AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. Contract ID Code	Page	Of
Cost-Plus-Fixed-Fee	1	7

2. Amendment/Modification No.	3. Effective Date	4. Requisition/Purchase Req No.	5. Project No. (If applicable)
P00002	2004JUL21	SEE SCHEDULE	

6. Issued By Code W56HZV

TACOM WARREN
AMSTA-AQ-ABGB
AL TRACIAK (586)574-7869
WARREN, MICHIGAN 48397-5000
HTTP://CONTRACTING.TACOM.ARMY.MIL
EMAIL: TRACIAKA@TACOM.ARMY.MIL

7. Administered By (If other than Item 6) Code S2305A

DCMA DETROIT
U.S. ARMY TANK & AUTOMOTIVE COMMAND
(TACOM)
ATTN: DCMAE-GJD
WARREN, MI 48397-5000

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

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

MKP STRUCTURAL DESIGN ASSOCIATES, INC.
3003 WASHTENAW AVE, SUITE 1-E
ANN ARBOR, MI. 48104-5107

TYPE BUSINESS: Other Small Business Performing in U.S.

Code 1V9M7 **Facility Code**

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

9B. Dated (See Item 11)

☒ **10A. Modification Of Contract/Order No.**
DAAE07-03-C-L010

10B. Dated (See Item 13)
2002DEC24

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)
NO CHANGE TO OBLIGATION DATA

13. THIS ITEM ONLY APPLIES TO MODIFICATIONS OF CONTRACTS/ORDERS

KIND MOD CODE: G

It Modifies The Contract/Order No. As Described In Item 14.

☐ **A. This Change Order is Issued Pursuant To: 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:** Mutual Agreement of the Parties

☐ **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)	
		WYMAN E. YOUNG II YOUNGE@TACOM.ARMY.MIL (586)574-8093	
15B. Contractor/Offeror	**15C. Date Signed**	**16B. United States Of America**	**16C. Date Signed**
_____ **(Signature of person authorized to sign)**		**By** /SIGNED/ **(Signature of Contracting Officer)**	2004JUL21

SECTION A - SUPPLEMENTAL INFORMATION

PROGRAM: SBIR Phase II, OPTIMAL DESIGN OF LIGHTWEIGHT AND HIGH PERFORMANCE STRUCTURE FOR FUEL-EFFICIENT ARMY AND COMMERCIAL GROUND VEHICLES

PURPOSE OF MODIFICATION: To replace a portion of the Statement of Work effort under Task III with Function-Oriented Material Design (FOMD) Methodology effort for the Hydraulic Launch Assist (HLA) system

PRIOR AND CURRENT CONTRACT AMOUNT: $ 730,000.00

1. This Modification P00002 is a bilateral supplemental agreement to contract DAAE07-03-C-L010. The purpose is to cancel effort for physical prototyping and validation testing a front rail system. The replacement effort is for enhanced FOMD capabilities and a function-oriented design of the Hydraulic Launch Assist (HLA) subframe mounting system. The replaced effort applies to the Ford 350 truck system, and the replacement effort can be applied to general vehicle systems, to include the Ford F350 truck system.

2. Based on this change in effort, Task III statement-of-work sections C.4.6 and C.4.7 are hereby removed. Task IV, with its two sub tasks is added in new Section C.7. Reference to the added effort is at Section C.1(3). (see complete revised version of Section C, pages 5, 6 & 7 of this modification)

3. The hardware deliverable at C.5.2 is hereby removed and replaced with "Specific to the Hydraulic Launch Assist (HLA) subframe-mounting system, new methodologies created in the FOMD software with multidisciplinary objectives, including weight, safety, durability, and noise, vibration and harshness (NVH), and a general concept design (a finite element and CAD model) for proof-of-concept of the methodologies developed. Both the finite element model to include the virtual prototyping results and the CAD model will be delivered to the Government as part of the Computer Software deliverable at A003."

4. The total dollars on contract will remain the same. The estimated cost of the tasks being removed in C.4.6 and C.4.7 is $80,000. The estimated cost of the new tasks in C.7 is $44,883. The contractor has experienced a cost growth of approximately $35,117 on Task C.2.3.1. The estimated cost of the removed tasks equates to the estimated cost of the new tasks plus cost growth. There should not be any fee associated with the cost growth, so the total fee is decreased by applying the fee rate of 5.0% to the cost growth of $35,117. or $1,755. The total fee on the contract is therefore reduced by $1,755 from $34,762 to $33,007. The fee amount reduction will not decrease the total amount of the contract. The total cost of the contract is therefore increased by $1,755 from $695,238.00 to $696,993.00 (see adjustment under CLIN 0001, page 3 of this modification).

5. The period of performance as originally stated in Section F.1 will remain the same.

6. All other terms and conditions of the contract remain in full force and effect.

*** END OF NARRATIVE A 002 ***

Name of Offeror or Contractor: MKP STRUCTURAL DESIGN ASSOCIATES, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS				
0001	R&D SERVICE NOUN: LIGHTWEIGHT STRUCTURES SECURITY CLASS: Unclassified Contractor shall furnish all the supplies and services to accomplish the tasks specified in Section C "Scope of Work" for SBIR Phase II. TOTAL ESTIMATED COST OF CONTRACT: $696,993.00* TOTAL FIXED FEE OF CONTRACT: $33,007.00* TOTAL ESTIMATED PRICE OF CONTRACT: $730,000.00 *Changed per modification P00002 (End of narrative B001) Inspection and Acceptance INSPECTION: Destination ACCEPTANCE: Destination	1	LO		$ 730,000.00
000101	R&D SERVICE NOUN: FY03 PHII MKP STRUCTURAL DESI PRON: E132C139EH PRON AMD: 02 ACRN: AA AMS CD: 665502M4055 (AMOUNT: $ 730,000.00)				
0002	CDRL DELIVERABLES SECURITY CLASS: Unclassified				
A002	FINAL TECHNICAL REPORT NOUN: CDRL A002, PARA. C.5.4 SECURITY CLASS: Unclassified Packaging and Marking Inspection and Acceptance INSPECTION: Destination ACCEPTANCE: Destination	3	EA	$ ** NSP **	$ ** NSP **

Name of Offeror or Contractor: MKP STRUCTURAL DESIGN ASSOCIATES, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
A003	COMPUTER SOFTWARE PRODUCT END ITEM NOUN: CDRL A003, DI-MCCR-80700 SECURITY CLASS: Unclassified Packaging and Marking Inspection and Acceptance INSPECTION: Destination ACCEPTANCE: Destination	1	EA	$ ** NSP **	$ ** NSP **

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

SECTION C: STATEMENT OF WORK (SOW)

OPTIMAL DESGN OF LIGHTWEIGHT AND HIGH PERFORMANCE STRUCTURES FOR FUEL-EFFICIENT ARMY AND COMMERICAL GROUND VEHICLES

C.1 Background and Objective: The goal of this SBIR II program is to develop Function-Oriented Material Design Methodology (FOMD) for the design of army ground vehicle structures. This design tool is critical to the material selection process to determine what new materials have the potential in terms of weight and performance. It will also provide an effective tool for the design, in an optimal way using the newly emerging engineered materials. Significant weight reduction up to 40 to 50 % is possible in the primary structures for future army ground vehicles. Besides the performance levels of Noise, Vibration and Harshness (NVH), crash energy absorption due to impact and stiffness/strength of army ground vehicles will be improved considerably.

The objective of this program is to refine the work conducted in SBIR Phase I program so that the methodologies can be used to lay out real and complex engineering designs for both military and commercial applications. This includes designing three-dimensional structures with consideration of high-velocity (ballistic) impact, durability and manufacturability. Three* major case studies include the:

(1) Optimum joint configuration (optimum joint structure and joint distribution) for an advanced composite armor to provide the Army a unique capability for developing advanced composite structural armor for the Future Combat System (FCS).

(2) Optimum crash energy absorption of the Front Rail structure of the Ford F350 truck frame to provide the Army, a unique capability to improve the design and performance of commercial truck platforms such as IMPACT program.

*(3) Development of FOMD methodologies in the software for the Hydraulic Launch Assist (HLA) mounting system.

* Added per Modification P00002.

The SBIR program will be conducted through four different tasks at C.2, C.3, C.4, and C.7.

C.2 TASK I: Development of new design methodologies: The contractor shall focus on the development of new design methodologies that shall provide the foundation for the more-application oriented developmental work. The subtasks to be performed are described in C.2.1, C.2.2, and C.2.3.

C.2.1 Topology optimization for high-velocity impact. The contractor shall extend the topology optimization developed in Phase I with the high-velocity impact problem. Theoretical and numerical investigations will be conducted with the consideration of the multi-physics process of the high-velocity impact in order to develop an effective method and efficient algorithm for the FOMD.

C.2.2 Topology optimization for durability. The contractor shall extend the topology optimization technique with the durability design problem in order to improve fatigue life of the structure. This effort will focus on the development of fundamental theory and numerical methods resulting in an advanced engineering tool for durability design problems.

C.2.3 Optimization algorithm for improving manufacturability. An advanced approach shall be developed for improving manufacturability of the design obtained from the FOMD. The contractor shall extend the multi-domain and multi-step topology optimization methods developed in the Phase I program to solve three-dimensional problems as well as the consideration of realistic manufacturing constraints in the optimization process.

C.2.3.1 Three-dimensional version of the FOMD: The contractor shall enhance the two-dimensional version of FOMD code developed in Phase I for designing advanced lightweight structures with more complex geometries and more realistic loading, boundary conditions and manufacturing constraints. The extended FOMD shall have a three-dimensional micro-cell element, which can be used to distribute materials in a three-dimensional domain. The numerical algorithm shall be enhanced for handling a design problem that is defined by a huge number (ten-thousands and more) of design variables. This development shall result in significantly reduced memory and storage requirements as well as significantly improved computational efficiency. The extended FOMD shall also consider more realistic manufacturing constraints so that the material pattern obtained from the design process can be fabricated at relatively low cost.

C.2.3.2 Graphic user interface for interactive design using FOMD. The contractor shall enhance the two-dimensional graphic user interface developed in Phase I to handle three-dimensional problems. This enhancement shall allow users to define the design problem, build the structural design model, and run optimization through the GUI, and also allow the user to access the design interactively to control the material distribution as desired.

C.3 TASK II: Joint design for advanced composite armor and its supporting structure. The contractor shall develop a mechanical joint concept for the attachment of an advanced composite armor to its supporting composite framed structure. The use of newly emerging armor material shall be considered. The subtasks to be performed are described in C.3.1 through C.3.6. The objective of this task is to deliver to the Army an effective engineering tool that can be used for modeling, simulation, and designing advanced composite armors for

future combat vehicles.

C.3.1 Identification of the Problem. A kick-off meeting will be held at TACOM to discuss unclassified technical details of the joint design problem including available modeling data and boundary and loading conditions that need to be considered.

C.3.2 Development of composite armor and supporting structure models. The contractor shall perform a finite element analysis for the ballistic impact and for the fatigue life prediction for the composite armor and the supporting structures.

C.3.3 Functional analysis of the joint. Based on the finite element models developed, the contractor shall analyze the joint to identify their exact roles in the structure and quantify the constraints for the optimization process.

C.3.4 Enhanced FOMD capabilities for the joint design. The contractor shall develop additional-necessary 3-Dimensional capabilities of the FOMD for the joint design problem. The necessary developments will depend on the results of the function analysis in paragraph C.3.3 and the specific considerations in armor design, material selections and fabrication processes for the composite armor and its supporting structure.

C.3.5 Optimum design of the joints. The contractor shall design optimum joints and their distribution (spacing of fasteners) with manufacturing constraints using the FOMD program. An interactive design process shall be employed with design iterations to obtain a suitable design.

C.3.6 Virtual prototyping and numerical validation: The contractor shall develop a virtual prototype of the final design using a commercial finite element code and shall perform numerical experiments to validate the design. If the virtual prototype cannot meet the design goal, a detailed study shall be conducted and a re-design process may be considered. Any redesign shall be subject to COTR approval.

C.4 TASK III: Concept design of a dual-use crash energy absorbing structure: The contractor shall develop a concept design for the Front Rail structure of a Ford F350 frame to improve its crash energy absorption capability and reduce the weight. Different materials can be considered as possible candidates in the material selection process to produce a real optimum structure. An optimum structure will consider both its mechanical performance and manufacturing costs. The subtasks to be performed are described below in paragraphs C.4.1 through C.4.7.

C.4.1 Identification of the problem and design specifications. The Government shall organize a meeting that will identify problems in the current design and will provide technical details of the Front Rail design problem including geometry information and loading conditions. The manufacturing process shall also be discussed to identify the manufacturing constraints and the materials and fabrication processes that can be used for making the part. The COTR shall coordinate the specific date, time, and location of the meeting.

C.4.2 Function analysis of the Front Rail structure. Function analysis of the Front Rail can be accomplished through a finite element analyses of the vehicle (or subsystem model) and through discussions with the COTR. Different loading conditions shall be considered including normal driving conditions and a variety of crash conditions (for example, different crash speeds and off-center crash conditions). Objectives and constraints shall then be determined through function analyses and will be considered in the optimization process.

C.4.3 Enhanced FOMD capabilities for the front rail design problem: Enhanced capabilities of the FOMD shall be developed for the Front Rail design problem. The necessary capabilities will depend on the results of the function analysis in paragraph C.4.2 and depend on the specific considerations of the Front Rail design and the manufacturing process employed for fabricating the part.

C.4.4 Function-oriented component design: The enhanced FOMD code shall be used to design the optimum structure. The contractor shall conduct a tradeoff study of the different objectives and constraints such as weight, stiffness, crash absorption capability and manufacturability, etc.

C.4.5 Virtual prototyping: The contractor shall develop a virtual prototype of the new design before developing an expensive physical prototype. The contractor shall conduct numerical experiments to determine what kind of physical prototype should be developed, as well as the loading and fixing conditions for the physical tests.

C.4.6, C.4.7: removed per modification P00002.

C.5 DELIVERABLES:

C.5.1: Software: The contractor shall deliver to the Government one complete CD-ROM set to include a full working copy of the final FOMD program at the end of the contract period.

** C.5.2: Specific to the Hydraulic Launch Assist (HLA) subframe-mounting system, new methodologies created in the FOMD software with multidisciplinary objectives, including weight, safety, durability, and noise, vibration and harshness (NVH), and a general concept design (a finite element and CAD model) for proof-of-concept of the methodologies developed. Both the finite element model to include

the virtual prototyping results and the CAD model will be delivered to the Government as part of the Computer Software deliverable at A003.

** Changed per Modification P00002

C.5.3 Status Reports: The contractor shall prepare and submit eight (8) status reports in accordance with CDRL item A001. The status reports shall summarize work completed, the contract tasks still not completed and any significant accomplishments, problems or delays. The status reports shall also report all total costs incurred to date, with specific reference to the costs incurred since the last status report was published.

C.5.4 Final Technical Report: The contractor shall prepare a draft final report in accordance with data item A002 and deliver to the COTR thirty (30) days prior to the end of the contract. The government shall review the draft and provide comments to the contractor within fifteen (15) days after receipt. The contractor shall include the recommendations into the final report and deliver to the Government within fifteen (15) days in accordance with the requirements set forth in Section F and CDRL A002.

C.6 Meetings

C.6.1 Kick-off Meeting: A kick-off meeting at TARDEC will be required at the start of the contract within 15 days after contract award.

C.6.2 First year review: There shall be a review meeting at TARDEC after the end of the first year.

C.6.3 Final Review: The final review meeting shall be at TARDEC after the end of the contract period.

***C.7 TASK IV: Hydraulic Launch Assist (HLA): The contractor shall develop FOMD methodologies for the HLA, and complete a function-oriented design of the concept HLA subframe mounting system, and perform a proof-of-concept through virtual prototyping. The subtasks to be performed are described below in paragraphs C.7.1 and C.7.2.

C.7.1 The contractor shall develop Function-Oriented Material Design (FOMD) methodologies for the HLA subframe-mounting system design problem for the Ford F350 with consideration of the multidisciplinary objectives of weight, safety, durability, and noise, vibration and harshness (NVH). These methodologies will be used to come up with the optimal design for HLA reinforcement structure, mounting system, and subframe. The methodologies will be developed to also be applicable to a general (other than Ford F350 specific) subframe design problem and to a general vehicle system.

C.7.2 The contractor shall complete the function-oriented design for the HLA subframe-mounting systems. The contractor shall develop a general (other than Ford F350 specific) concept design for the HLA supporting system, including the optimum HLA reinforcement structure, optimum mounting system, and optimum subframe, as an integrated system. The contractor shall also conduct virtual prototyping for demonstrating the proof-of-concept, using finite element analyses and other analytical tools. Iterations will be conducted between Tasks C.7.1 and this subtask (C.7.2) until suitable designs are obtained. The final results shall be suitable for use in the HLA program by providing a design process for the Ford F350 HLA subframe-mounting system.

*** Added per Modification P00002

*** END OF NARRATIVE C 001 ***