AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. Contract ID Code	Page 1 Of 10
Cost-Sharing	

2. Amendment/Modification No.	3. Effective Date	4. Requisition/Purchase Req No.	5. Project No. (If applicable)
P00002	2007MAY09	SEE SCHEDULE	

6. Issued By Code W56HZV

U.S. ARMY TACOM LCMC
AMSTA-AQ-AGSA
MICHAEL CIACIUCH (586)574-2324
WARREN, MICHIGAN 48397-5000
HTTP://CONTRACTING.TACOM.ARMY.MIL
WEAPON SYSTEM: WPN SYS: 00
EMAIL: CIACIUCM@TACOM.ARMY.MIL

7. Administered By (If other than Item 6) Code S2303A

DCMA GRAND RAPIDS
RIVERVIEW CENTER BLDG
678 FRONT ST., NW
GRAND RAPIDS, MI 49504-5352

SCD C **PAS** NONE **ADP PT** HQ0337

8. Name And Address Of Contractor (No., Street, City, County, State and Zip Code)

GENERAL DYNAMICS LAND SYSTEMS INC
LAND SYSTEMS
640 SEMINOLE RD
MUSKEGON, MI 49441-4720

TYPE BUSINESS: Large Business Performing in U.S.

Code 075J2 **Facility Code**

☐ **9A. Amendment Of Solicitation No.**

9B. Dated (See Item 11)

☒ **10A. Modification Of Contract/Order No.**
W56HZV-05-C-0017

10B. Dated (See Item 13)
2005FEB09

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ **The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers**

☐ **is extended,** ☐ **is not extended.**

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendments: (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. Accounting And Appropriation Data (If required)
ACRN: AC NET INCREASE: $29,226.00

13. THIS ITEM ONLY APPLIES TO MODIFICATIONS OF CONTRACTS/ORDERS
It Modifies The Contract/Order No. As Described In Item 14.

KIND MOD CODE: A

☒ **A. This Change Order is Issued Pursuant To:** Changes Clause I-59 52.243-2 Alt V **The Changes Set Forth In Item 14 Are Made In The Contract/Order No. In Item 10A.**

☐ **B. The Above Numbered Contract/Order Is Modified To Reflect The Administrative Changes (such as changes in paying office, appropriation data, etc.) Set Forth In Item 14, Pursuant To The Authority of FAR 43.103(b).**

☐ **C. This Supplemental Agreement Is Entered Into Pursuant To Authority Of:**

☐ **D. Other (Specify type of modification and authority)**

E. IMPORTANT: Contractor ☐ **is not,** ☒ **is required to sign this document and return _____ copies to the Issuing Office.**

14. Description Of Amendment/Modification (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

SEE SECOND PAGE FOR DESCRIPTION

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. Name And Title Of Signer (Type or print)		16A. Name And Title Of Contracting Officer (Type or print)	
		DEREK MCALEER DEREK.MCALEER@US.ARMY.MIL (586)574-8093	
15B. Contractor/Offeror _____ (Signature of person authorized to sign)	15C. Date Signed	16B. United States Of America By /SIGNED/ (Signature of Contracting Officer)	16C. Date Signed 2007MAY09

SECTION A - SUPPLEMENTAL INFORMATION

1. In accordance with the Changes Clause and as a result of a mutual agreement between the parties, this bilateral Modification P00002 changes Contract W56HZV-05-C-0017 by adding $29,226.00 to the Contract in order to incorporate a work requirement to conduct expanded fuel economy testing for power generation/generator testing of the refurbished vehicles export power capabilities.

2. The Changes effected by this Modification are incorporated into the existing Statement of Work (SOW) by adding the following Paragraph C.5.2:

"C.5.2 Generator Testing. The Contractor shall conduct expanded fuel economy testing for power generation/generator testing of the refurbished vehicles export power capabilities, in addition to power quality testing. The Contractor shall conduct the following MIL-STD tests:

a) MilStd 705C Method 601.1d Voltage Waveform Test
b) MilStd 705C Method 601.4b Voltage Waveform Test (Harmonic Analysis)
c) MilStd 705C Method 601.5.1 Voltage Waveform Test (Deviation Factor)
d) MilStd 705C Method 602.11 Voltage Modulation Test
e) MilStd 705C Method 608.1b Frequency and Voltage Stability Test (short term)
f) MilStd 705C Method 608.2a Frequency Voltage Stability Test (long term)
g) MilStd 705C Method 619.1b Voltage and Frequency Regulation Test
h) MilStd 705C Method 619.2c Voltage Dip and Rise for Rated Load Test
i) MilStd 705C Method 640.1d Max Power Test
j) MilStd 705C Method 670.1b Fuel Consumption Test

C.5.2.1 Results of this additional testing from Paragraph C.5.2 above shall be included with the reporting requirements of Paragraph C.5.1.4, and this additional testing will extend the period of performance for this Contract to 15 November 2007."

3. As noted above, the Contract Period of Performance (POP) is extended to 15 November 2007 as a result of this Modification.

4. Funding Details:

a. Previous: $1,228,835 ($895,176 Govt share + $333,659 GDLS share)

b. This action: $29,226 (all Govt, $26,576 cost + $2,649 fee)

c. Total: $1,258,061 ($924,402 Govt share + $333,659 GDLS share)

d. Add $29,226.00 under SubCLIN 000104 in Contract Section B (Supplies or Services and Prices/Costs).

4. Contract Sections B, C (Description/Specifications/Work Statement), F (Deliveries or Performance) and G (Contract Administration Data) have all been revised to reflect the changes as a result of this Modification, and a copy of each of these revised Sections is included with this Modification.

5. In consideration of the Modification agreed to herein, and as complete and equitable adjustment for the additional project effort as a result thereof, the Contractor hereby releases the Government from any and all liability under this Contract for further equitable adjustments attributable to such facts or circumstances giving rise to the Contractors "Electric Motors and Inverters for Hybrids Proposal" as it currently stands.

6. Except for the changes resulting from this Modification, all other Contract terms and conditions remain unchanged.

*** END OF NARRATIVE A 0002 ***

Name of Offeror or Contractor: GENERAL DYNAMICS LAND SYSTEMS INC

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS				
0001	MOTORS AND INVERTERS FOR HYBRIDS	1	LO		$ 1,258,061.00
	NOUN: FY04 BAA TOPIC 07 SECURITY CLASS: Unclassified				
	Inspection and Acceptance INSPECTION: Destination ACCEPTANCE: Destination				
	Deliveries or Performance DLVR SCH REL CD 001 — QUANTITY 1 — PERF COMPL DATE 30-OCT-2007 $ 1,258,061.00				
000101	MOTORS AND INVERTERS FOR HYBRIDS PRON: R352C006R3 PRON AMD: 03 ACRN: AA AMS CD: 622601H9111 (AMOUNT: $ 540,000.00)				
000102	MOTORS AND INVERTERS FOR HYBRIDS PRON: R342C330R3 PRON AMD: 01 ACRN: AB AMS CD: 622601H9111 (AMOUNT: $ 60,000.00)				
000103	MOTORS AND INVERTERS FOR HYBRIDS PRON: R362V032R3 PRON AMD: 02 ACRN: AC CUSTOMER ORDER NO: M9545006MPR6ET7 (AMOUNT: $ 295,176.00)				
000104	MOTORS AND INVERTERS FOR HYBRIDS PRON: R362V032R3 PRON AMD: 02 ACRN: AC CUSTOMER ORDER NO: M9545006MPR6ET7 (AMOUNT: $ 29,226.00)				

B.1 Estimated Cost and Payment

B.1.1 The estimated cost for performance of the work required under this contract is as stated in Section B Schedule. For the purposes of this Section B, the term "cost" includes a fee for SubCLINs 000103 and 000104 pertaining to RST-V refurbishment.

B.1.2 The Contractor will be paid for the cost stated in Section B under CLIN 0001 for the performance of work under the Contract the reimbursement of cost shall constitute full and complete consideration for the Contractor's service in connection with the work required and performed under this Contract.

B.1.3 Allowable cost shall be determined, and payment shall be provided, in accordance with the Contract Clause entitled "ALLOWABLE COST AND PAYMENT."

B.2 Payment

The Contractor may submit public vouchers monthly for payment under this Contract. The costs will be payable at the time of reimbursement at the same rate subject to any withholding pursuant to provisions of this Contract.

B.3 This contract incorporates cost sharing as follows:

Government Share (73.5%):	$ 924,402
Contractor Share (26.5%):	$ 333,659
Total:	$1,258,061

*** END OF NARRATIVE B 0001 ***

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

Advanced Electric Motor and Inverter for Hybrid Electric Vehicle Propulsion

Introduction

The objective of this project is the demonstration of an advanced high-torque and power density traction motor and motor drive inverter for military hybrid electric vehicle application. Development is needed with the objectives of making these components smaller, more efficient, and rugged enough to meet combat vehicle requirements. Development of motors and inverters capable of operating at high coolant temperature is needed to reduce the burdens of thermal management on the vehicle cooling system.

C.1: Requirements
The contractor, acting as an independent contractor and not an agent of the government, shall provide the resources necessary to design, develop, and deliver a motor and motor control inverter capable of meeting or exceeding the requirements below:

C.1.1: Motor Torque & Power Density
The traction motor shall be capable of a torque-density of at least 80 N-m/l and a power-density of at least 10 kW/l.

C.1.2: Motor Performance and Efficiencies
The traction motor shall be capable of developing at least 150 N-m of torque, and at least 50 kW of power coupled with a motor efficiency of approximately 95%.

C.1.3: Motor G-force Rating
The traction motor shall be designed to withstand a minimum 80 g, 11 ms shock environment.

C.1.4: The inverter shall be designed to handle 100kW continuous power with a coolant temperature of 80 degree Celsius minimum.

C.1.5: Thermal Management
The motor and motor control inverter shall be capable of operating at a minimum inlet coolant temperature of 80 degree Celsius. The design objective is to achieve the highest practical outlet temperature of the traction motor (100 degree Celsius) in order to minimize cooling system burdens.

C.2: Tasks
The contractor shall provide the resources necessary to complete the following tasks outlined below.

C.2.1: Trade Studies
The contractor shall conduct subsystem level trade studies based on design concept and research results to establish the final design of the demonstration motor and inverter. The contractor shall also find an optimum balance between active length and total length of the motor that will achieve the highest torque density and power density.

C.2.2: Motor Development
The contractor shall design and validate a motor that meets the torque, power, efficiency, and g-force requirements stated in C.1. The contractor shall execute the final design and fabrication of the motor based upon results of system research and trade studies.

C.2.2.1: Torque
The contractor shall measure and document the maximum torque generated by the motor at several speeds below 1000 rpm.

C.2.2.1.1: The contractor shall test and document both peak and continuous operation and use the data to calculate the peak and average torque density.

C.2.2.1.2: The contractor shall calculate the peak and average torque density using the data obtained from peak and continuous operation on the dynamometer.

C.2.2.1.3: Power
The contractor shall calculate and document the output power of the motor at several speeds over the rated operating range for both peak and continuous operation. The contractor shall calculate and document the average and peak power densities.

C.2.2.1.4: Efficiency
The contractor shall calculate and document the efficiency of the motor using the measured input and output power and calculate the motor control inverter efficiency.

C.2.2.1.5: The contractor shall also calculate and document the motor /motor control inverter combined system efficiency over the rated operating range.

C.2.2.1.6: G-Force
The contractor shall design and validate the motor to meet the shock and vibration requirements stated in C1.

C.2.2.2: Motor Components:

C.2.2.2.1: Stator Cooling
The contractor shall evaluate, investigate, and develop better coolant flow channel routing, channel geometry, and potting material with better heat transfer characteristics to reduce heat transfer resistance in the stator.

C.2.2.2.2: Stator Insulation
The contractor shall evaluate, test, and implement alternate insulation materials to develop a system that will allow core temperature of about 160 degree C to 200 degree C. The contractor shall choose the best technical approach during the research phase of the project and perform thermal testing of the stator insulation.

C.2.2.2.3: Stator Losses
The contractor shall analyze, design, and prototype new stator winding geometry. The contractor shall conduct bench tests to validate the design.

C.2.2.2.4: Rotor Cooling
The contractor shall increase the power density of the motor by designing and implementing a rotor that will efficiently transmit rotor losses to the water cooled stator and the surrounding air.

C.2.3 Inverter Development
The contractor shall analyze, design, and build the inverter to handle the current, voltage, and waveform requirements of the advanced high power and torque traction motor that meets the requirements of C.1.

C.2.3.1: Power
The contractor shall set up and document a 3-phase load in conjunction with the motor control inverter to determine the maximum power density.

C.2.3.2: Efficiency
The contractor shall evaluate, calculate, and document the power efficiency of the motor control inverter as a function of switching frequency.

C.2.3.2.1: The contractor shall calculate and document the maximum power of the motor control inverter at several different frequencies and document variations in the controller efficiency.

C.2.3.3: Coolant Temperature
The contractor shall calculate and document the Insulated Gate Bi-polar Transistor (IGBT) junction temperature and the thermal management system efficiency by allowing the coolant temperature to increase until reaching the IGBT safe limit and determine the maximum baseline performance.

C.2.3.4: Thermal Design Improvement
The contractor shall improve the cold plate design and conduct pressure and flow loss tests to verify design.

C.2.3.5: Switching Loss Reduction
The contractor shall reduce switching losses by implementing power capacity enhancements to the inverter through optimization of the phase current wave form to reduce the switching losses during high power and high speed operation.

C.3: Meetings

C.3.1: Start of Work Meeting
The contractor shall conduct a start of work meeting within 30 days after contract award at TACOM, Warren, MI., or as mutually agreed between the contractor and the COR.

C.3.2: Quarterly Meetings
The contractor shall host Quarterly meetings at his facility, at the date and time mutually agreed between the contractor and the COR. There shall be four (4) meetings per year for the duration of the contract. At the quarterly meetings, the contractor shall present the progress made during the previous quarter and validate it against the contract SOW, schedule and objectives.

C.4: Deliverables

C.4.1: Progress, Status & Management Report
The contractor shall prepare quarterly progress, status & management reports and prepare reviews in accordance with CDRL item A001, DID Number: DI-MGMT-80227. The status reports shall summarize the work completed; the contract tasks not completed and significant accomplishments, problems or delays. The reports shall include the status of on-going studies and studies completed during the reporting time period, as well as test results and their analysis and impact. The first report shall be due 90 days after contract award; the contractor shall deliver the status report to the COR approximately one week prior to the scheduled Quarterly Review Meetings described in C.3.2, above.

C.4.2: Scientific & Technical Reports
The contractor shall prepare the scientific and technical status reports and prepare reviews in accordance with CDRL item A002. The status reports shall summarize the work completed, the contract tasks not completed and significant accomplishments, problems or delays. The reports shall include the status of on-going studies and studies completed during the reporting time period, as well as test results and their analysis and impact on the program.

C.4.3: Performance and Cost Reports
The contractor shall prepare every-other-month performance and cost reports in accordance with CDRL item A003. The performance and cost reports shall report all total costs incurred to date, list of parts ordered, with specific reference to the cost incurred since the last performance and cost report. The first report shall be delivered to the COR approximately 60 days after contract award; for reporting periods when the progress and status reports are due, the performance and cost report shall be delivered concurrently with the progress and status report.

C.4.4: Motor and Inverter
The contractor shall deliver a motor and motor control inverter as described in paragraph C.1 through C.1.5

C.5 Vehicle Refurbishment. The Contractor shall refurbish a Government Furnished Hybrid Electric (HE) RSTV vehicle for a shakedown test at the Aberdeen Test Center (ATC) to establish a baseline performance data for derivation of system requirements that are needed for the design of the traction motor and inverter. The RSTV to be refurbished is already located at the Contractors Muskegon, Michigan facility.

C.5.1 Description/Special Instructions. The traction motor shall be integrated into the HE RSTV cited in Paragraph C.5. Vehicle test data are needed to design the motor in accordance with the vehicle performance requirements. Therefore, the Contractor shall refurbish the RSTV vehicle and make it ready for testing at the ATC.

C.5.1.1 Performance Requirement Development. The Contractor shall support Government testing of the RSTV vehicle to establish baseline performance for derivation of system requirements for advanced traction drive subsystems. Test support is defined at Paragraph 5.1.3.

C.5.1.2 Vehicle Refurbishment. The Contractor shall refurbish the RSTV vehicle to make it fully functional to perform shakedown testing at the ATC. This task shall be completed within 21 days from the award date of the applicable Contract modification. The refurbishment effort shall include the following:

a) replacement/upgrade of the air conditioning system
b) chassis inspection and repair of any damage found
c) suspension inspection, replacement of worn bushings, and all necessary adjustments
d) brake inspection, replacement of worn parts, and re-adjustment as required
e) inspection of all existing sensors and built-in data recording devices to insure functionality
f) functional check/system shakedown test.

C.5.1.3 Test Support. After vehicle refurbishment, the Contractor shall deliver the RSTV vehicle to the ATC with equipment and personnel to support testing, maintenance, and data collection. Contractor support shall consist of providing the following on-site engineering services: repair, maintenance and collection of data (power, torque, acceleration and speed, batterys state of charge, temperature of the electric drive components, voltage and current). Anticipated on-site engineering support is expected to consist of two engineers for six weeks and four trips to the ATC. At the conclusion of the testing period, the Contractor shall recover the vehicle and support equipment (including test data) from the ATC, returning and securing them in the Contractors facilities.

C.5.1.4 Reporting. The Contractor shall include all pertinent reporting data related to Section C.5 for the refurbishment of an RSTV and shakedown testing with the motor and inverter integrated along with the reporting requirements currently specified in the Contract. This includes Progress, Status & Management Reports (SOW Paragraph C.4.1, CDRL Item A001), Scientific & Technical Reports (SOW Paragraph C.4.2, CDRL Item A002), and Performance and Cost Reports (SOW Paragraph C.4.3, CDRL Item A003).

C.5.1.5 Performance Period. The Contractor shall refurbish the vehicle within 21 days from the award date of the applicable Contract modification and ship the vehicle to the ATC for performance testing. In addition, the Contractor will provide on-site engineering support as stated in Section C.5.1.3. This effort shall be executed concurrently with the current motor development activities, and the Period of Performance date for all work under this Contract is extended to 30 October 2007.

C.5.2 Generator Testing. The Contractor shall conduct expanded fuel economy testing for power generation/generator testing of the refurbished vehicles export power capabilities, in addition to power quality testing. The Contractor shall conduct the following MIL-STD tests:

a) MilStd 705C Method 601.1d Voltage Waveform Test
b) MilStd 705C Method 601.4b Voltage Waveform Test (Harmonic Analysis)
c) MilStd 705C Method 601.5.1 Voltage Waveform Test (Deviation Factor)
d) MilStd 705C Method 602.11 Voltage Modulation Test
e) MilStd 705C Method 608.1b Frequency and Voltage Stability Test (short term)
f) MilStd 705C Method 608.2a Frequency Voltage Stability Test (long term)
g) MilStd 705C Method 619.1b Voltage and Frequency Regulation Test
h) MilStd 705C Method 619.2c Voltage Dip and Rise for Rated Load Test
i) MilStd 705C Method 640.1d Max Power Test
j) MilStd 705C Method 670.1b Fuel Consumption Test

C.5.2.1 Results of this additional testing from Paragraph C.5.2 above shall be included with the reporting requirements of Paragraph C.5.1.4, and this additional testing will extend the period of performance for this Contract to 15 November 2007.

*** END OF NARRATIVE C 0001 ***

SECTION F - DELIVERIES OR PERFORMANCE

F.3: Delivery

F.3.1: All items called for in this Contract shall be delivered FOB Destination to:

U.S. Army Tank-Automotive and Armaments Command
ATTN: AMSRD-TSR-R / MS 121
Kenneth Ratcliff
6501 E. 11 Mile Rd.
Warren, Michigan 48397-5000

F.3.2: Delivery of Data set forth in the Contract shall be in accordance with DD Form 1423 (Section J).

F.3.2.1: Data item A001: Contractor's Progress, Status & Management report.

F.3.2.2: Data item A002: Final Technical Report (FTR)

F.3.2.3: Data item A003: Performance and Cost Reports

F.3.3: A complete motor and motor control inverter as described in C.1 through C.1.5 shall be delivered to the Government at the end of Contract performance.

F.4: Performance

The Period of Performance for this Contract shall from the date of award through 15 November 2007.

*** END OF NARRATIVE F 0001 ***

Name of Offeror or Contractor: GENERAL DYNAMICS LAND SYSTEMS INC

SECTION G - CONTRACT ADMINISTRATION DATA

LINE ITEM	PRON/ AMS CD/ MIPR	ACRN	OBLG STAT/ JOB ORD NO	PRIOR AMOUNT	INCREASE/DECREASE AMOUNT	CUMULATIVE AMOUNT
000104	R362V032R3	AC	2	$ 0.00	$ 29,226.00	$ 29,226.00
	M9545006MPR6ET7		62V032			
				NET CHANGE	$ 29,226.00	

SERVICE NAME	NET CHANGE BY ACRN	ACCOUNTING CLASSIFICATION	ACCOUNTING STATION	INCREASE/DECREASE AMOUNT
Marine Corps	AC	17 671319M7KC2506785400674432DC9864A00006MPR6ET7		$ 29,226.00
			NET CHANGE	$ 29,226.00

	PRIOR AMOUNT OF AWARD	INCREASE/DECREASE AMOUNT	CUMULATIVE OBLIG AMT
NET CHANGE FOR AWARD:	$ 895,176.00	$ 29,226.00	$ 924,402.00

ACRN	EDI ACCOUNTING CLASSIFICATION
AC	17 06071319M7KC 250678540067443 2DC9864A00006MPR6ET7 M9545006MPR6ET7 067443