characteristic of the intended location.

Note: Environmental kits shall be used to aid in the protection of the semi-trailers against excessive amounts of snow.

3.15.1.5.4 Ice

CDT mobile system trailers shall design to withstand the effects of ice accumulation characteristic of the intended location.

Note: Environmental kits shall be used to aid in the protection of the semi-trailers against excessive amounts of ice.

3.15.2 Shock and Vibration

Mobile systems shall design such that it shall not damage, nor shall performance degrades when it is subjected to the shock and vibrational stresses produced during transit conditions as described in Sec. 3.3.10 'Transportability' and normal use. All equipment shall be mounted or have provisions for securing in a manner that precludes damage and shifting during transit.

3.15.3 Mobile System Trailers

Each mobile system trailer shall be in accordance with the following requirements. Dimensions and tolerances shall be such that standard commercial parts shall be interchangeable. All mobile system trailers shall comply with the Department of Transportation (DoT) and Federal Highway Administration regulations for transportation on the U.S. Interstate System without requiring special permits. All mobile system trailers shall comply with Federal Motor Vehicle Safety Standards.

The CDT mobile system trailer shall allow for the transport and operation of one standard CDT variant driver training system. The CDT variant training system shall include the CDT STS's which includes the motion system, VDU's, simulation computer racks, and variant driver's compartments; IOS's, CDS, and AAR/AS. The mobile system trailer shall contain storage for spare parts, maintenance work area, and self-contained power generation. The mobile system trailer shall have the capability to transport by air, sea, and over standard U.S. highways. The mobile system trailer shall be able to operate from either external power (shore power) or self-contained power generation. All mobile system trailers shall comply with Federal Motor Vehicle Safety Standards.

3.15.3.1 Mobile System Trailer Capability Requirements

The CDT mobile system trailer variant shall provide in a mobile system trailer setup as specified herein. The CDT mobile system trailer variant shall be functionally equivalent to and provide the same degree of performance, reliability, supportability, and maintainability as the fixed site CDT variant. All requirements for the fixed site version shall apply to the mobile system trailer version unless specifically stated otherwise herein. The CDT mobile system trailer shall meet Department of Transportation regulations for transportation without requiring special permits.

3.15.3.2 Mobile System Trailer Configuration

The CDT mobile system trailer shall be a mobile system trailer setup that can transport from location to location on improved roads, without special permits within and outside CONUS. The CDT mobile system trailer shall include the following functional components:

a. 2 CDT STSs with vehicle variant driver's compartment for new MTFs; 1 CDT STS for technology refresh of legacy MTFs
b. IOS
c. CDS
d. 2 AAR/AS station for new MTFs; 1 AAR/AS station for technology refresh of legacy MTFs
e. Shock isolated electronics and computer racks.
f. Spares storage
g. Maintenance area
h. HVAC System
i. Power Generation System
j. Fire Alarm System
k. Fire Suppression
l. Crane lift points

3.15.3.3 Mobile System Trailer Set Up And Tear Down

The CDT mobile system trailer shall be able to be set up into a ready for power within four hours of arrival at the designated operating location. The CDT mobile system trailer shall be able to configure for transportation within four hours of shutdown. This requirement shall meet with no more than a three person technical team with at least one person fully trained on configuring the CDT mobile system trailer for transport or operation. Set-up and dismantling of the CDT mobile system trailer for training or transit shall not affect within temperature range listed in paragraph 3.15.1 – Environmental Conditions for CDT operation.

3.15.3.4 Identification Marking and Data Plates

Trailers shall have identifying labels per the requirements of Sec.3.6 in locations where they shall be both visible and legible. Trailers shall provide for the attachment of vehicle license plates.

3.15.3.5 Color

Trailer exteriors shall be white IAW FED-STD-595 color number 17875.

3.15.3.6 Corrosion Prevention

Trailers and accompany hardware, such as stairs and platforms, shall manufacture from corrosion-resistant materials or treated to provide protection against corrosion and deterioration. Underbody corrosion prevention compounds shall meet the requirements of MIL-PRF-62218B.

3.15.3.7 Wood

Wood shall not use as a structural component of the mobile system trailer.

3.15.3.8 Wood Treatment

Wood surfaces shall treated to resist deterioration from water intrusion and damage from insects.

3.15.4 Furniture and Chairs

The mobile system trailer shall furnish with all the furniture and chairs for both the IOS and AAR/AS stations. All tables and work surfaces shall be of sturdy construction and shall be finished with high pressure laminate. All furniture and chairs shall securely mount in the mobile system trailer or provide with a means for securing during transit.

3.15.5 Fire Extinguishers

The CDT mobile system trailer shall have Class ABC hand held fire extinguishers in each compartment. The main simulator compartment shall have a minimum 5 lb. dry chemical fire extinguisher and other compartments shall have a minimum 2.5 lb dry chemical extinguisher.

3.15.6 Miscellaneous Equipment

All equipment necessary for CDT and mobile system trailer set-up, tear-down and operation shall be stored in or on the mobile system trailer when being transported.

3.15.7 Lighting System

Light fixtures shall supply to provide proper luminance levels for all personnel areas in accordance with Sec. 5.8.2 of MIL-STD-1472. If different illumination criteria are applicable for a single area, the highest recommended illumination level shall provide for the entire area.

3.15.8 Emergency Lighting System

Battery emergency lighting, both internal and external, shall provide for all personnel areas. A battery charger shall be provide for the emergency lighting which operates from either the shelter self-contained power or external power. A method shall provide to disable the emergency lighting during storage and transit.

3.15.9 Network Interface Connection System

The CDT mobile system trailer shall provide easy connection to other simulation systems via a fiber optic or Ethernet connection (RG-45 interface). An interface connection shall be located on the exterior of the mobile system trailer.

3.15.10 Fire Detection System

A Fire Detection System shall provide which shall detect the onset of a possible emergency. The system shall meet NFPA 101 for the design of the Fire Detection System and shall meet NFPA 70 and 72 for the installation, test, and maintenance of the system. Components used in the Fire Detection System shall be UL approved.

3.15.11 Lightning Protection System

The CDT mobile system trailer configuration shall provide with lightning protection for the enclosure and all equipment components during transit, use, and non-use. The mobile system trailer expansion modules shall have compliant lightning protection that ties into to the main lightning protection system when set up for training. The lightning protection system shall be capable of redirecting most lightning strikes to ground to minimize damage to equipment and

increase safety of personnel. The mobile system trailer lightning protection system shall be in accordance with NFPA 780.

3.15.12 Grounding System

The CDT mobile system trailer grounding system shall provide electrostatic discharge control, lightning strike protection, and Electromagnetic Compatibility (EMC) grounding of the mobile system trailer system equipment. If a facility grounding attachment is available, grounding straps shall provide to make the attachment. The CDT mobile system trailer grounding equipment shall include:

a. Grounding rods - Four 5/8 inch diameter, eight foot long
b. Grounding straps - between mobile system trailer and the grounding rods
c. Means of easily driving and extracting the grounding rod

3.15.13 Heating, Ventilation and Air Conditioning (HVAC) System

The HVAC system shall automatically control the environment within the mobile system trailer when at a stationary location for CDT mobile system trailer training. The HVAC system shall control via thermostat. The HVAC system shall have the capacity to maintain the operational environment inside the CDT mobile system trailer within the requirements of Sec. 3.3.8 and Sec. 3.15.1 – Environmental Conditions.

All components of the CDT mobile system trailer shall be fully functional within this temperature/humidity range. The HVAC system shall have airflow and ducting to maintain a constant temperature throughout the mobile system trailer. The HVAC system shall utilize an environmentally friendly, non-ozone-depleting refrigerant. The HVAC unit shall be isolated from the mobile system trailer body to the maximum extent possible to preclude vibrations from transmitting to the mobile system trailer body.

Humidity controls shall provide to maintain a beneficial environment for equipment and personnel within the humidity operating limits specified for the CDT in Sec. 3.3.8 and Sec. 3.15.1 – Environmental Conditions.

3.15.14 Electrical System

The new CDT mobile system trailer shall have an electrical system that distributes electrical power throughout the mobile system trailer. Receptacles shall be located within the mobile system trailer to minimize power cable runs within the mobile system trailer. The electrical system design and installation shall be in accordance with NFPA 70. The new CDT mobile system trailer electrical system shall have the capability to be energized by shore power or the on board power generation system. A visual indicator for the active power source shall provide. The CDT mobile system trailer shall connect to shore power through a watertight receptacle NEMA SS-2 (quantity of 2) mounted on the outside of the mobile system trailer. The new CDT mobile system trailer shall have the following characteristics:

a. Voltage: 208/240 VAC +/- 10%
b. Frequency: 60 Hz +/- 1% for CONUS; 50 Hz +/- 1% for OCONUS
c. Phases: Single or Three Phase

d. Wires: 4-Wire

A 100 ft. power cable shall provide to connect the mobile system trailer to shore (facility) power.

The mobile system trailer shall provide with emergency circuit breaker(s) IAW Section 645-10 of NFPA 70.

3.15.14.1 Internal

The following shall provide:

a. Power for computers, simulators, lighting, and for electrical receptacles as necessary for maintenance equipment
b. Extra electrical receptacles, in addition to those necessary for computers and equipment, at a minimum of four per compartment
c. If both conditioned and unconditioned power receptacles provided, conditioned power receptacles shall be visibly different in color or marking from unconditioned receptacles
d. Light switches, to operate the interior mobile system trailer lighting shall have a minimum of one per external door

3.15.14.2 External Utility Assemblies

External electrical assemblies shall rate weatherproof IAW NFPA 70.

3.15.14.3 External Panels and Cables

A means shall provide at one location of the mobile system trailer for connecting trailer power, communications, and trailer-to-trailer cabling. Externally mounted connectors shall provide at a panel and shall be sheltered from the elements. All external connections and cables shall be weatherproof. When connected, the fire detection cables, power, telephone, and LAN/WAN cables shall make a watertight connection.

Watertight protective caps shall provide for all external cable and panel connectors for use in transit. These protective caps shall securely attach to their associated connectors to preclude loss. Cable jackets and connector connections shall be resistant to cracking and deteriorating when exposed for long periods to water, snow, freezing, and sunlight. All external connections and cables shall be weatherproof. Storage for cables shall provide suitable means (such as connector keying) shall provide to preclude incorrect cable connections. All cables shall travel from trailer-to-trailer without impeding vehicular and personnel traffic and shall be protected from damage from such traffic. All cables shall be of 100ft length.

3.15.15 Power Generation System

The CDT mobile system trailer shall contain a power generator capable of supporting full, standalone CDT operation. The power generator shall have capacity to provide the following:

a. 2 CDT STSs, 1 IOS and 1 AAR/AS
b. Two 30 Amp 208-240 VAC, 3 phase circuit for CDT motion system operation
c. Four general purpose 20 Amp 120 VAC circuits

d. HVAC system
e. All lighting
f. Minimum of 20% spare capacity over the above requirements

The power generation equipment shall employ standard noise and smoke reduction techniques for mobile system trailer generators. Noise control shall include the use of a critical-grade (tuned) exhaust silencer. The power generator unit shall be isolated from the mobile system trailer body to the maximum extent possible to preclude vibrations from transmitting to the mobile system trailer body. Fuel capability shall provide for a minimum of 40 hours of operation. The power generator shall operate using JP8/F24 fuel. The fuel tank shall mount to allow refueling by a person standing directly on the ground. The mobile system trailer shall have EPA compliant fuel spill containment. The fuel tank shall have an external indicator of the fuel level without removing the fill cap. The fuel tank shall have a security protected, accessible drain plug to drain fuel if necessary. The area at the fuel/gas cap shall have a clear warning/indication of the type of fuel that uses by the power generation system. The generator and fuel tank shall electrically ground to the mobile system trailer.

3.15.16 Mobile System Trailer Leveling, Stabilization and Anchoring System

The CDT mobile system trailer shall have leveling indicators (lateral and longitudinal) built-in as well as leveling and landing jacks that provide sufficient longitudinal and lateral mobile system trailer support for full motion CDT operation.

The jacking/leveling system shall have the capability to jack up the mobile system trailer on a non-level surface with up to 5.0 deg of slope over the short dimension of the mobile system trailer and 2.0 deg of slope over the long dimension of the mobile system trailer so that there is no weight on the suspension system. The jacking/leveling system shall provide a minimum of four independently adjustable supporting legs to support the STS area of the mobile system trailer. The jacking/leveling system shall have a means to mechanically lock the supporting legs to prevent any leg droop during CDT mobile system trailer operation. Either the mobile system trailer shall also support, at a minimum, each corner of the overhang areas (front goose neck area and rear behind the wheels area) by locking legs or mechanical jack stands to prevent droop or movement during CDT operation.

The CDT mobile system trailer design shall ensure the mobile system trailer facility has the provisions to anchor the mobile system trailer in the event high winds anticipated at the installation site. Anchor points shall support system tie down for up to 125 mph sustained winds.

3.15.17 Weights, Loads and Dimensions

3.15.17.1 Net Weight

The net weight of the complete mobile system trailer shall include the chassis weight and the weight of all attachments, accessories, and equipment (excluding internal Mobile system equipment). The net weight shall be the minimum practicable.

3.15.17.2 Rated Payload Capacity

The rated payload capacity, evenly distributed over the load space, shall be that required to support all internal mobile system trailer system equipment and personnel, but shall not be less than 10,886 Kilograms (Kg) (24,000 pounds). Each trailer bay shall have a maximum personnel loading of 30 people. Each semi-trailer expandable wing shall have a maximum loading capacity of 15 people.

3.15.17.3 Gross Weight

The Gross Vehicle Weight (GVW) of the mobile system trailer shall consist of its net weight plus its rated payload. The GVW shall not exceed Interstate Commerce Commission (ICC) limits on gross mobile system trailer weight to include running gear.

3.15.17.4 Dimensions

Dimensions and clearances shall measure with the mobile system trailer fully loaded with its associated Mobile CDT equipment, and the tires and suspension system adjusted to normal road conditions.

3.15.17.5 External Dimensions

Overall, the new mobile system trailer dimensions shall not exceed 44’ L x 12 ‘ H x 8.5’ W. Ground clearance for landing gear and leveling jacks shall not be less than 12 in.

3.15.17.6 Interior Dimensions

The inside body-dimensions shall be as follows:

a. Interior mobile system trailer width shall be the maximum allowable considering necessary insulation and structural reinforcement for equipment mounting.
b. Interior mobile system trailer height--the distance from the floor to the bottom of lights, cable runs, and other protuberances over the aisles and standing work spaces--shall not be less than 78 in. However, when the occupants seldom stand to perform normal operations, the ceiling height shall reduce to 74.5 in.
c. The minimum opening for personnel access shall be 76 in. height and 30 in. width.
d. The simulator rooms shall have minimum interior dimensions of 21 ft. x 7.5 ft. when open and minimum vertical interior height of 124 in. from the trailer interior ceiling to the floor of the trailer itself. The expandable rooms shall have a minimum interior height of 110 in. The trailer shall also have an externally accessed equipment room (personnel rated) 8ft. wide x 6 ft. long internal dimensions.

3.15.18 Performance

The mobile system trailer, fully equipped and loaded with rated payload, shall show no evidence of damage when tested as specified herein, and when towed over improved roads (smooth concrete or paved asphalt) at 65 mph and improved gravel roads at 30 mph. The mobile system trailer fully equipped and loaded with rated payload shall show no evidence of damage when towed over unimproved roads (unpaved, un-stabilized road having an occasional chuck-hole or exposed rock) at an average speed of five miles per hour with a maximum speed of 15 mph.

3.15.18.1 Turning Ability

The mobile system trailer shall assume a 90 degree angle to the coupled towing vehicle without cramping and without damage to the mobile system trailer and the towing vehicle. The mobile system trailer shall be able to be towed and backed-up when coupled to a towing vehicle.

3.15.18.2 Tracking Ability

The mobile system trailer shall conform to the tracking requirements of 49 CFR 393.

3.15.18.3 Brake Performance

Service brakes shall comply with the performance requirements of 49 CFR 393.

3.15.18.4 Slope and Grade

The mobile system trailer, with payload, shall operate on a 0 to 20 percent grade and 0 to 12 percent side slope up and down the respective grades and slopes without malfunction. When the mobile system trailer is on the inclines specified herein, the mobile system trailer shall not interfere with components of the towing vehicle except where the upper fifth wheel plate couples to the towing vehicle fifth wheel.

3.15.18.5 Suspension System

The mobile system trailer shall furnish with a commercially available air-ride suspension system and shall be equipped with an air-ride upper fifth wheel. The suspension system shall attenuate the road-induced vibration and shock to the payload for the road conditions specified herein. The air suspension shall provide for automatic self-load leveling air controls. Air release valve(s) shall provide to facilitate mobile system trailer leveling. The suspension system shall design for lifting the mobile system trailer off the ground. The suspension shall be supported so as not to bottom on the air bag and shock absorbers when lifted. The supports shall not inhibit the normal travel of the air-ride suspension. The suspension system shall withstand the weight of the mobile system trailer, the payload, and a snow load of 42 lbs/ft^2 distributed over the entire roof. Clearance shall preclude interference between tires and all parts of the mobile system trailer under the operating conditions specified herein.

3.15.18.6 Axles

Axle ratings of the mobile system mobile system trailer shall be at least equal to the load imposed, but shall in no case be less than 20,000 pounds per axle measured at the ground. The wheel bearings and axle spindles shall be oil lubricated. The hubcaps shall have a means for visual determination of oil level. The hubs shall be fitted with leak proof seals. Provisions for venting, or another method of withstanding internal pressure buildup, and for replenishing the oil supply shall provide.

3.15.18.7 Wheels, Rims, Tires, and Tubes

3.15.18.7.1 Wheels, Rims, and Tires

Trailers shall furnish with tubeless, radial tires. Rims and tire ratings shall conform to Tire and Rim Association (TRA) recommendations for the type and size of tires furnished. Tires and rim sizes shall be the same for all wheels of the mobile system trailer. Tires shall be of a rated capacity at least equal to the load imposed on each tire, measured at each wheel at the ground, with the mobile system trailer loaded with its rated payload described in paragraph 3.8.4.6.2. Each trailer shall have one spare tire (composed of the tire, wheel, and carrier) of the same size and type furnished with the trailer. The spare shall secure to the trailer.

3.15.18.7.2 Drum Balancing

Drums shall balance.

3.15.18.7.3 Rear Wheel Splash and Stone Throw Protection

The rear wheels of the mobile system trailer shall have mud flaps at the rear. Splash and stone throw protection shall not be greater than 6 inches from the road surface when the mobile system trailer is loaded.

3.15.18.8 Brakes

3.15.18.8.1 Service Brakes

Service brakes shall provide for the mobile system trailer. Service brakes shall be of the full air type. The braking system shall be equipped with all components required for a complete air brake system. Gladhands shall conform to SAE J318. Air hose location shall comply with SAE J702. The braking system shall install in a manner which provides road clearance for travel over uneven terrain and protection against damage caused by objects striking components. No part of the braking system shall extend below the bottom of wheel rims.

3.15.18.8.2 Parking Brakes

Spring or air diaphragm mechanical lock type parking brakes shall provide on the mobile system trailer. The parking brake shall automatically apply upon disconnection of the emergency air line and under emergency braking conditions. The parking brakes shall remain in the applied condition with no additional application and despite depletion of all air pressure. Parking brakes shall hold the mobile system trailer, with rated payload, on a 20 percent grade despite the depletion of the compressed air supply.

3.15.18.9 Upper Fifth Wheel Plate

The upper fifth wheel plate shall be designed for coupling to a full oscillating and fore and aft rocking fifth wheel and shall support a fifth wheel 36 in. in diameter. The kingpin shall conform to SAE J700. The forward end of the upper fifth wheel plate or skid plate shall have a turned-up lip for ease of coupling.

3.15.18.10 Landing Gear and Leveling Jacks

The mobile system trailers shall supply with two independently operated, vertical lift, nonrotating landing legs. The landing legs shall be equipped with self-leveling skid pads. Supports for crank extension shafts and clips for holding cranks when folded shall provide if applicable. The landing gear shall withstand, without deformation, the combined static and dynamic forces due to proportion of gross weight sustained and the forces resulting from impact during coupling and uncoupling operations. When placed in travel position, the landing gear legs shall remain positively locked. The landing gear shall protect to preclude the entrance of foreign matter, which would impair its functioning or mechanical efficiency. The landing gear shall have a range of adjustments to vary the height of the upper 5th wheel plate, at centerline of kingpin, from 47 in to at least 1.321 m (52 in) from the ground. With the mobile system trailer coupled to a towing tractor the clearance under the fully retracted landing gear shall exceed the mobile system trailer ground clearance, but shall be in no case less than 30.5 cm (12 in). Two leveling jacks shall provide on the rear of the mobile system trailer and shall conform to the same requirements as the landing gear. As a minimum, the landing gear and leveling jacks shall provide leveling of the mobile system trailer when on a slope of up to 5.0 degrees over the short dimension of the mobile system trailer and 2.0 degree over the long dimension of the mobile system trailer.

3.15.18.11 Level Indicators

Four level indicators shall provide and shall mount on the exterior walls of the mobile system trailer. One shall be located on each side in a readable location and all four shall protect from accidental damage. The level indicators shall permit readout of front-to-rear and side-to-side tilt within +/- 5 degrees.

3.15.18.12 Lifting and Tie-Down Attachments

When set up at a mobile system trailer site, the tie down attachments shall prevent the fully loaded mobile system trailer from tipping and falling over due to wind speeds up to and including 202 Km/hr (125 mph). Tie-down attachments shall base on the methods detailed in MIL-HDBK-1002/2. Tie-downs shall include the attachment points on each mobile system trailer and the cables, straps, or other means of tying down each mobile system trailer. Tie-down attachments shall label. A minimum of two curbside and two roadside tie-downs per trailer shall provide. Maximum Shipping Weight (MSW) shall define as the Gross Vehicle Weight (GVW) of the mobile system trailer.

3.15.18.13 Rear End Protection

Rear end protection (bumper) shall furnish on the mobile system trailer in accordance with 49 CFR 393.

3.15.18.14 Lubrication

Lubrication means shall provide on the mobile system trailer for all parts of the equipment normally requiring lubrication. The lubricating points shall be easily visible and accessible. Where high lubrication pressure shall damage grease seals and other parts, fittings with a pressure release mechanism shall utilize.

3.15.18.15 Body Construction

Trailer body construction shall meet requirements as specified herein.

3.15.18.15.1 Platform

The platform shall withstand the load of all equipment and personnel to be located within, but in no case shall the platform capacity be less than the rated payload capacity described in Sec. 3.15.17.2 'Rated Payload Capacity'.

3.15.18.15.2 Side Wall and Roof Framing

Outside side wall frame members shall be full length and support the roof loads described in the next section 3.15.18.15.3 'Roof'.

3.15.18.15.3 Roof

The roof shall withstand, without permanent deformation and degradation, the following:

a. A load of at least 115 Kg (253.5 lbs) concentrated in an area of one square foot at any location on the roof.
b. A snow load of at least 2 KPa (42 lbs/ft^2) distributed over the entire roof.

A drip molding, rain gutter, or tarp shall provide over the doors.

3.15.18.15.4 Front End

The front end shall have beveled or rounded corners which sacrifice a minimum of the interior's volume. The front end shall conform to the swing radius requirement of 133.350 cm (52.5 in) maximum and shall be in accordance with DOT bulkhead requirements.

3.15.18.15.5 External doors

Door gaskets shall install with corners tightly fitted to provide a complete seal. Doors shall permit folding back against the body sides and shall provide with a means for holding each door in the fully open position. A method for securely latching the doors in the fully closed position shall provide. A lock and key shall provide for each door. One key shall open all mobile system trailer body door locks. Doors for personnel ingress and egress shall be operable by personnel wearing arctic gloves. Doors shall have dimensions in accordance with Sec. 'Transportability'. Personnel doors shall open from the inside when padlocked on the outside.

3.15.18.15.6 Rear doors

If rear doors provided, they shall not use as personnel entrance or exit.

3.15.18.15.7 Other external doors

Other exterior doors shall provide as follows:

a. One or more emergency exit(s) shall provide for safety purposes and shall provide access to and egress from the working spaces of the mobile system trailer. Each

emergency exit shall be in accordance with best commercial standards. Location of the emergency exit(s) shall dictate by the interior layout of the mobile system trailer. Marking and lighting or illumination of the emergency exit(s) shall provide and shall conform to 49 CFR 393.

b) An external door or access panel in the ECS section of the mobile system trailer shall provide which shall meet ECS and generator/fuel system installation and maintenance access requirements.
c) Additional external doors shall install as mobile system trailer layout and maintenance access dictates.

3.15.18.15.8 Thermal protection

The mobile system trailer body shall insulate so that the body insulating efficiency shall not reduce through the wall, door, floor, and roof sections. The insulation shall properly vent to prevent the formation of ice and water between the walls. The average heat-loss per square foot per degree Fahrenheit of the mobile system trailer shall not exceed 0.3 BTU per hour.

3.15.18.16 Interior Construction

The interior construction shall be such that the interior acoustical noise shall not cause personnel injury, interfere with voice or any other communications, cause fatigue, or in any other way degrade overall system effectiveness.

3.15.18.17 Walls and Partitions

The interior walls and partitions shall securely fasten in place. They shall provide acoustical damping and shall be able to withstand impact from personnel using the equipment.

3.15.18.18 Ceiling

The ceiling material shall provide acoustical damping. A false ceiling shall provide with spacing for ECS ducts, lighting installations, and access for air flow and temperature sensor maintenance.

3.15.18.19 Floors

The interior floor shall provide a safe walking surface free of hazards (such as cables). The floor shall withstand a concentrated load of 300 lbs/ft^2.

3.15.18.20 Interior Doors

Interior doors shall provide sound isolation. Doors for personnel access shall be at least 1.93m (76 in) high and 760 mm (30 in) wide.

3.15.18.21 Lighting

3.15.18.21.1 Trailer Marker Lighting

All mobile system trailer marker lights and reflectors shall protect from damage by mounting in recessed or otherwise guarded locations. All electrical wiring shall conform to SAE J1292.

Clearance and identification lights shall construct for easy removal and replacement of lamps and lenses without the use of special tools.

3.15.18.21.2 Twelve-Volt Direct Current (VDC) System

A 12-volt direct current VDC lighting system shall provide to power mobile system trailer lights.

3.15.18.21.3 Receptacle, 12VDC

The front of the mobile system trailer shall be equipped with a 7 contact, 12VDC receptacle conforming to SAE J560 with the connectors connected, and color coded as specified therein. The receptacle shall provide with a self-closing cover. The receptacle shall be located in accordance with SAE J702.

3.15.18.21.4 Interconnected 24VDC System

Hardware to operate the 12VDC system from a towing vehicle equipped with a nominal 24VDC electrical system shall provide. The 12 contact receptacle described in Sec. 3.15.18.21.3 'Receptacle, 12VDC' shall be provided a voltage dropping circuit to reduce the voltage provided by the towing vehicle from a nominal 24VDC to within the maximum rated voltage of the mobile system trailer electrical components.

3.15.18.21.5 Receptacle, 24VDC

The front of the mobile system trailer shall be equipped with a 12 contact, 24VDC receptacle and cover conforming to MS75021, part number MS75021-1. The receptacle shall connect to the lights such that the normal 12V turn signal lights shall function both as turn signals and stop lights, and normal 12V stop lights shall not be operational when the mobile system trailer is connected to a towing vehicle with a 24V power supply. The receptacle shall be located in accordance with SAE J702.

3.15.18.21.6 Interior Lighting

All interior lighting shall be UL listed and conformed to NFPA 101.

3.15.18.21.6.1 Normal Lighting

Recessed light fixtures shall supply to provide lighting levels for all personnel areas. Illumination levels shall distribute to reduce glare and specular reflection in accordance with OSHA lighting standards. Capability for dimming shall provide.

3.15.18.21.6.2 Emergency Lighting

Emergency lighting shall provide for all personnel areas. The lighting units shall comply with NFPA 101, and shall be UL listed. The battery power supply furnished shall be 12 volt. A switch shall provide to disable the lamps during storage and transit.

3.15.18.21.7 Exterior Lighting

Exterior lighting shall supply to provide lighting for the set up and dismantling of the mobile system trailer configuration. The exterior lighting units shall supply with a 12 volt battery power

supply. The exterior lighting units shall utilize the 12 volt battery power supply. A switch shall provide to disable the lights during storage and transit. Portable lights shall provide for personnel performing visual tasks in areas where fixed illumination does not provide.

3.15.18.22 Battery Charging System

A battery charging system, which operates from the 120 volt, 60 Hz, electrical system shall provide to provide the following:

a. The battery backup and charging system shall provide backup power for the following systems: Illumination system (emergency exit lights) (ten minute backup)

d) Emergency light system (Exit signs) (one hour backup)
e) Intrusion detection (Security) system (24 hours backup)
f) Fire detection system (24 hours backup)

3.15.18.23 External Platforms, Railings and Stairways

External platforms, railings, and stairways shall provide for access to and egress from the mobile system trailer doors which serve as entrance and exit doors. All external platforms, railings, and stairways shall be capable of being rigidly attach and secure to the mobile system trailer. The weight of the individual parts shall not exceed the maximum limit for a two person carry. A two person team shall be capable of the assembly, disassembly, movement, and storage of the platforms, railings, and stairways. A platform shall provide at the top of each stairway to permit opening of the doors from the outside. The platforms and stairways shall have a type of tread to permit drainage. The upper surface of each tread shall have a non-skid pattern. The platforms and stairways shall have independently operating adjustable legs to provide a means of height adjustment to compensate for uneven terrain. Step surfaces shall remain level and horizontal. Collapsible railings shall provide on both sides of each stairway and around each platform. Provisions shall make for the secure stowage of platforms, railings, and stairways while in transit. Stowage shall be outside of the training/simulator compartment of the trailer. All stairs and railings shall be in accordance with OSHA standards.

3.15.18.24 Fire Extinguishers

Fire extinguishers shall furnish in accordance with Sec. ‘Personnel Safety’ and shall provide with brackets to secure the fire extinguishers during both transit and site use.

3.15.18.25 Fire Detection System

A fire detection system shall provide which shall detect the onset of a possible emergency. The system shall meet the NFPA 101 for the design of the fire detection system and shall meet NFPA 70 and NFPA 72 for the installation, test, and maintenance of the system. Components used in the fire detection System shall be UL approved.

3.15.18.26 Provisions For Storage of Support Equipment and Materials

Storage areas for dashes, vehicle kits, and spares shall provide for the following:

a. Contractor maintenance level spare parts required to support mobile system trailer operations
b. Operations and maintenance manuals and other technical documentation (including drawings) required to support the system and identified on the Government-approved custody and inventory record
c. Carry-on units, cables, magnetic tapes and discs, printer paper, hard copy device paper, and all other non-mounted trainer equipment
d. Undercarriage storage shall provide and utilize for stowage of stairways, platforms, railing, and cables. Undercarriage storage compartments shall be watertight and doors shall provide with provisions for latching them in both the fully open and closed positions. Each door shall provide with a lock and key. One key shall open all undercarriage door locks. Access to the undercarriage storage compartments shall be from the exterior of the mobile system trailer only.

3.15.18.27 Usable Life of Trailer

The mobile system trailer shall have a usable life of 15 years with only routine maintenance and refurbishment accomplished during the 15 years period.

3.15.19 Storage

The mobile system trailer shall provide a storage area for spare parts and kits. At a minimum, the Parts and Kits Storage Area shall consist of two racks for storing parts or kits.

3.15.20 Auxiliary Mounting Fixture

When installation is required in a facility where standard anchoring to the concrete floor is not possible, an auxiliary mounting fixture shall provide. The auxiliary mounting fixture shall have provisions to provide a level mounting platform for the motion system with a minimum of two inches of height variation adjustment for the floor contacts. The auxiliary mounting fixture shall only make contact with the floor without drilling, anchoring, or physical modification to the floor. The auxiliary mounting fixture shall increase the overall height to the standard CDT operational motion envelope no more than 12 inches. When mounted to the auxiliary mounting fixture there shall be no tipping or rocking when operating the CDT in full motion mode. Lateral Movement shall not exceed two inches in any direction during 40 hours when operating the CDT in full motion.

3.16 Scenario Generation System (SGS)

The CDT SGS shall be used to support the development and sustainment of scenarios used on CDT training devices to train individual drivers in driver specific tasks and vehicle crews in crew coordination tasks.

Scenarios developed using the CDT SGS shall use on a wide variety of CDT training devices including: full-fidelity, virtual environment trainers in permanent classroom, relocatable and mobile system trailer configurations; deployable and table-top trainers; and vehicle appended/embedded training systems. The scenarios shall assist in the training of military vehicle drivers during initial entry training (IET), new equipment familiarization training, pre-

deployment training, post-deployment training, and home station sustainment training. The scenarios shall enable training in the critical driver and crew coordination tasks that can repetitively train in a simulator, and trained in the "real world" (i.e. driving on ice, fording streams, driving under blackout conditions, driving down steep embankments when coming off an improved road, convoy driving, and driving in tactical and high threat environments).

3.16.1 User Roles

The CDT scenario generation system shall utilize the user's system level username to determine the user's CDT scenario generation system user role and associated privileges.

The CDT scenario generation system shall include the following user roles and associated capabilities:

3.16.1.1 Scenario Author

The CDT SGS shall only grant scenario author level privileges to a user who has assigned to a scenario author role by a CDT system administrator. The CDT SGS shall allow a scenario author to create new scenarios. The CDT SGS shall allow a scenario author to retrieve (i.e. open) existing scenarios from the computer hard drive and/or external media in accordance with DODI 8500.01 Cybersecurity guidance. The CDT SGS shall allow a scenario author to modify scenarios. The CDT SGS shall allow a scenario author to store (i.e. save) scenarios on the computer hard drive and/or external media including CDs or DVDs. The CDT SGS shall allow a scenario author to copy scenarios from the computer hard drive to external media including CDs or DVDs or from external media to the computer hard drive.

3.16.1.2 Scenario Manager

The CDT scenario generation system shall only grant Scenario Manager level privileges to a user who has assigned to a Scenario Manager role by a CDT System Administrator.

3.16.1.3 CDT System Administrator

The CDT SGS shall allow a CDT System Administrator to assign scenario author and scenario manager roles to authorized CDT SGS users.

The CDT SGS shall be able to assign users with specific roles.

3.16.1.4 User

The CDT SGS shall automatically assign any user who has not assigned to either a Scenario Author or Scenario Manager role to a generic User role.

The CDT scenario generation system shall prevent any User from editing, modifying, revising, altering, or deleting any CDT scenarios using the CDT scenario generation system.

The CDT scenario generation system shall only allow a User to review scenarios using the CDT scenario generation system.

3.16.2 SGS Requirements

The CDT SGS shall allow a scenario author to use the all original CDT moving and static models to include Ultra High Resolution Buildings (UHRB) models.

The CDT SGS shall allow a scenario author to create scenarios for single own vehicles as well as multiple own vehicles from any of the IOS and/or CDS.

The CDT SGS shall provide the following:

a. Show dynamic terrain changes occurring during real-time reflected in 2D and three dimension (3D) views
b. Allow the user to digitize linear 'strings' (immobile and movable objects) that are automatically placed into the scene end-to-end with the correct orientation. A minimum of 256 objects can be inserted in a single operation
c. A capability to create minefields by digitizing close polygons using the 2D map
d. Ability to create scoring areas (boxes/rectangles) by digitizing polygons using the 2D map
e. Selection of default scoring for the scenario edited or designed.
f. Scoring areas shall be tagged with a unique ID that shall reference CDT scoring algorithms
g. Enhanced capability for scripted events to trigger events on other objects allowing complex 'composite' behaviors to be created
h. Capability to add/edit a text field for any 'non-verbal' cue that exist in the scenario
i. Capability to turn the display of environment (weather, time of day and wind) on, off and through varying patterns (i.e. 0 to 100%)
j. Capability to associate aural cues with own vehicle waypoints, rather than just absolute map grid coordinates
k. Capability to visually display the locations of the aural cues on the 2D map

The CDT SGS shall be capable of opening, editing and saving existing CDT scenarios in the original CDT scenario format. Scenario files generated using the CDT scenario generation system shall be backwards compatible with the existing CDT Class Manager and runtime software. The CDT scenario generation system shall be capable of opening, modifying and saving existing CDT scenarios to make them compatible with any new CDT scenario format changes from any IOS or CDS station. The provided SGS GFI is for references only and there's no mandate to use/reuse, as long as all CDT VPL requirements are satisfied.

The CDT SGS shall prompt the user for verification before overwriting any existing file including but not limited to scenario files, scenario description files, database files, and model files. The CDT SGS shall include an undo capability.

The CDT SGS shall allow an operator/trainer to add new vehicle, human and entity models to existing libraries.

The CDT SGS shall have an option to run a real time capability concurrently with the simulation, allowing live scenario monitoring and editing. For example, IOS operator shall have the

capability to add objects and/or vehicles during the execution of the scenario. During a scenario for both scripted and free play, an IOS operator shall have the capability to at a minimum perform the following functions:

a. Insert, remove, or change the position/orientation of moveable objects on-the-fly during scenario runtime/execution.
b. Optionally save scenario changes that made during real-time execution.
c. Copy and paste functions for groups of entities/objects at one time, rather than just single objects.

The CDT SGS shall have the capability to generate scripted and unscripted scenarios utilizing any training environment (visual data base and ancillary data) installed on the CDT. The CDT shall have the capacity to store scripted training scenarios as stated for each specific variant. Storage space for scenarios shall not exceed 20% of the CDS storage.

3.16.2.1 File Management

The CDT SGS shall allow the scenario author to edit the default save path or default filename prior to saving the scenario.

The CDT SGS shall display the default working file save path and a default filename whenever a scenario manager selects the 'File – Save' or 'File - Save As' option.

The CDT SGS shall allow the scenario author or scenario manager to edit scenarios from any IOS or CDS station and the default save path or default filename prior to saving the scenario.

3.16.2.2 Sounds / Aural Cues

The CDT SGS shall allow an operator/trainer to add new sound/aural cues files to existing sound libraries.

The CDT shall utilize the aural cues and sounds subsystem of the CDT to produce realistic or authentic aural cues in response to vehicle operation (e.g. movement, malfunctions and gun fire), interaction with the physical (e.g. terrain interaction) and tactical environment (e.g. weapons effects).

The aural cues produced by the CDT shall occur simultaneously with the condition causing the sound. The following operating or environmental conditions listed in priority order shall produce appropriate aural responses to the driver trainee as listed in Table 2. The table spreads across the following pages with known sound reference by row and variant application by column.

Reference	Aural Cue / Sounds	TV-M1A2-SEPv3	TV-M1A2-SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
1	iDID/DCDP voice (M1A2 SEP V2/V3) – Audible voice announcing warnings over the intercom system	x	x			
2	Own vehicle hit by RPG.	x	x	x	x	x
3	Own vehicle hit by small arms fire	x	x	x	x	x
4	Own vehicle hit by an IED	x	x	x	x	x
5	Own vehicle triggering a mine	x	x	x	x	x
6	Collision when the vehicle collides with an object. Aural cue shall be representative of the collision object.	x	x	x	x	x
7	Collision when own vehicle collides with another vehicle in the database. Aural cue shall be representative of the collision object.	x	x	x	x	x
8	Main Gun Firing, the breech opening and the brass cartridge hitting the turret floor	x	x	x	x	x
9	Nearby Explosion Cue is active only when friendly and/or enemy fire enables and produces the sound of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle.	x	x	x	x	x
10	Soft/Glancing Collision	x	x	x	x	x
11	Fire Extinguisher Shot discharge – Simulates the sound of high pressure gas escaping through a valve	x	x	x	x	x
12	Throwing a track – A series of pops to simulate the road wheels riding up on the track center guides	x	x	x	x	x
13	Thrown track – A loud grinding metal noise with a three second duration	x	x	x	x	x
14	Turning (variable speeds)	x	x	x	x	x

Reference	Aural Cue / Sounds	TV-M1A2-SEPv3	TV-M1A2-SEPv2	TV-M1A1	TEV-JAB	TEV-ABV
15	Track clatter sounds shall be active as long as the vehicle is moving. Track clatter sound shall vary appropriately with the speed of the vehicle.	x	x	x	x	x
16	Parking Brake Engagement and Release – Parking brake engagement shall simulate the ratcheting sound of setting the parking brake. Parking brake release shall simulate the sharp metallic sound of releasing the parking brake.	x	x	x	x	x
17	Engine Shutdown – Simulates the spinning down of the turbine engine.	x	x	x	x	x
18	Engine Startup – Simulates the starter motor whine and the spin up of the turbine engine.	x	x	x	x	x
19	Engine Startup Abort	x	x	x	x	x
20	Starter Motor activation	x	x	x	x	x
21	Engine running. Varies appropriately with engine RPM (including gear changes).	x	x	x	x	x
22	Personnel Heater Fan	x	x	x	x	x
23	Engine running in protective mode	x	x	x	x	x
24	Bilge Pump	x	x	x	x	x
25	Gas Particulate Filter Fan	x	x	x	x	x
26	Overpressure system	x	x	x	x	x
27	Mine Roller rolling on ground	x	x	x		
28	Mine Roller disconnect	x	x	x		
29	Mine Clearing Blade	x	x	x		
30	Electric motor whine (Mine clearing blade raise/lower)	x	x	x		
31	M2 .50 cal machine gun firing	x	x	x		
32	M240 7.62 mm machine gun firing	x	x	x		
33	Smoke grenade firing	x	x	x		

34	Mine detonation (on contact with FEE blade)					x
Reference	**Aural Cue / Sounds**	**TV-M1A2-SEPv3**	**TV-M1A2-SEPv2**	**TV-M1A1**	**TEV-JAB**	**TEV-ABV**
35	Linear Demolition Charge System (LDCS) raise					x
36	LDCS rocket launch					x
37	LDCS detonation					x
38	LDCS lowering					x
39	FEE raise/lower					x
40	Scissor Bridge deployment/recovery				x	
41	ABV collision with obstacles/barricades					x
42	JAB HPU operation				x	
43	Load handling or palletized loading system operation					
44	Towed trailer sounds if appropriate (brake chatter, tire hop and air expulsion)					
45	Braking sounds (air brakes)					

Table 2– Sounds /Aural Cues

Reference	Aural Cue / Sounds	TWV	M1083A1	M1120A4 HEMTT	M915A3	M915A5
1	iDID/DCDP voice (M1A2 SEP V2/V3) – Audible voice announcing warnings over the intercom system					
2	Own vehicle hit by RPG.	x	x	x	x	x
3	Own vehicle hit by small arms fire	x	x	x	x	x
4	Own vehicle hit by an IED	x	x	x	x	x
5	Own vehicle triggering a mine	x	x	x	x	x
6	Collision when the vehicle collides with an object. Aural cue shall be representative of the collision object.	x	x	x	x	x
7	Collision when own vehicle collides with another vehicle in the database. Aural cue shall be representative of the collision object.	x	x	x	x	x
8	Main Gun Firing, the breech opening and the brass cartridge hitting the turret floor.					
9	Nearby Explosion. Cue is active only when friendly and/or enemy fire enables and produces the sound of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle.	x	x	x	x	x
10	Soft/Glancing Collision	x	x	x	x	x

11	Fire Extinguisher Shot discharge – Simulates the sound of high pressure gas escaping through a valve					
12	Throwing a track – A series of pops to simulate the road wheels riding up on the track center guides					
Reference	**Aural Cue / Sounds**	**TWV**	**M1083A1**	**M1120A4 HEMTT**	**M915A3**	**M915A5**
13	Thrown track – A loud grinding metal noise with a three second duration					
14	Turning (variable speeds)					
15	Track clatter sounds shall be active as long as the vehicle is moving. Track clatter sound shall vary appropriately with the speed of the vehicle.					
16	Parking Brake Engagement and Release – Parking brake engagement shall simulate the ratcheting sound of setting the parking brake. Parking brake release shall simulate the sharp metallic sound of releasing the parking brake.					
17	Engine Shutdown – Simulates the spinning down of the turbine engine.					
18	Engine Startup – Simulates the starter motor whine and the spin up of the turbine engine.	x	x	x	x	x

19	Engine Startup Abort					
20	Starter Motor activation					
21	Engine running. Varies appropriately with engine RPM (including gear changes).	x	x	x	x	x
22	Personnel Heater Fan					
23	Engine running in protective mode					
24	Bilge Pump					
25	Gas Particulate Filter Fan					
26	Overpressure system					
27	Mine Roller rolling on ground					
28	Mine Roller disconnect					
29	Mine Clearing Blade					
Reference	**Aural Cue / Sounds**	**TWV**	**M1083A1**	**M1120A4 HEMTT**	**M915A3**	**M915A5**
30	Electric motor whine (Mine clearing blade raise/lower)					
31	M2 .50 cal machine gun firing					
32	M240 7.62 mm machine gun firing					
33	Smoke grenade firing					
34	Mine detonation (on contact with FEE blade)					
35	LDCS raise					
36	LDCS rocket launch					
37	LDCS detonation					
38	LDCS lowering					
39	FEE raise/lower					
40	Scissor Bridge deployment/recovery					
41	ABV collision with obstacles/barricades					
42	JAB HPU operation					
43	Load handling or palletized loading system operation	x	x	x	x	x

44	Towed trailer sounds if appropriate (brake chatter, tire hop and air expulsion)	x	x	x	x	x
45	Braking sounds (air brakes)	x	x	x	x	x

Table 2– Sounds /Aural Cues - (continued)

Reference	Aural Cue / Sounds	HMMWV	7-Ton Truck	Buffalo	MRAP	M-ATV
1	iDID/DCDP voice (M1A2 SEP V2/V3) – Audible voice announcing warnings over the intercom system					
2	Own vehicle hit by RPG.	x	x	x	x	x
3	Own vehicle hit by small arms fire	x	x	x	x	x
4	Own vehicle hit by an IED	x	x	x	x	x
5	Own vehicle triggering a mine	x	x	x	x	x
6	Collision when the vehicle collides with an object. Aural cue shall be representative of the collision object.	x	x	x	x	x
7	Collision when own vehicle collides with another vehicle in the database. Aural cue shall be representative of the collision object.	x	x	x	x	x
8	Main Gun Firing, the breech opening and the brass cartridge hitting the turret floor.					
9	Nearby Explosion. Cue is active only when friendly and/or enemy fire enables and produces the sound of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle.	x	x	x	x	x
10	Soft/Glancing Collision	x	x	x	x	x

11	Fire Extinguisher Shot discharge – Simulates the sound of high pressure gas escaping through a valve					
Reference	**Aural Cue / Sounds**	**HMMWV**	**7-Ton Truck**	**Buffalo**	**MRAP**	**M-ATV**
12	Throwing a track – A series of pops to simulate the road wheels riding up on the track center guides					
13	Thrown track – A loud grinding metal noise with a three second duration					
14	Turning (variable speeds)					
15	Track clatter sounds shall be active as long as the vehicle is moving. Track clatter sound shall vary appropriately with the speed of the vehicle.					
16	Parking Brake Engagement and Release – Parking brake engagement shall simulate the ratcheting sound of setting the parking brake. Parking brake release shall simulate the sharp metallic sound of releasing the parking brake.					
17	Engine Shutdown – Simulates the spinning down of the turbine engine.					
18	Engine Startup – Simulates the starter motor whine and the spin up of the turbine engine.	x	x	x	x	x

19	Engine Startup Abort					
20	Starter Motor activation					
21	Engine running. Varies appropriately with engine RPM (including gear changes).	x	x	x	x	x
22	Personnel Heater Fan					
23	Engine running in protective mode					
Reference	**Aural Cue / Sounds**	**HMMWV**	**7-Ton Truck**	**Buffalo**	**MRAP**	**M-ATV**
24	Bilge Pump					
25	Gas Particulate Filter Fan					
26	Overpressure system					
27	Mine Roller rolling on ground					
28	Mine Roller disconnect					
29	Mine Clearing Blade					
30	Electric motor whine (Mine clearing blade raise/lower)					
31	M2 .50 cal machine gun firing					
32	M240 7.62 mm machine gun firing					
33	Smoke grenade firing					
34	Mine detonation (on contact with FEE blade)					
35	LDCS raise					
36	LDCS rocket launch					
37	LDCS detonation					
38	LDCS lowering					
39	FEE raise/lower					
40	Scissor Bridge deployment/recovery					
41	ABV collision with obstacles/barricades					
42	JAB HPU operation					
43	Load handling or palletized loading system operation	x	x	x	x	x

44	Towed trailer sounds if appropriate (brake chatter, tire hop and air expulsion)	x	x	x	x	x
45	Braking sounds (air brakes)	x	x	x	x	x

Table 2– Sounds /Aural Cues - (continued)

Reference	Aural Cue / Sounds	LVSR	JLTV	HIMARS	SV - STRYKER
1	iDID/DCDP voice (M1A2 SEP V2/V3) – Audible voice announcing warnings over the intercom system				
2	Own vehicle hit by RPG.	x	x	x	x
3	Own vehicle hit by small arms fire	x	x	x	x
4	Own vehicle hit by an IED	x	x	x	x
5	Own vehicle triggering a mine	x	x	x	x
6	Collision when the vehicle collides with an object. Aural cue shall be representative of the collision object.	x	x	x	x
7	Collision when own vehicle collides with another vehicle in the database. Aural cue shall be representative of the collision object.	x	x	x	x
8	Main Gun Firing, the breech opening and the brass cartridge hitting the turret floor				
9	Nearby Explosion. Cue is active only when friendly and/or enemy fire enables and produces the sound of an explosion when a simulated round impacts or IED detonates within 200 meters or closer to the vehicle.	x	x	x	x
10	Soft/Glancing Collision	x	x	x	x
11	Fire Extinguisher Shot discharge – Simulates the sound of high pressure gas escaping through a valve				
12	Throwing a track – A series of pops to simulate the road wheels riding up on the track center guides				

13	Thrown track – A loud grinding metal noise with a three second duration				
14	Turning (variable speeds)				
Reference	**Aural Cue / Sounds**	**LVSR**	**JLTV**	**HIMARS**	**SV - STRYKER**
15	Track clatter sounds shall be active as long as the vehicle is moving. Track clatter sound shall vary appropriately with the speed of the vehicle.				
16	Parking Brake Engagement and Release – Parking brake engagement shall simulate the ratcheting sound of setting the parking brake. Parking brake release shall simulate the sharp metallic sound of releasing the parking brake.				
17	Engine Shutdown – Simulates the spinning down of the turbine engine.				
18	Engine Startup – Simulates the starter motor whine and the spin up of the turbine engine.	x	x	x	x
19	Engine Startup Abort				
20	Starter Motor activation				
21	Engine running. Varies appropriately with engine RPM (including gear changes).	x	x	x	x
22	Personnel Heater Fan				
23	Engine running in protective mode				
24	Bilge Pump				
25	Gas Particulate Filter Fan				
26	Overpressure system				
27	Mine Roller rolling on ground				
28	Mine Roller disconnect				
29	Mine Clearing Blade				

30	Electric motor whine (Mine clearing blade raise/lower)				
31	M2 .50 cal machine gun firing				
32	M240 7.62 mm machine gun firing				
33	Smoke grenade firing				
34	Mine detonation (on contact with FEE blade)				
Reference	**Aural Cue / Sounds**	**LVSR**	**JLTV**	**HIMARS**	**SV - STRYKER**
35	LDCS raise				
36	LDCS rocket launch				
37	LDCS detonation				
38	LDCS lowering				
39	FEE raise/lower				
40	Scissor Bridge deployment/recovery				
41	ABV collision with obstacles/barricades				
42	JAB HPU operation				
43	Load handling or palletized loading system operation	x	x	x	
44	Towed trailer sounds if appropriate (brake chatter, tire hop and air expulsion)	x	x	x	
45	Braking sounds (air brakes)	x	x	x	x

Table 2– Sounds /Aural Cues - (continued)

3.16.2.3 Terrain Databases

The CDT SGS shall allow a scenario author to create scenarios on any terrain database.

3.16.2.4 Scenario Data Requirements

The CDT SGS shall allow a scenario author to create a scenario description for each scenario.
The CDT SGS shall automatically create or update a scenario file for each scenario whenever a scenario author or scenario manager saves the scenario.

3.16.2.4.1 Scenario Description

The CDT SGS shall allow the scenario author to create, save, and modify a scenario description for a scenario.

3.16.2.4.2 Scenario File (SF)

The SF shall be a human-readable text file in English. The SF shall include a header section containing Scenario Identification Parameters. The SF shall include a section containing Physical Environment Parameters. The SF shall include a section containing Operational Environment Parameters. The SF shall include a section containing Entity/Object Parameters. The SF shall include a section containing Special Condition Parameters. The SF shall include Scripted Paths, Waypoints, and Scripted Events.

3.16.2.4.3 Scenario Identification Parameters

The CDT SGS shall allow the scenario author to enter a scenario number for each scenario. It shall check if existing number and report overwrite or change. The CDT SGS shall store the user's username in a scenario author field whenever a scenario saves by a scenario author. The CDT SGS shall store the user's username in a scenario manager field whenever a scenario saves by the scenario manager. The CDT SGS shall store the current system date in the 'Data Saved' field whenever a scenario saves by a user.

3.16.2.4.4 Physical Environment Parameters

The CDT SGS shall allow the scenario author to select a terrain database for each scenario from a pull-down menu. The CDT SGS shall allow the scenario author to enter the 'Time of Day' for the scenario. The 'Time of Day' shall provide a smooth linear transition from full darkness at midnight to full daylight at noon and back to full darkness at midnight. The CDT SGS shall allow the scenario author to enter a 'Visibility' parameter (e.g. unlimited or restricted) and a percentage level for the scenario. The CDT SGS shall allow the scenario author to enter the 'Wind Velocity' and 'Wind Direction' for the scenario. The CDT SGS shall allow the scenario author to enter the type and intensity of any 'Environmental Conditions' (e.g. rain, snow, fog, dust, and clouds) for the scenario.

'Time of Day', 'Visibility', and 'Environmental Conditions' shall only affect the 2D and 3D viewing capabilities when the scenario author is previewing a scenario.

3.16.2.4.5 Operational Environment Parameters

None

3.16.2.4.6 Entity/Object Parameters

The CDT SGS shall support entity and object definition as part of a scenario. The CDT SGS shall allow the scenario author to place new entities and objects using either the 2D or 3D view of the database. The CDT SGS shall allow the scenario author to reposition or move entities and objects using either the 2D or 3D view of the database. The CDT SGS shall allow the scenario author to delete entities and objects using either the 2D or 3D view of the database. The CDT SGS shall allow the scenario author to select and initially position a new entity or object by performing only three actions or less. The CDT SGS shall allow the scenario author to create a new entity or object by copying and pasting any previously place entity or object to a new location within the database.

3.16.2.4.6.1 Own Vehicles

The CDT SGS shall allow the scenario author to select an own vehicle type for each own vehicle in the scenario from a pull-down menu listing all available CDT variants. The CDT SGS shall allow a scenario author to associate scripted events with own vehicles.

3.16.2.4.6.2 Civilian Vehicles

The CDT SGS shall allow the scenario author to set the overall civilian vehicle traffic density and aggressiveness for SAF controlled entities for the scenario. The CDT SGS shall allow the scenario author to select individual civilian vehicles from a pull-down menu and place them in the scenario. The CDT SGS shall allow a scenario author to create, modify, edit, and delete paths and waypoints for any individually scripted civilian vehicle. The CDT SGS shall allow a scenario author to associate scripted events with any individually scripted civilian vehicle.

3.16.2.4.6.3 Military Vehicles

The CDT SGS shall allow the scenario author to select individual friendly military vehicles from a pull-down menu and place them in the scenario. The CDT SGS shall allow a scenario author to create, modify, edit, and delete paths and waypoints for any individually scripted military vehicle. The CDT SGS shall allow a scenario author to associate scripted events with any individually scripted military vehicle.

3.16.2.4.6.4 Threat Vehicles

The CDT SGS shall allow the scenario author to select individual threat vehicles from a pull-down menu and place them in the scenario. Threat vehicles shall include enemy military vehicles, armed civilian vehicles, and vehicle-borne IEDs. The CDT SGS shall allow a scenario author to create, modify, edit, and delete paths and waypoints for any individually scripted threat vehicle. The CDT SGS shall allow a Scenario Author to associate scripted events with any individually scripted threat vehicle.

3.16.2.4.6.5 Humans

The CDT SGS shall allow the scenario author to select individual human models from a pull-down menu and place them in the scenario. The CDT SGS shall allow the scenario author to place humans at any realistic location within the terrain database. The CDT SGS shall allow a scenario author to create, modify, edit, and delete paths and waypoints for any individually scripted human. The CDT SGS shall allow a scenario author to associate scripted events with any individually scripted human.

The CDT SGS shall include a library of human models capable of performing the hand and arm actions of mounted and dismounted ground guides. The CDT SGS ground guide models shall include both day and night models. The CDT SGS shall allow a scenario author to select ground guide models from a pull-down menu and place them in a scenario. The CDT scenario generation system shall allow a scenario author to designate any waypoint along an own vehicle path to activate the ground guide behavior for the ground guide model.

3.16.2.4.6.6 Animals

The CDT SGS shall allow the scenario author to select animal models from a pull-down menu and place them at any realistic location within the terrain database in the scenario. The CDT SGS shall allow a scenario author to create, modify, edit, and delete paths and waypoints for any individually scripted animal. The CDT SGS shall allow a scenario author to associate scripted events with any individually scripted animal.

3.16.2.4.6.7 Objects

The CDT SGS shall allow the scenario author to select individual objects from a pull-down menu containing, at a minimum, the following types of objects and place them in the scenario:

a. Jersey Barriers
b. Shipping Containers
c. Stack of Tires
d. Stack of Burning Tires
e. Concertina Wire
f. Destroyed Vehicles (various types)
g. Own vehicle Fighting Positions
h. Bunkers
i. Undamaged/Damageable Bridges
j. Undamaged/Damageable Buildings
k. Undamaged/Damageable UHRBs
l. Chain-Link Fences
m. Rock Walls (36 inch height)
n. Pipelines
o. IEDs - various types including, but not limited to:
    1. Trash Bags
    2. Shipping Boxes
    3. Dead animals
    4. Undamaged/Damaged/Destroyed Vehicles
    5. Munition Cases
    6. Large Caliber Artillery Rounds
    7. Any Moving Model

The CDT SGS shall allow a scenario author to create a string or wall of one type of object by selecting the object, clicking, and holding down the left mouse button on a location on the terrain and dragging the mouse to another point on the terrain before releasing the button. The fence, wall, roll of concertina wire, row of jersey barriers or other string of objects shall follow the contours of the terrain on which it is placed.

The CDT SGS shall allow the scenario author to create a minefield by defining a closed freeform area. The CDT SGS shall allow the scenario author to set the mine density within the minefield. The CDT SGS shall allow the scenario author to place minefield markers around the perimeter of the minefield. The CDT SGS shall allow the scenario author to create static IEDs at any realistic location within the terrain database in the scenario.

3.16.2.4.7 Scripted Paths

The term "scripted entity" shall refer to any vehicle, human, animal or object capable of movement and individually scripted within the scenario. The CDT SGS shall allow the scenario author to select a starting point on the 2D map for each scripted entity included in the scenario. The CDT SGS shall allow the scenario author to plot scripted paths on the 2D map for each scripted entity included in the scenario. The CDT SGS shall allow the scenario author to select behavior(s) for an entity to perform.

3.16.2.4.8 Waypoints

The CDT SGS shall allow the scenario author to add, delete, reposition, and modify the characteristics of waypoints to define the path for each scripted entity. The CDT SGS shall allow the scenario author to add, delete, reposition, and modify the characteristics of waypoints using either the 2D or 3D view of the database. The CDT SGS shall allow the scenario author to select a 'Snap To Lane' option to facilitate creating paths within the database.

The CDT scenario generation system shall add waypoints which shall place along any path within a scenario. For scripted entities, waypoints shall use to set or alter the entity's speed. For scripted entities, waypoints shall use to set or alter the entity's direction. For scripted entities, the CDT SGS shall allow the scenario author to enter a pause or delay time in seconds at any waypoint along the entity's path.

3.16.2.4.9 Scripted Events

A scripted event shall be defined as the playing of visual and/or aural cues at specified times or places within a scenario. Scripted events shall include, but not be limited to:

a. Activation of a scripted or pre-recorded instructor brief aural cue at the start of a scenario
b. Activation of a scripted or pre-recorded aural cue directing the student to perform a specific action along a route (i.e. turn right onto the road)
c. Activation of a vehicle malfunction
d. Activation of a threat attack (i.e. ambush, enemy small arms fire, RPG attack, vehicle-borne IED attack or static IED explosion)
e. Activation of a mine
f. Activation or deactivation of a ground guide
g. Activation of a specific behavior or action by a scripted entity (i.e. child running into the road and a specific IED in a string of IEDs exploding)

The CDT SGS shall allow the scenario author to create scripted events as part of the scenario. The CDT SGS shall allow the scenario author to modify scripted events within a scenario. The CDT SGS shall allow the scenario author to view scripted events within a scenario. The CDT SGS shall allow the scenario author to delete scripted events from a scenario. The CDT SGS shall allow for the creation of at least 80 scripted events which shall place within a scenario. The CDT SGS shall allow the scenario author to associate a scripted event with any waypoint along any scripted entity's (own vehicle, civilian vehicle, military vehicle, threat vehicle, individually scripted human and individually scripted animal) path.

The CDT SGS shall allow the scenario author to create a 'Wait' (i.e. time delay in seconds from start of the scenario) constraint for a waypoint. The CDT SGS shall allow the scenario author to create a 'Time To Go' (i.e. time in seconds before the scripted entity reaches the waypoint) constraint for a waypoint. The CDT SGS shall allow the scenario author to create a 'Distance To Go' constraint for a waypoint.

3.16.3 Training Progression

Training progression shall be determined based on the scores obtained by the student in previous scenarios. At the completion of a scenario, if the student passes, the CDT shall provide the next recommended scenario based on the Program of Instruction (POI) for the student. The instructor shall be able to:

a. Select the next recommended scenario.

b. Run the previous scenario by selecting the scenario by number.

c. Select a different scenario by selecting the scenario by number.

d. Run same scenario by selecting re-run.

Selection of a scenario other than the CDT recommended scenario shall not affect the normal progression of the student. At the completion of a scenario selected by instructor, the student must go back to the next scenario in the POI to continue the normal progression.

3.16.4 Scoring Area

A scoring area is a pre-defined area useable in CDT scoring algorithms to determine:

a. if a vehicle has entered a scoring area (i.e. used to initiate a timer or determine if the own vehicle is in the proper location to perform a particular task)
b. left a scoring area (i.e. used to stop a timer or determine if the own vehicle has left a particular area unnecessarily, or incorrectly positioned a trailer)
c. or remained in a scoring area for a particular amount of time (i.e. exceeded a time standard for performing a particular task, deployment of an ABV Mine Clearing Line Charge (MCLC), or performing appropriate corrective actions for a malfunction within a certain time limit)

The CDT SGS shall allow the scenario author to create scoring areas by defining a closed free-form area. The CDT SGS shall allow the scenario author to associate a unique identifier with each scoring area. The CDT SGS shall allow the scenario author to set the default scoring for the scenario.

The CDT IOS shall provide automatic performance grading for pre-programmed scenarios. The student's performance shall compare and grade against predetermined criteria for student actions. The predetermined criteria for scoring the student actions shall display to the instructor. Each criteria step shall display to the instructor and indicate if the criteria step passed or failed. The system shall display data to the instructor to indicate why a criteria step failed. Scoring events shall present to the instructor on the IOS scoring page when they occur with a time tag during

both pre-programmed and scripted/unscripted scenarios. All scoring shall be available to use in all CDT databases. Scoring events shall use to adjust the trainee's numerical score and retained in the trainee's record only during pre-programmed scenarios. Scoring events during free play scenarios shall be for instructor information and after action review and shall not retain in the trainee's record. The general areas of scoring shall include, at a minimum, management of switches and controls, physical control of the vehicle, response to malfunctions, and actions required by the tasks such as:

a. Speeding violations: shall score based off of the scenario designed speed for the ownership(s). Point or scoring reductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. When enabled, point deductions shall occur when the trainee(s) exceeds greater than 6mph over the required speed. The required speed shall be able to change to deduct for speeding violations when the required speed changes during the scenario. Speeding deductions at a minimum shall grade speeds (in increments of 5 mph) from 5 to 65 mph. Speeding deductions shall be available while the ownship(s) is operating in any CDT database and on all terrain types regardless of the ownship(s) being on or off roads. Speeding violations shall modify, per vehicle variant, in the SGS tool.

b. Spacing/distance between vehicles violations: shall be scored based off of the scenario designed distances when the ownship(s) is following another vehicle in front (scripted or ownship). Point or scoring deductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. When the feature enables, improper spacing between vehicles in a convoy of +/- 50 meters shall result in point reductions. The required interval shall be able to change to deduct for interval violations when the required interval changes during the scenario. Interval deductions at a minimum shall grade intervals (in increments of 50 meters) from 50 to 300 meters. Interval deductions shall be available while the ownship(s) is operating in any CDT database and on all terrain types regardless of the ownship(s) being on or off roads. Spacing/distance between vehicles violations shall modify, per vehicle variant, in the SGS tool.

c. Stop signs violations: shall score accordingly when the ownship(s) fails to stop properly at a stop sign. Point or scoring deductions (for failure to stop) shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. During scenario set-up, scoring assessments shall be enabled/disabled at each placement of a stop sign location. Stop sign (fail to stop) deductions shall be available while the ownship(s) is operating in any CDT database where a stop sign is placed and or present. The SGS tool shall allow the instructor to insert "Stop Sign(s)" anywhere on the terrain during scenario generation. Stop signs violations shall modify, per vehicle variant, in the SGS tool.

d. Traffic lights violation: shall score when the ownship(s) fails to stop properly at a red light. Point or scoring deductions (or failed to stop) shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. During scenario design, scoring assessments shall enable/disable at each placement of a traffic light location. Stop light (fail to stop) deductions shall be available while the ownship(s) is operating in any CDT database where stop lights (traffic lights) are placed and or present. The SGS tool shall allow the instructor to insert "Traffic Light(s)" anywhere on the terrain during

scenario generation. Traffic lights violations shall modify, per vehicle variant, in the SGS tool.

e. Collisions violations: shall score accordingly when the ownship(s) collides into an object in the scenario. Point or scoring deductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. Deductions shall assess depending on the result of a minor or major collision. Minor collision deductions shall assess when the ownship(s) collides with fences, animals, and street signs. Major collision deductions shall assess when the ownship(s) collides with other vehicles, pedestrians, buildings/structures, light poles, trees, and containers. Collisions violations shall modify, per vehicle variant, in the SGS tool.

f. Lane position violations: shall score accordingly when the ownship(s) fails to maintain proper position on single and multi-lane improved roads. Point or scoring deductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. A lane position deduction shall assess when the ownship(s) fails to maintain position in a single or multi-lane road for over three seconds during the scenario. Lane position deductions shall be available while the ownship(s) is operating in any CDT database where improved single and multi-lane roads place or is present. Lane positions violations shall modify, per vehicle variant, in the SGS tool.

g. Vehicle turning violations: shall score accordingly when the ownship(s) execute a turn on single or multi-lane improved roads, or enters opposing traffic lanes. Scoring deductions shall assess if the ownship executes an improper turn, e.g. cuts the corner on an improved road. Point or scoring deductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. Turning deductions shall be available while the ownship(s) is operating in any CDT database where improved single and multi-lane roads place or is present. Vehicle turning violations shall modify, per vehicle variant, in the SGS tool.

h. Vehicle reacts to malfunction violations: shall score accordingly when the ownship(s) execute a malfunction series of actions. Scoring deductions shall assess if the ownship executes an improper steps, e.g. parking brake before moving to the right lane. Point or scoring deductions shall be enabled or disabled when designing scenarios (with SGS) or during set up free mode. Turning deductions shall be available while the ownship(s) is operating in any CDT database. Vehicle react to malfunction violations shall have pre-set default values with adjustable parameters.

i. Driver's compartment controls and functions: shall monitor continuously during scenario execution. A control or function error shall be produced in accordance with the following criteria:

   (1) MASTER POWER – An error shall assign when the MASTER POWER turns OFF while the engine is running
   (2) Gear Shift Selector – An error shall be assigned when the gear shift selection is changed between any two positions other than LOW (L) and DRIVE (D) while own vehicle is moving at greater than 0.5 MPH
   (3) PARKING BRAKE – An error shall be assigned when the parking brake is engaged while the own vehicle is moving at greater than three MPH

(4) Steering control – An error shall be assigned when the steering control is deflected beyond the dead band while the SHIFT CONTROL is in NEUTRAL (N)
(5) CREW FIRE HANDLE – An error shall assign when the CREW FIRE HANDLE pulls
(6) ENGINE FIRE HANDLE – An error shall be assigned when the ENGINE FIRE HANDLE is pulled without the engine fire indicator being illuminated (engine fire malfunction being activated)
(7) 2nd SHOT Switch – An error shall be assigned when the 2nd shot switch is activated without the 1st shot being activated either automatically or manually
(8) Hatch – An error shall be assigned if the driver's hatch is not in the locked position (either open or closed) when the own vehicle is moving
(9) STARTER ONLY ENGAGED – An error shall assign when the STARTER ONLY ENGAGED button is pressed for two continuous minutes
(10) BILGE PUMP – An error shall assign when the BILGE PUMP turns on for three continuous minutes
(11) Startup – An error shall assign when the MASTER POWER turns on and any of the following conditions are true:

(a) The TACTICAL IDLE switch is set to ON
(b) The SHIFT CONTROL Selector is not set to NEUTRAL (N)
(c) The PARKING BRAKE is not set

(12) Vehicle Startup – An error shall assign for vehicle startup if an attempt to start the engine and any of the following conditions are true:

(a) The LIGHTS are not turned OFF
(b) The Personal Heater and Fan are not turned OFF
(c) The BILGE PUMP is ON
(d) The TACTICAL IDLE switch is set to ON
(e) The SHIFT CONTROL Selector is not set to NEUTRAL (N)
(f) The Steering Control in not centered
(g) The PARKING BRAKE is not set

(13) Vehicle Shutdown – An error shall assign if the VEHICLE MASTER POWER turns OFF and any of the following conditions are true:

(a) The DVE switch is ON
(b) The LIGHTS are not turned OFF
(c) The Personal Heater and Fan are not turned OFF
(d) The BILGE PUMP is ON
(e) The SMOKE GENERATOR is ON
(f) The TACTICAL IDLE switch is set to ON
(g) The SHIFT CONTROL Selector is not set to NEUTRAL (N)
(h) The PARKING BRAKE is not set

(14) Shutdown – An error shall assign if the engine shuts down and any of the following conditions are true:

(a) The BILGE PUMP is ON
(b) The SMOKE GENERATOR is ON
(c) The TACTICAL IDLE switch is set to ON
(d) The SHIFT CONTROL Selector is not set to NEUTRAL (N)
(e) The PARKING BRAKE is not set

(15) Rear View Sensor System – An error shall assign if the tank operates with any of the following conditions true:

(a) Vehicle operation with the RVSS debris shield "Open", the vehicle speed over 5 mph and operating on grass, plowed field, sand, dirt, mud, swamp, gravel or water. There shall be a deduction of one (1) point every 30 seconds the condition is true with a maximum deduction of five (5) points.
(b) Vehicle operation (vehicle movement) in reverse with the RVSS "Off" or the debris shield "Closed." There shall be a deduction of one (1) point every 30 seconds the condition is true with a maximum deduction of five (5) points.

j. Vehicle control: shall monitor continuously during scenario execution. A vehicle control error shall be produced in accordance with the following criteria:

(1) Skidding or Sliding:

(a) Due to turning – An error shall be assigned due to improper turning when the own vehicle slides across the terrain for at least one second and the rate of turn commanded from the steering/throttle control at the onset of the slide exceeds six degrees per second. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the track speed is greater than two MPH.
(b) Due to braking - An error shall assign due to improper braking when the own vehicle slides across the terrain for at least one second The rate of turn commanded from the steering/throttle control at the onset of the slide was six degrees per second or less and the service or parking brake applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the track speed is greater than two MPH.
(c) Due to acceleration - An error shall assign due to improper acceleration when the own vehicle slides across the terrain for at least one second. The rate of turn commanded from the steering/throttle control at the onset of the slide was six degrees per second or less, neither the service or parking brake was applied at the onset of the slide and the throttle was applied at the onset of the slide. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the track speed is greater than two MPH.

(d) Due to terrain – An error shall be assigned for skidding and/or sliding due to poor terrain selection when the own vehicle slides across the terrain for at least one second and the criteria for other causes for a slide or skid are not met. The own vehicle shall be considered to be skidding or sliding when the difference between the own vehicle speed and the track speed is greater than two MPH. Skid scoring shall inhibit while exiting the water during a water fording task and while any tank track is in contact with any sandy type terrain.

(2) Loss of Mobility:

(a) Due to a mired own vehicle – An error shall be assigned for loss of mobility due to a mired own vehicle when the terrain type on which the own vehicle is located indicates that it is impassable

(b) Due to bellied own vehicle – An error shall be assigned for loss of mobility due to a bellied own vehicle when a collision is detected on the underside of the own vehicle hull

(c) Due to a thrown track – An error shall be assigned for loss of mobility due to a thrown track when either of the own vehicles tracks are thrown

(3) Collisions:

(a) Hard Collisions – An error shall be assigned whenever a collision occurs with hard collision objects at speeds greater than three MPH

(b) Slow Speed Hard Collisions - An error shall be assigned whenever a collision occurs with hard collision objects at speeds less than or equal to three MPH

(c) Soft Collisions – An error shall be assigned whenever a collision occurs with soft collision objects at any speed

(4) Special Action Scoring – Special action scoring shall supersede conflicting normal training criteria and be applied only during the performance of the special training actions listed below:

(a) Ground Guide Control – An error shall be assigned whenever the following occurs during ground guide control:

1. Vehicle speed exceeds 5.0 mph
2. Failure to respond to ground guide commands within 10 seconds after the command is initially given
3. Turn left in response to a ground guide command to turn right for more than 6.5 seconds
4. Turn right in response to a ground guide command to turn left for more than 6.5 seconds
5. Acceleration in response to the ground guide command to stop for more than 6.5 seconds

6. Turning in response to ground guide command to stop for more than 6.5 seconds
7. Forward motion in response to ground guide command to move in reverse for more than 6.5 seconds
8. Rearward motion in response to the ground guide command to move forward for more than 6.5 seconds
9. Neutral steering when the neutral steer command has not been given for more than 6.5 seconds
10. Failure to neutral steer when the neutral steer command has been given for more than 6.5 seconds

(b) Water Fording – An error shall be assigned whenever any of the following occurs during a water fording maneuver:

1. SHIFT CONTROL not set to LOW (L) while in the water
2. TACTICAL IDLE switch set to OFF while in the water
3. DRAIN VALVE open while in the water
4. Throttle greater than 30% while entering the water
5. Vehicle speed exceeding 8 MPH while in the water
6. Failure to accelerate when exiting the water

(c) Convoy Driving:

1. Vehicle Speed – An error shall be assigned if the vehicle speed during convoy driving exceeds the maximum speed specified in the scenario description
2. Vehicle Interval (for the TV and TEV only) – An error shall be assigned if the distance between own vehicle and the vehicle immediately in front of own vehicle varies from the prescribed distance by +/- 25 meters or more. Vehicle interval scoring shall start 15 seconds from the initial start of the leading vehicle
3. Ideal path -
   a. Off-Road Ideal Path - An error shall be assigned if the own vehicle deviates more than +/- 15 meters in off road scenarios
   b. On-Road Ideal Path – An error shall be assigned if the own vehicle does not maintain the same lane as the leading vehicle. When the leading vehicle changes lanes, own vehicle shall change lanes within +/- 25 meters of the leading vehicle lane change location. Standard stay in lane, lane change and turning scoring criteria shall be applied otherwise

(d) Formation Driving:

1. Vehicle Speed – An error shall assign if the vehicle speed during convoy driving exceeds the maximum speed specified in the scenario description

2. Vehicle Interval – An error shall be assigned if the distance between own vehicle and the vehicle immediately in front of own vehicle varies from the prescribed distance by +/- 25 meters or more. Vehicle interval scoring shall start 15 seconds from the formation command
3. Ideal path - An error shall be assigned if the own vehicle deviates more than +/- 15 meters from the ideal path

(e) Ditch Crossing – An error shall assign whenever any of the following occurs during a ditch crossing maneuver:
1. SHIFT CONTROL not set to LOW (L) while over the ditch
2. Angle of approach when entering the ditch is less than 70 degrees
3. Throttle greater than 30% while entering the ditch
4. Vehicle speed exceeding 7 MPH while over the ditch
5. Failure to accelerate when exiting the ditch

(f) Wall/Log Traversing - An error shall assign whenever any of the following occurs when driving over a wall or log:
1. SHIFT CONTROL not set to LOW (L) while in contact with the wall or log
2. Angle of approach when contacting the wall or log is less than 70 degrees
3. Throttle greater than 30% when contact makes with the wall or log
4. Vehicle speed exceeding 7 MPH while in contact with the wall or log
5. Throttle greater than 30% when contacting the terrain on the other side of the wall or log

(g) Transport Loading – An error shall assign whenever any of the following occurs when executing a transport loading or unloading exercise:
1. Responses to ground guide as defined in Ground Guide Control above
2. Speed in excess of 5 MPH while under Ground Guide Control.
3. Movement outside of the prescribed vehicle boundaries (i.e., off the edge of the trailer, contacting the inside of an aircraft transport, etc.)

(h) Bridge Crossing - An error shall assign whenever any of the following occurs when executing a bridge crossing exercise:
1. Responses to ground guide as defined in Ground Guide Control above
2. Speed in excess of 5 MPH while under Ground Guide Control
3. Movement outside of the prescribed vehicle boundaries

The full performance/proficiency analysis shall be available to the instructor for electronic display and printout in hard copy form. At the end of a scenario and through an optional manual scoring GUI, the instructor shall have the capability to amend or override the automatic scoring and provide a free text written explanations for the changes. The instructor shall provide the option to store the student performance/proficiency analysis or discard it.

Since the automatic scoring completes within the Vehicle Specific Component (VSC), operation of the system in either integrated or networked mode shall have no effect on the automatic scoring functionality. However, an instructor, located at the IOS in integrated mode or at the IOS in networked mode, shall be able to monitor and manage the scoring for all Vehicle Specific Components connected to the IOS.

3.16.5 Driving Tutor

The Driving Tutor shall have two modes: instructional mode and correctional mode. The modes shall be selectable On/Off by the instructor either prior to the start of the scenario or during the scenario.

3.16.5.1 Instructional Mode

The Instructional Mode shall provide verbal driving instructions to the STS driver throughout the scenario. The instructor shall be able to select the time settings (e.g. 5 or 10 seconds, depending on the vehicle speed) for when the verbal driving instructions broadcast to the STS driver's headset throughout the scenario. The driving instructions shall provide guidance to the STS driver, but not limited to speed, turns, and hazards.

3.16.5.2 Correctional Mode

In Correctional Mode, the STS shall include a Scoring Assistant Subsystem (SAS). The SAS shall provide verbal cues to the driver whenever a scoring violation occurs; see Sec. Scoring Area (a-j) for complete list of violations. The instructor shall have the option to select which scoring violations SAS shall provide verbal notification for during scenario setup at the IOS Setup Window and an option to mute the verbal cues.

3.17 Visual System

See Appendix A for Visual System Requirements.

3.18 System Safety Design Checklist

See Appendix B for System Safety Design Checklist.

3.19 CDT Family of Vehicles Simulator Modules

3.19.1 TEV Family of Vehicles Simulator Modules

See Appendix C for unique requirements for the TEV.

3.19.2 TV Family of Vehicles Simulator Modules

See Appendix C for unique requirements for the TV.

3.19.3 TWV Family of Vehicles Simulator Modules

See Appendix D & E for unique requirements for the TWV.

3.19.4 SV Family of Vehicles Simulator Modules

See Appendix F for unique requirements for the SV.

3.19.5 MV Family of Vehicles Simulator Modules

See Appendix G for unique requirements for the MV.

3.19.6 JLTV Family of Vehicles Simulator Modules

TBD.

4. VERIFICATION

4.1 Methods of Verification

The following methods will utilize to accomplish the verification of requirements:

1) Analysis
2) Demonstrations
3) Examinations
4) Tests

4.2 Classes of Verifications

The trainer will be subject to the verification classes listed below. Under each verification class, the trainer will be subject to inspections and tests as shown in the Requirement/Verification Cross-Reference Matrix. The inspections and tests specify below.

A. Qualification Testing Dry Run
B. Contractor Testing
C. Formal Qualification Test
D. Test During Installation
E. N/A

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.1			X		X		X	X	X		
3.1.1			X		X		X	X	X		
3.1.2			X		X		X	X	X		
3.1.3			X		X		X	X	X		
3.1.3.1			X		X		X	X	X		
3.1.3.2				X		X					
3.1.3.2.1				X		X					
3.1.3.2.2				X		X					
3.1.3.2.3				X		X					
3.1.3.2.4				X		X					

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.1.3.3			X	X	X	X			X		
3.1.3.4			X	X	X	X			X		
3.1.3.5				X		X		X	X		
3.1.3.6				X						X	
3.1.3.7					X			X	X		
3.1.3.8				X						X	
3.1.3.9				X	X	X			X		
3.1.3.10				X						X	
3.1.3.11.1					X	X		X	X		
3.1.3.11.2			X		X	X		X	X		
3.1.3.11.3			X		X	X		X	X		
3.1.3.11.4			X		X	X			X		
3.1.3.12.1			X		X	X		X	X		
3.1.3.12.2			X		X	X		X	X		
3.1.3.12.3				X						X	
3.1.3.12.4			X		X	X		X	X		
3.1.3.12.5			X	X		X					
3.1.3.12.6				X		X					
3.1.3.12.7			X		X	X		X	X		
3.1.3.12.8				X		X					
3.1.3.12.9				X		X					
3.1.3.12.10			X		X	X		X	X		
3.1.4				X		X		X			
3.1.4.1				X						X	
3.1.4.2				X						X	
3.1.4.3				X	X			X	X		
3.1.4.4				X						X	
3.1.4.5				X	X	X		X	X		
3.1.4.6				X		X					

Requirement/Verification Cross-Reference Matrix

SECTION 3 REQUIREMENT	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4 VERIFICATION
	N/A	1	2	3	4	A	B	C	D	E	
3.1.4.7		X		X		X		X			
3.1.4.8		X		X		X		X			
3.1.4.9		X		X		X		X			
3.1.4.10		X		X		X		X			
3.1.4.11		X		X						X	
3.1.4.12			X	X						X	
3.1.4.13	X									X	
3.1.4.14				X	X	X		X	X		
3.1.4.15				X						X	
3.1.4.15.1	X									X	
3.1.4.15.2				X						X	
3.1.4.15.3				X	X	X		X	X		
3.1.4.15.4				X	X	X		X	X		
3.1.4.15.5				X	X	X		X	X		
3.1.4.15.6				X		X			X		
3.1.4.15.6.1				X		X			X		
3.1.4.15.6.2				X		X			X		
3.1.4.15.6.3				X		X			X		
3.1.4.15.6.4				X		X			X		
3.1.4.15.6.5				X		X			X		
3.1.4.15.6.6				X		X			X		
3.1.4.15.6.7				X		X			X		
3.1.4.15.7				X		X			X		
3.1.4.16			X		X	X		X	X		
3.1.4.16.1			X		X	X		X	X		
3.1.4.16.2			X		X	X		X	X		
3.1.5			X		X	X		X	X		
3.1.6.1			X		X	X		X	X		
3.1.6.2			X		X	X		X	X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.1.6.2.1			X		X	X		X	X		
3.1.6.2.2			X		X	X		X	X		
3.1.6.2.3			X		X	X		X	X		
3.1.6.3			X		X	X		X	X		
3.1.6.4			X		X	X		X	X		
3.1.6.5			X		X	X		X	X		
3.1.6.6			X		X	X		X	X		
3.1.6.7			X		X	X		X	X		
3.1.6.8			X		X	X		X	X		
3.1.6.9			X		X	X		X	X		
3.1.6.10			X	X		X					
3.1.7				X	X				X		
3.1.8			X		X	X		X	X		
3.1.8.1			X		X	X		X	X		
3.1.8.2			X		X	X		X	X		
3.1.9		X	X							X	
3.1.10.1		X								X	
3.1.10.2			X		X	X			X		
3.1.10.3			X		X	X		X	X		
3.1.10.4			X		X	X		X	X		
3.1.10.5		X	X		X				X		
3.1.10.6			X		X	X		X	X		
3.1.11		X	X			X		X	X		
3.1.11.1		X	X			X					
3.1.11.2			X		X	X		X	X		
3.1.11.3		X	X			X			X		
3.1.11.4			X		X	X		X	X		
3.1.11.5			X		X	X		X	X		

Requirement/Verification Cross-Reference Matrix

SECTION 3 REQUIREMENT	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4 VERIFICATION
	N/A	1	2	3	4	A	B	C	D	E	
3.1.11.6			X		X	X		X	X		
3.1.11.7			X		X	X		X	X		
3.1.11.8			X		X	X		X	X		
3.1.11.9			X		X	X		X	X		
3.1.11.10			X		X	X		X	X		
3.1.12.1		X	X			X			X		
3.1.12.2		X		X					X		
3.1.12.3			X	X	X	X		X	X		
3.1.12.4		X		X						X	
3.1.12.5		X		X						X	
3.1.12.6		X		X						X	
3.1.12.7				X					X		
3.2		X								X	
3.2.1.1		X								X	
3.2.1.2			X		X	X		X	X		
3.2.1.3		X		X						X	
3.2.1.4		X								X	
3.2.1.5		X								X	
3.2.2			X		X	X		X	X		
3.2.3.1		X									
3.2.3.2		X		X		X		X	X		
3.2.3.3		X		X		X		X	X		
3.3		X		X					X		
3.3.1		X		X					X		
3.3.2		X		X					X		
3.3.3		X		X					X		
3.3.4		X		X					X		
3.3.5.1		X									
3.3.5.2		X									

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.3.5.3				X	X	X		X	X		
3.3.5.3.1				X	X	X		X	X		
3.3.5.3.2				X	X	X		X	X		
3.3.5.3.3				X	X	X		X	X		
3.3.6			X			X					
3.3.7.1				X					X		
3.3.7.2				X					X		
3.3.7.3				X					X		
3.3.7.4				X					X		
3.3.7.5				X					X		
3.3.7.6				X					X		
3.3.7.7				X					X		
3.3.8		X				X					
3.3.8.1		X				X					
3.3.8.2		X				X					
3.3.9		X	X	X		X					
3.3.10				X						X	
3.4			X	X		X			X		
3.4.1			X	X		X			X		
3.4.2			X	X		X			X		
3.4.2.1			X	X		X					
3.4.2.2			X	X		X			X		
3.4.3			X	X		X					
3.5.1				X					X		
3.5.2				X					X		
3.5.3				X					X		
3.5.3.1				X		X			X		
3.5.3.1.1				X		X			X		
3.5.3.1.2				X		X			X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.5.3.1.3				X		X			X		
3.5.4				X		X			X		
3.5.4.1				X		X			X		
3.5.4.2		X				X					
3.5.4.3		X		X		X					
3.5.4.4		X		X		X					
3.5.4.5				X		X					
3.5.4.6	X									X	
3.5.6.1				X		X					
3.5.6.2				X		X					
3.5.6.3				X		X					
3.5.6.4				X		X					
3.5.6.5		X		X		X					
3.5.6.6		X		X		X					
3.5.6.7		X		X		X					
3.5.6.8		X		X		X					
3.5.7		X		X		X					
3.6				X		X			X		
3.6.1				X		X			X		
3.6.1.2				X		X			X		
3.6.1.3				X		X			X		
3.6.2				X		X			X		
3.6.3				X		X			X		
3.6.4				X		X			X		
3.6.5				X		X			X		
3.6.5.1				X		X			X		
3.6.5.2				X		X			X		
3.7				X		X			X		
3.8.1			X		X	X		X	X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.8.1.1			X		X	X		X	X		
3.8.1.2			X		X	X		X	X		
3.8.1.3			X		X	X		X	X		
3.8.1.4			X		X	X		X	X		
3.8.1.5			X		X	X		X	X		
3.8.1.6			X		X	X		X	X		
3.8.1.7			X		X	X		X	X		
3.8.1.8			X		X	X		X	X		
3.8.1.9			X		X	X		X	X		
3.8.1.10			X		X	X		X	X		
3.9			X		X	X		X	X		
3.9.1			X		X	X		X	X		
3.9.2.1			X		X	X		X	X		
3.9.2.2			X		X	X		X	X		
3.9.2.3			X		X	X		X	X		
3.10			X		X	X		X	X		
3.11.1			X		X	X		X	X		
3.11.2			X		X	X		X	X		
3.11.3			X		X	X		X	X		
3.12.1			X		X	X		X	X		
3.12.2				X		X			X		
3.12.3				X		X			X		
3.12.4			X		X	X		X	X		
3.12.5			X		X	X		X	X		
3.12.6			X		X	X		X	X		
3.12.7			X		X	X		X	X		
3.13			X		X	X		X	X		
3.14			X		X	X		X	X		
3.15.1		X				X					

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.15.1.1		X				X					
3.15.1.2		X				X					
3.15.1.3				X					X		
3.15.1.4				X					X		
3.15.1.5.1		X				X					
3.15.1.5.2		X				X					
3.15.1.5.3		X				X					
3.15.1.5.4		X				X					
3.15.2			X		X	X		X	X		
3.15.3			X	X	X	X		X	X		
3.15.3.1			X		X	X		X	X		
3.15.3.2				X					X		
3.15.3.3		X								X	
3.15.3.4				X		X			X		
3.15.3.5				X		X			X		
3.15.3.6		X				X					
3.15.3.7				X		X			X		
3.15.3.8				X		X			X		
3.15.4				X					X		
3.15.5				X		X			X		
3.15.6				X		X			X		
3.15.7				X		X			X		
3.15.8				X		X			X		
3.15.9					X				X		
3.15.10				X		X			X		
3.15.11				X		X			X		
3.15.12				X		X			X		
3.15.13				X		X			X		
3.15.14				X		X			X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.15.14.1				X		X			X		
3.15.14.2				X		X			X		
3.15.14.3				X		X			X		
3.15.15				X		X			X		
3.15.16				X					X		
3.15.17.1		X		X					X		
3.15.17.2		X		X					X		
3.15.17.3		X		X					X		
3.15.17.4		X		X					X		
3.15.17.5		X		X					X		
3.15.17.6		X		X					X		
3.15.18		X		X					X		
3.15.18.1				X		X					
3.15.18.2				X		X					
3.15.18.3				X		X					
3.15.18.4				X		X					
3.15.18.5				X		X					
3.15.18.6				X		X					
3.15.18.7.1				X		X					
3.15.18.7.2				X		X					
3.15.18.8.1				X		X					
3.15.18.8.2				X		X					
3.15.18.9				X		X					
3.15.18.10				X		X					
3.15.18.11				X		X					
3.15.18.12				X		X					
3.15.18.13				X		X					
3.15.18.14				X		X					
3.15.18.15.1				X		X					

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.15.18.15.2				X		X					
3.15.18.15.3				X		X					
3.15.18.15.4				X		X					
3.15.18.15.5				X		X					
3.15.18.15.6				X		X					
3.15.18.15.7				X		X					
3.15.18.15.8				X		X					
3.15.18.16				X		X					
3.15.18.17				X		X					
3.15.18.18				X		X					
3.15.18.19				X		X					
3.15.18.20				X		X					
3.15.18.21.1				X		X					
3.15.18.21.2				X		X					
3.15.18.21.3				X		X					
3.15.18.21.4				X		X					
3.15.18.21.5				X		X					
3.15.18.21.6.1				X		X					
3.15.18.21.6.2				X		X					
3.15.18.21.7				X		X					
3.15.18.22				X		X					
3.15.18.23				X		X					
3.15.18.24				X		X					
3.15.18.25				X		X					
3.15.18.26				X		X					
3.15.18.27		X				X					
3.15.19				X		X					
3.15.20				X		X					
3.16			X		X	X		X	X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION
3.16.1			X		X	X		X	X		
3.16.1.1			X		X	X		X	X		
3.16.1.2			X		X	X		X	X		
3.16.1.3			X		X	X		X	X		
3.16.1.4			X		X	X		X	X		
3.16.2			X		X	X		X	X		
3.16.2.1			X		X	X		X	X		
3.16.2.2			X		X	X		X	X		
3.16.2.3			X		X	X		X	X		
3.16.2.4			X		X	X		X	X		
3.16.2.4.1			X		X	X		X	X		
3.16.2.4.2			X		X	X		X	X		
3.16.2.4.3			X		X	X		X	X		
3.16.2.4.4			X		X	X		X	X		
3.16.2.4.5	X									X	
3.16.2.4.6			X		X	X		X	X		
3.16.2.4.6.1			X		X	X		X	X		
3.16.2.4.6.2			X		X	X		X	X		
3.16.2.4.6.3			X		X	X		X	X		
3.16.2.4.6.4			X		X	X		X	X		
3.16.2.4.6.5			X		X	X		X	X		
3.16.2.4.6.6			X		X	X		X	X		
3.16.2.4.6.7			X		X	X		X	X		
3.16.2.4.7			X		X	X		X	X		
3.16.2.4.8			X		X	X		X	X		
3.16.2.4.9			X		X	X		X	X		
3.16.3			X		X	X		X	X		
3.16.4			X		X	X		X	X		
3.17				X					X		

Requirement/Verification Cross-Reference Matrix

SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS					SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	D	E	VERIFICATION

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5. ACRONYMS

A	Annual
2D	Two Dimensional
3D	Three Dimensional
AAR	After Action Review
AAWS-M	Anti-Armor Weapon System – Medium
ABCS	Army Battle Command System
ABV	Assault Breecher Vehicle
AC	Alternating Current
ACE	Armored Combat Earthmover
ACS	Automated Cueing Subsystem
ACSL	Abrams Common Software Library
AFATDS	Advanced Field Artillery Tactical Data System
AFOV	Apparent field of view
ANSI	American National Standards Institute
A_o	Operational Availability
AOAC	Army Officer Advanced Course
AOBC	Army Officer Basic Course
AOI	Area of Interest
AOS	Air Ocean Space
API	Application Programming Interface
AS	Ancillary Station
ASA	Acoustical Society of America
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
ATCCS	Army Tactical Command and Control System
AVLB	Armored Vehicle Launched Bridge
BCC	Bradley Commander Course
BCIS	Battlefield Combat Identification System
BIT	Built-In-Test
BM	Bi-Monthly
BTU	British Thermal Unit
BW	Bi-Weekly
C2	Command and Control
CAC	Common Access Card
CAGE	Contractor and Government Entity
CaNDI	Commercial and Non-Developmental Items
CD	Compact Disk

CD-R	Compact Disk Read Only
CDS	Common Data Server
CDT	Common Driver Trainer
CIG	Computer Imagery Generator
CIGI	Common Image Generator Interface
CM	Class Manager
CM2	Common Moving Models
CMOS	Complementary Metal-Oxide-Semiconductor
COTS	Commercial Off The Shelf
CVC	Combat Vehicle Crewman
D	Demo
DC	Direct Current
DIP	Driver's Instrument Panel
DIS	Distributed Interactive Simulation
DMA	Defense Mapping Agency
DOD	Department of Defense
DORT	Daily Operational Readiness Test
DRA	Dead Reckoning Algorithms
DRC	Daily Readiness Checks
DRSS	Drivers Rear View Sensor System
DTED	Detail Training Environment Data
DVD	Digital Video Disk
DVE	Driver's Viewer Enhancer
ECS	Environmental Control System
EDM	Environment Data Manager
EIA	Electronic Industries Alliance
EML	Electronic Maintenance Log
EPO	Emergency Power Off
ERC	Environmental Runtime Component
ERC UHRB	ERC Ultra High Resolution Building
ERF	Electronic Remote Fill
E-STOP	Emergency Stop
FA	First Article
FAAD	Forward Area Air Defense
FABTOC	Field Artillery Battalion Tactical OC
FBCB2	Force XXI Battle Command Brigade and Below
FCEU	Fire Control Electronics Unit
FD	Failure Definition
FD/SC	Failure Definition and Scoring Criteria
FDC	Fire Direction Center

FDDI	Fiber Distributed Data Interface
FED	Forward Entry Device
FH	Frequency hopping
FIST-V	Fire Support Team Vehicle
FL	Fault Localization
FLIR	Forward Looking Infrared
FO	Forward Observer
FOV	Field Of View
FSE	Fire Support Element
GAS	Gunner's Auxiliary Sight
GB	Giga Bytes
GCDP	Gunner's Control and Display Panel
GCH	Gunner's Power Control Handle
GCHA	Gunner's Control Handle Assembly
GCU	Gun Control Unit
GFCI	Ground Fault Circuit Interrupter
GFE	Government-Furnished Equipment
GFI	Government Furnished Information
GHS	Gunner's Hand Station
GIS	Geographical Information Systems
GLLD	Ground Laser Locator Designator
GPS	Global Positioning System
GPS	Gunner's Primary Sight
GPSE	Commander's GPS extension
GSCP	Gunner's Sight Control Panel
GTD	Gun/Turret Drive Electronics
GUI	Graphical User Interface
GVW	Gross Vehicle Weight
HAT	Height Above Terrain
HFE	Human Factors Engineering
HLA	High Level Architecture
Hz	Hertz
I/O	Input/Output
IA	Information Assurance
IAW	In Accordance With
ICD	Interface Control Document
ID	Identification
IET	Initial Entry Training
IG	Image Generation
IO	Instructor Operator
IOS	Instructor Operator Station

IP	Internet Protocol
IUID	Item Unique Identification
JAB	Joint Assault Bridge
JTA-A	Joint Technical Architecture - Army
km	Kilometers
LAN	Local Area Network
LCCS	Life Cycle Contractor Support
LDCS	Linear Demolition Charge System
LRU	Lowest Replaceable Unit
M	Meter
MANPRINT	Human Performance and Human Factors Engineering
MATV	MRAP All Terrain Vehicle
M-EML	Master Electronic Maintenance Log
MPH	Miles Per Hour
MRAP	Mine Resistant Ambush Protected
ms	Milliseconds
MSDS	Material Safety Data Sheets
M-SUM	Master System Usage Monitor
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MV	Mine Resistance Ambush Protection Variant
NDI	Non Developmental Item
NRTL	Nationally Recognized Test Laboratory
NSTISSP	National Security Telecommunications and Information System Security Policy
ºC	Degrees Celsius
ºF	Degrees Fahrenheit
OneSAF	One Semi-Automated Forces
OS	Operating System
OSHA	Occupational Safety and Health Agency
OTF	Objective Terrain Format
OTW	Out The Window
PC	Personal Computer
PEO STRI	Program Executive Office, Simulation, Training And Instrumentation
PM	Program Manager
PdM VTS	Product Manager for Virtual Training Systems
PMCS	Preventive Maintenance Check System
POI	Program Of Instruction
PVC	Polyvinyl Chloride
PVD	Plan View Display
Q	Quarterly

RAM	Random Access Memory
RITM	Resident Individual Training Management
RMS	Root Mean Square
RTF	Ready To Train
RVSS	Rear View Sensor System
S	Semi-annual
SAF	Semi-Automated Forces
SAS	Scoring Assistant Subsystem
SE Core	Synthetic Environment Core
SEDRIS	Synthetic Environmental Digital Representation and Interchange
SGS	Scenario Generation System
SMM	System Maintenance Manual
SRD	System Requirement Document
SSN	Social Security Number
STS	Student Training Station
SUM	System Usage Monitor
SV	Stryker Variant
T	Training
TA-244	Training Area 244
TB	Terabyte
TEV	Tank Engineering Variant
TRADOC	Training and Doctrine Command
TSRD	Training System Requirements Document
TV	Tank Variant
UEI	United Electronics Industries
UGM-A	Universal Gold Master - Army (UGM-A)
UL	Underwriters Laboratories
USA PEO STRI	US Army Program Executive Office Simulation Training and Instrumentation
VAC	Volts Alternating Current
VBS2	Virtual Battlespace 2
VCR	Video Cassette Recorder
VDD	Vehicle Description Document
VDIS	Virtual Distributed Interactive Simulation
VDU	Vehicle Display Unit
VOIP	Voice Over Internet Protocol
VSC	Vehicle Specific Component
W	Weekly

6. VEHICLE DYNAMIC DATA INPUT TEMPLATE

A vehicle dynamics data input template use to collect vehicle parameter during a motion based dynamic tuning event to facilitate driving feedback motion realism. The form is included on the following pages.

Wheelbase 1		
Wheelbase 2 (and more, depending on axles count)		
Wheelbase 3 (and more, depending on axles count)		
Wheelbase 4 (and more, depending on axles count)		
Width		
Height		
Front overhang		
Rear overhang		
Rear hitch-axle distance		
Rear hitch heigth		
CG Location: vertical		
CG Location: longitudinal		
Eye Location: vertical		
Eye Location: longitudinal		
Axle track(s)		
Weights		
Curb weight		
Fully loaded weight (GVWR)		
GCWR		
Steering		
Lock to lock turns count		
Ackerman geometry (all steering axles)		
Chassis		
Suspension adjustment		
Suspension travel (dyn.)		
Springs data		
Shocks data		
Tires radius		

Table B: Components Inventory		
Model:	**Variant 1**	**Variant (i)**
Steering		
Sterring box ration		
Chassis		
Spring data		
Shocks data		
Tires type		
Notes on suspension type		
Notes on braking system		
Engine		
Model		
Power		
Torque		
Idle RPM		
Other items observed		
Transmission		
Model		
Torque converter model/ratio		
Transfer case		
Axle ratios		
Other items observed		
Features		
ABS (what axles?)		
Traction control (with details)		
Engine brake		

Table C: Performance measures		
Model:	**Variant 1**	**Variant (i)**
Speeds		
Max Road Speed		
RPM at 60 MPH		
RPM at 30 MPH		
Acceleration		
Acceleration to 50 MPH		
Acceleration to 20 MPH		
Acceleration to 40 MPH		
Acceleration to 60 MPH		
Gearshift (full throttle)		
RPM 1 to 2		
RPM 2 to 3		
RPM 3 to 4		
RPM 4 to 5		
RPM 5 to 6		
Mobility		
Forward Slope		
Side Slope		
Step Climbing		
Lateral acceleration/roll threshold		
Steering		
Turning circle (curbs)		
Braking / Deceleration		
From 20 MPH		
From 40 MPH		
From 60 MPH		
No-jake coast 60-40 MPH		
No-jake coast 40-10 MPH		
Jake coast 60-40 MPH		
Jake coast 40-10 MPH		

7. RITM REPORT EXAMPLE

A Resident Individual Training Management (RITM) Report example is included as an example of an instructor generated class report.

SS#	LAST 4	Last Name, First Name, MI	Gain UPC	Service Comp	Course Title	Course ID	FY	CLASS	PHASE	START DATE	END DATE
123456789	6789	Rucker, Alfonso, Q III	W32 L8B	RA	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12
987654321	4321	Sparrow, Jack	W62 R2D	NG	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12
564738902	8902	Solo, Han	W33 X90	AR	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12
908872134	2134	Grant, Hihram S.	U88 W4X	AR	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12
763555131	5131	Whirly, Clarence	W32 L8B	RA	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12
612300812	0812	Showlaces, Tyrone U.	W33 X90	AR	IN FLIGHT MISSLE	911-12D10	2012	001	0	25-Dec-11	10-Jan-12

					MAINTENANCE / REPAIR						
83343 3190	319 0	Upchuck, Ralph	W62 R2D	NG	IN FLIGHT MISSLE MAINTENANCE / REPAIR	911-12D10	2012	001	0	25-Dec-11	10-Jan-12