RECONNAISSANCE SURVEILLANCE AND TARGETING VEHICLE (RST-V)

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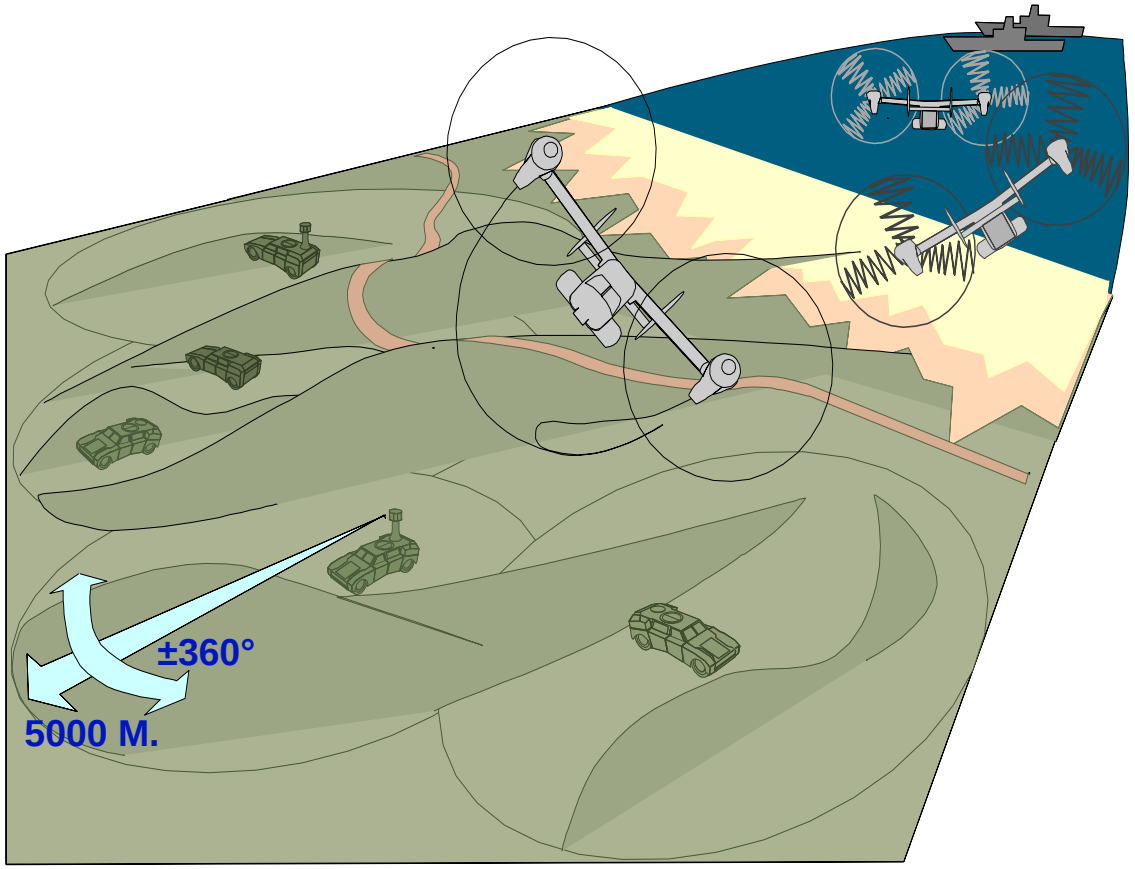
System Concept

- **Hybrid Electric Drive**
  - Improved Fuel Economy
  - Improved Range
  - Extended Silent Watch
- **Integrated Survivability**
  - Ballistic
  - AP Mine
  - Managed Signature
- **V-22 Internal Transport**
  - Deployment Ready
  - Tactical and Deep Insertion
  - 10 Day Mission



Key Automotive Features

HV Batteries Low but, Accessible

155 Hp Commercial Diesel

Variable Speed Cooling Fans

Independently Removable Propulsion Elements

Steering Rack

Stiff, Closed, Low-profile Frame, All Aluminum Construction

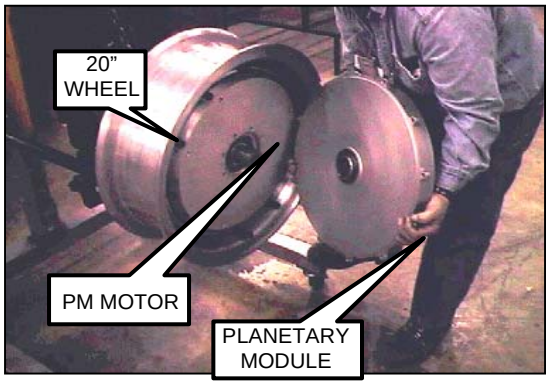
Wheel Motor Assy

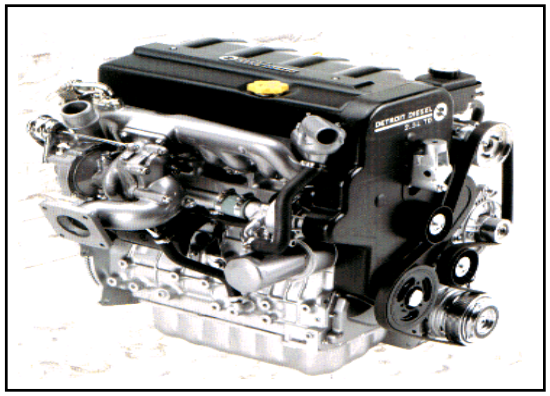
Modular Folding Suspension Assy Fits All Corners

Key Subsystems

Wheel Drive Unit

- MM Permanent Magnet Motor
- Modular Design
- Torque 3660 Nm (Peak) 3030 Nm (Continuous)





IC Engine

- DDC TD DI-4V, 2.5 liter,
- Maximum intermittent power 105 kW (141 hp) at 3800 rpm
- Common Rail Direct Injection Diesel
- Turbocharged, Intercooled

Energy Storage

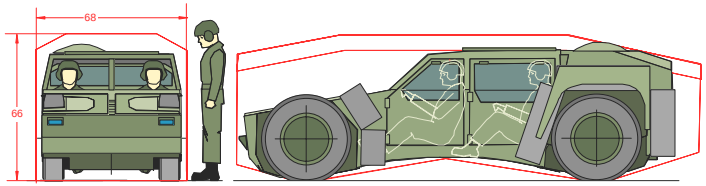
- Saft Lithium-Ion Battery Technology
- EV Optimized Battery Chosen for Application
- 2 Packs, 60 HE 44 Cells - ~234V
- Burst Power 60 kW

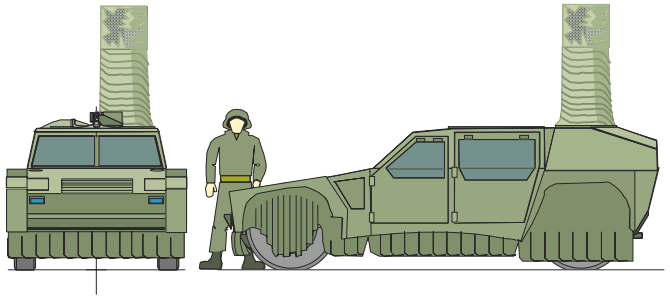
Contractor TPM Testing

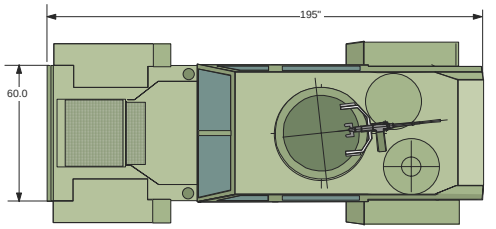
Event	RST-V Achieved	RST-V Goal	HMMWV
0-30 MPH	3.41 sec ✓	4 sec	9.4 sec
0-60 MPH	12.1 Sec ✓	15 sec	(0 - 50) 26.1 sec
Top Speed	70 MPH ✓	70 MPH	70 MPH
Top Speed on Batteries (Recorded)	57 MPH ✓	No Goal	0 MPH
Distance on Battery (GVW 6800 lbs)	23 miles ✓	20 miles	0 miles
Distance on Battery (GVW 8440 lbs)	20 miles ✓	20 miles	0 miles
Step Climb	24 inches ✓	15 inches	No Data
Negotiate 60% Slope (All 3 Modes)	Yes ✓	Yes	No

RST-V Performance

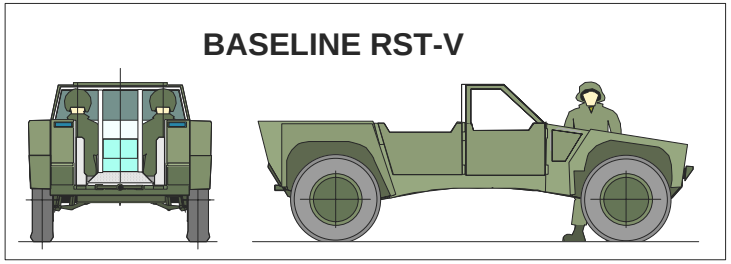
Characteristics	RST-V Design	HMMWV (M1025A2)	RST-V Measured
Gross Vehicle Weight	8000 lbs	10300 lbs	8440 lbs
Chassis Width	60 in	84 in	60 in
Approach Angle	60 deg.	60 deg.	60 deg.
Departure Angle	60 deg.	40 deg.	60 deg.
Reducible Height	65.0 in	72 in	65.0 in
Ground Clearance	4-24 in (variable)	15.3 in	4-24 in (variable)
Acceleration 0-30 mph	4 sec	9.4 sec	3.4 sec
0-60 mph	15 sec	25+ sec	12.1 sec
Braking 30-0 mph	69 ft.		47 ft.
60-0 mph	256 ft.		195 ft.
Step Climb	16 in	16 in	24 in
Gradeability (HEV)	60%	60%	60%
(Batteries)	No Requirement	Not Applicable	60%
Side Slope	40%	40%	>40% (90% on tilt table)
Range on Batteries	20 mi	Not Applicable	23 mi
Dash Speed	70 mph	70 mph	70 mph
Dash Speed (Batteries)	No Requirement	Not Applicable	57 mph
Sustained Highway Speed	68 mph (tire limited)	70 mph	68 mph (tire limited)
Payload	3000 lbs	3520 lbs	3000 lbs (by analysis)
Air Transport	V-22, CH53, CH47	C130	V-22, CH53, CH47 (by analysis)
Range (HEV)	450 mi	270 mi	test pending
Relative Fuel Economy	1.5-2.0 x	Reference	test pending
Fording Depth	36 in	36 in	36 in (by analysis)
Ride Limiting Speed	~22 mph	~12 mph	test pending
VCI - Off Road (25% Deflection)	19.8	20.2	19.8 (by analysis)

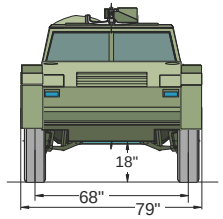


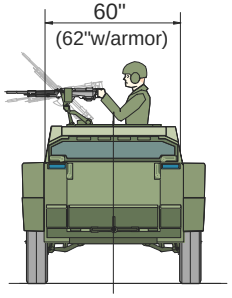


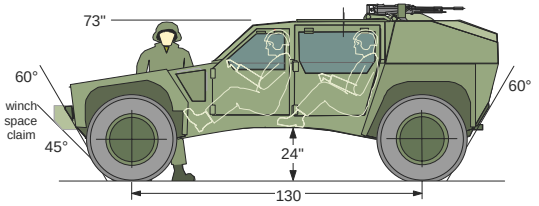


BASELINE RST-V









RST-V Follow-on Demonstration

RST-V Follow-on Demonstrations

- 2 vehicles to be upgraded in 2005
- Armor Add-on Kit
- 7 kW Electric On-Board Power
- 20-30 kW Electric Export Power
- Long Range Communications Suite
- Experimentation in OIF in 2006

Objectives

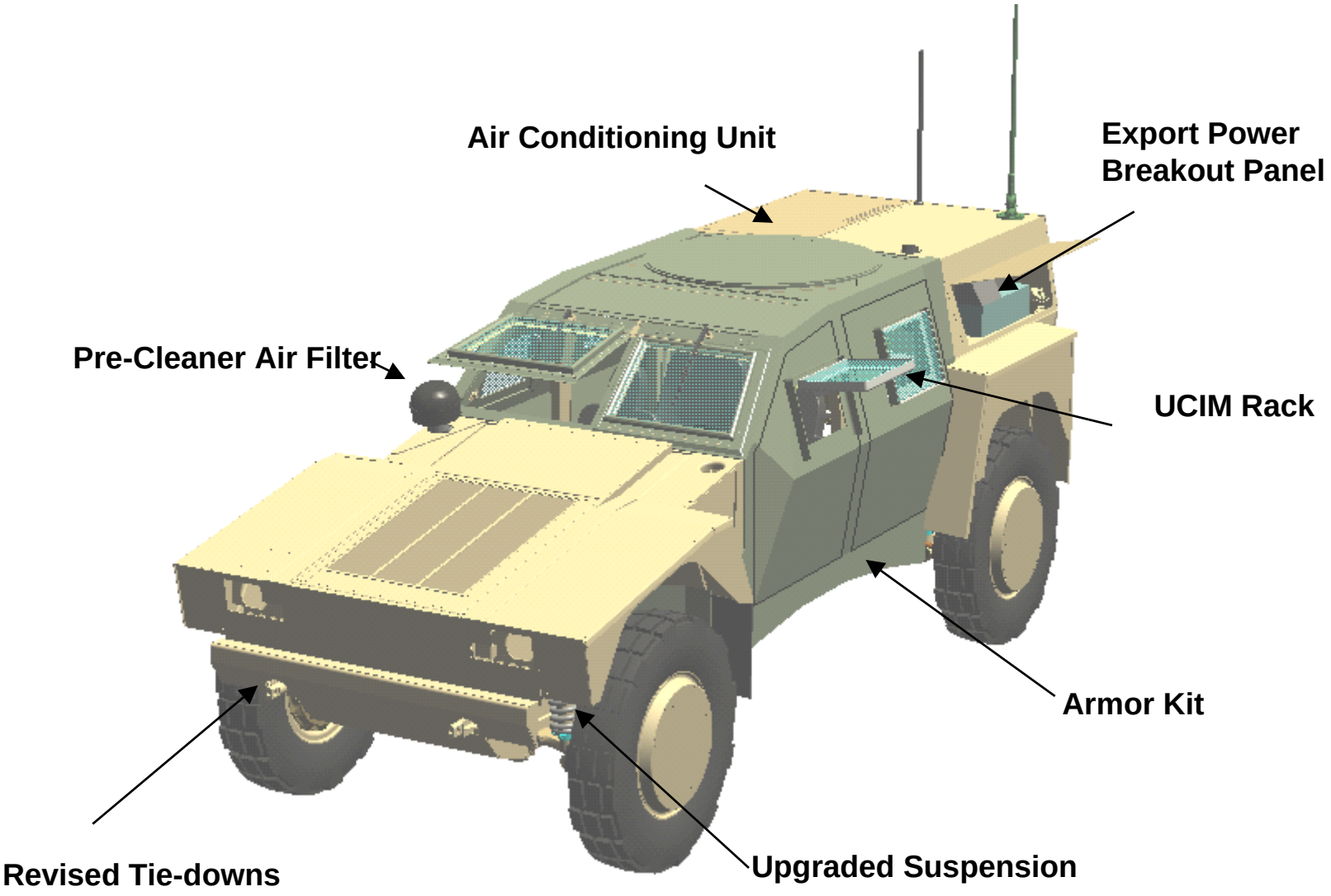
PHASE I (FY05)

- Mature current RST-V technology to TRL 6
- Demonstrate ability to provide up to 30kW electric power
- Demonstrate improved MMBOMF

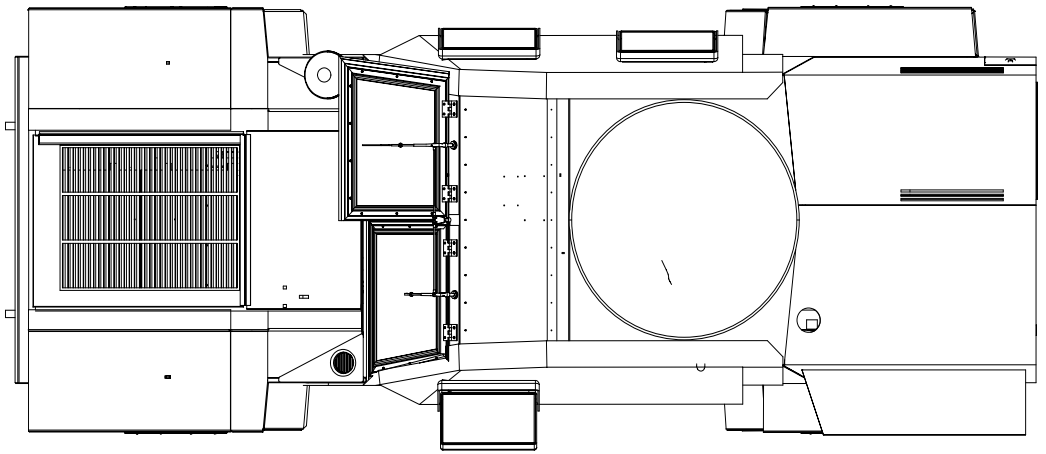
PHASE II (FY06)

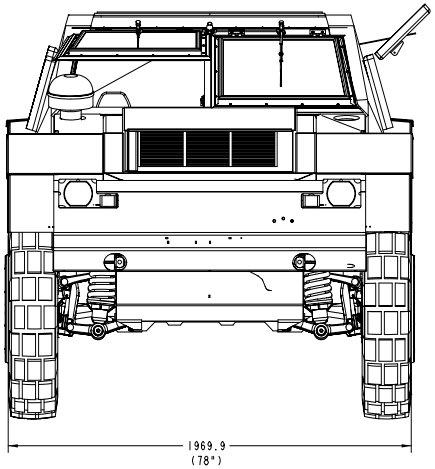
- Host platform with inherent power for jump Command Post.
- Provide exportable power to:
    - USMC Unit Operations Center
    - General 60 Hz power comparable to 30kW TQG
    - Special 400 Hz power for TPQ-46A Radar

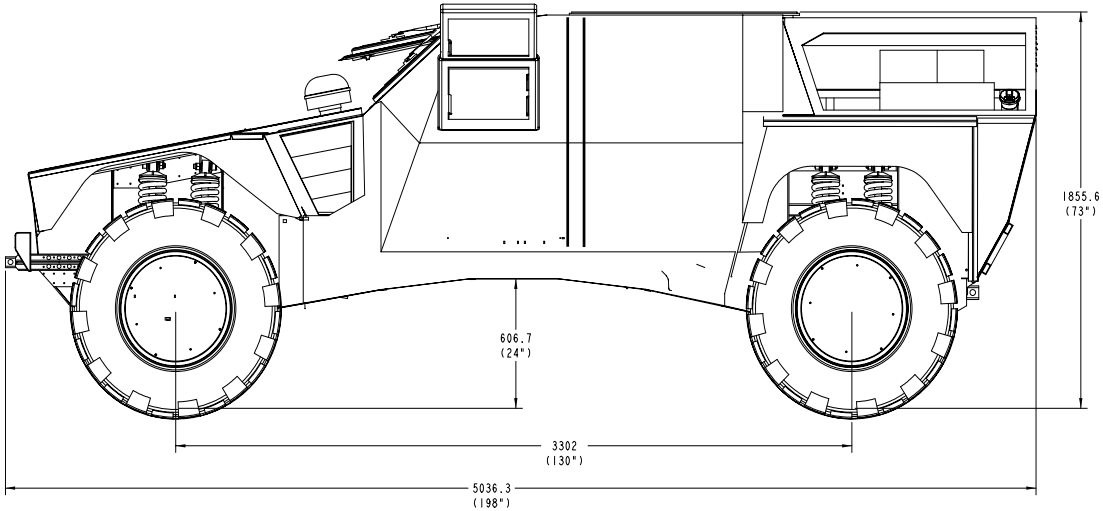
Vehicle Exterior View



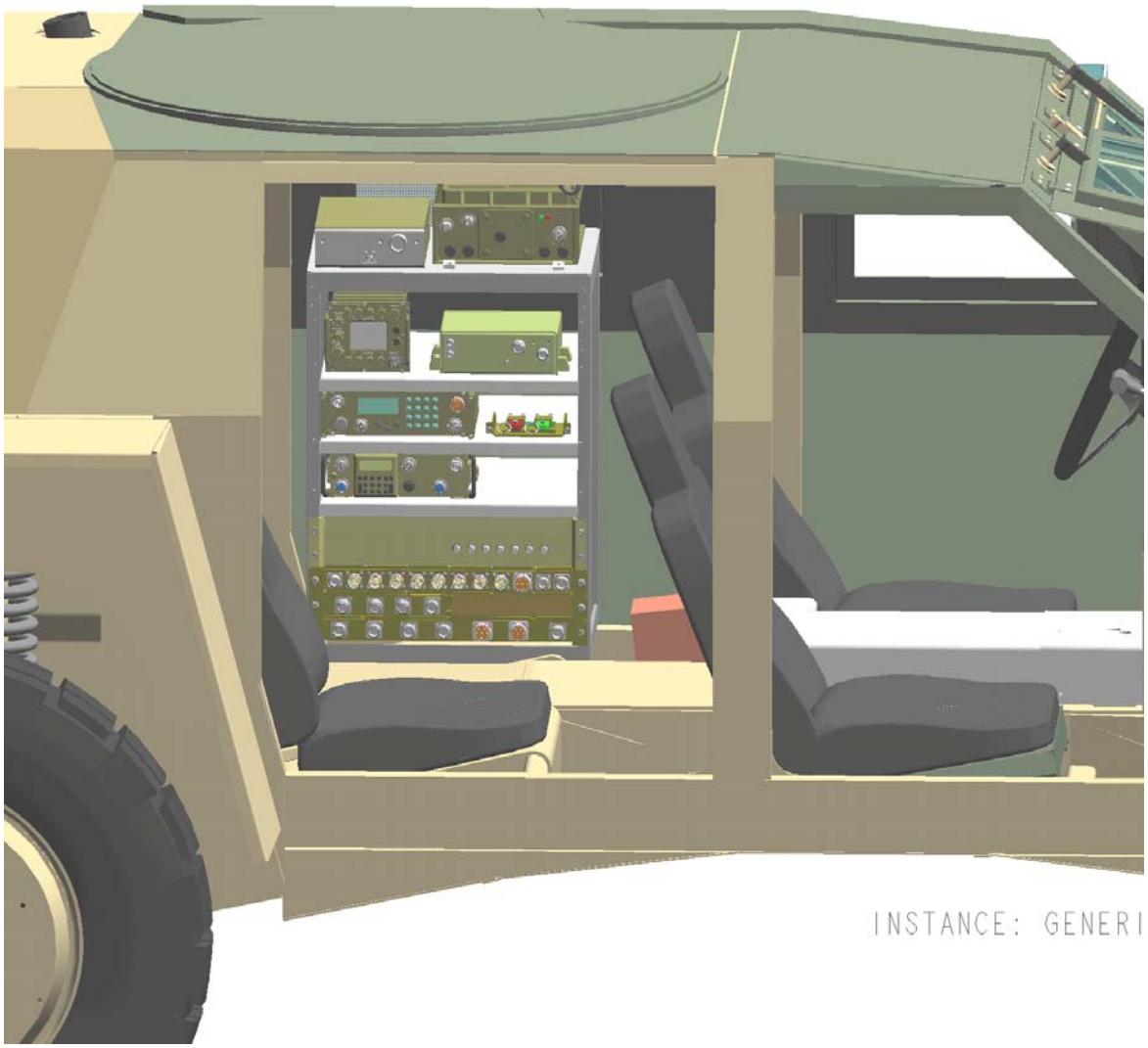
Vehicle 3 View Drawing







Vehicle Interior View - UCIM Rack



Generator Export Power Quality

Paragraph				Mil-Std-1332B, Table II Electrical Performance Characteristics Parameters - Alternating Current Generator Sets	RST-V Demo	Test Method Mil-Std-705
				Characteristics Parameters		
a				**Voltage Characteristics**		
	1			Regulation (%)	2	608.1
	2			Steady-state-stability (variation) (bandwidth%)		
		a		Short Term (30 sec)	1	608.1
		b		Long Term (4 hrs)	2	608.2
	3			Transient Performance		
		a		Application of Rated Load		
			1	Dip	20	619.2
			2	Recovery (sec)	3	619.2
		b		Rejection of Rated Load		
			1	Rise	30	619.2
			2	Recovery (sec)	3	619.2
		c		Application of Simulated Motor Load (twice rated current)		
			1	Dip (%)	40	619.1
			2	Recovery to 95% of Rated Voltage (sec) (note 1)	5	619.1
	4			Waveform (note 2)		
		a		Maximum Deviation Factor (%)	5	601.1
		b		Maximum Individual Harmonic (%)	2	601.4
	5			Voltage Unbalance with Unbalanced Loads (%) (note 3)	5	620.2
	6			Phase Balance Voltage (%)	1	508.1
	7			Voltage Adjustment Range (%) (min) (note 4)	+/-10	511.1
b				**Frequency Characteristics**		
	1			Regulation (%)	0-5 Adj.	608.1
	2			Steady-state-stability (variation) (bandwidth%)		
		a		Short Term (30 sec)	0.5	608.1
		b		Long Term (4 hrs)	1	608.1
	3			Transient Performance		
		a		Application of Rated Load		
			1	Undershoot (%)	4	608.1
			2	Recovery (sec)	4	608.1
		b		Rejection of Rated Load		
			1	Overshoot (%)	4	608.1
			2	Recovery (sec)	4	608.1
	4			Frequency Adjustment Range (%) (min) Where Required	+/-4	511.2

Contractor Testing

Contractor Testing Will Provide Design Data, Schedule Risk Reduction and Early Validation / Verification

Testing Will Consist Of:

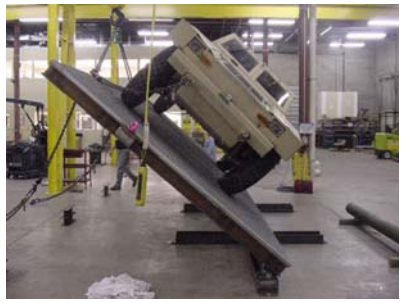
- **Lab & Bench Testing**
  - **Components**
  - **Export Power Unit**
- **Integration / Testing of Body Controls**
- **System Integration Lab Testing**
  - **JP-8 Assessment**
  - **Hot Testing of Cooling Group**
  - **System Control Software**
- **System Testing on Test Tracks** (see next)

System Testing At Getty St. Facility

Contractor Testing Will Provide Initial Testing Of Vehicle Modifications And Confirm Proper Assembly.

Testing Will Consist Of:

- **Shakedown**
- **Basic Functional:**
  - **Steering**
  - **Brakes**
  - **Cooling System**
  - **Engine Control System**
  - **Exportable Power**
- **Tilt Table Stability At GVW**
- **Safety Evaluations**
- **JP8 Compatibility** **(Will Continue Throughout Testing)**



Testing at Bosch Proving Grounds

BPG Testing Will Provide The Performance And Safety Data On The Modified Vehicles And Mobile Power Units

Testing At GVW Will Include:

- **Multi-Course Shakedown**
- **Safety Series**
  - **Braking ***
  - **Acceleration ***
  - **Avoidance Maneuvers ***
  - **Steering / Handling ***
  - **Highway Speed***
  - **Longitudinal 40% Slope ***
  - **Parking Brake 30% Slope ***
- **Preliminary Durability**

*In Conjunction With APG Testers

APG Testing

APG Testing Will Establish Safe Operation Regime For Marines and Assess Performance Against Program Goals

Testing At GVW May Include:

- Weight & CG
- Obstacles
- Cross Country Handling
- Cross Country Speed
- Side Slope
- 1500 Mile Endurance Run
- Exportable Power
- EMI Tests
- Transportability / Tie-Down Tests

Limited User Evaluation

The LUE will start at Marine Corps Base Quantico, VA, and be concluded at Marine Corps Base Camp Lejeune, NC

5-Day LUE in November 2005 to consist of:

- **Communications Checkout Between Both Vehicle Payloads.**
- **Communications Check Between Vehicles And Third Station.**
- **Driver Training**
- **Demonstrations of all Export Power regimes**
- **300 mile drive from Quantico to Camp Lejeune**