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Research, Evaluation and Analysis of Design Changes to the MLRS Launcher and Carrier (5-20162 & 5-20163)

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6 May 1998 through 31 December 1999

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Prepared by:

Gary A. Maddux

Systems Management & Production Lab
The University of Alabama in Huntsville
Huntsville, Alabama 35899

Prepared for:

U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898
Attn.: Mr. Doug Johnston

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Gary A. Maddux

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Univ. of Alabama in Huntsville
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The Industrial Operations Division (IOD), Engineering Directorate (ED), RDEC, AMCOM has the mission and function of providing technical management and engineering analysis as they relate to design changes for AMCOM supported weapon systems. This management and analysis ensures that design changes are incorporated only after a systematic technical evaluation and review of the cost of the change is conducted. The systems engineering analysis evaluates the long-term life cycle consequences of the change, to include impacts on the manufacturability, maintainability and supportability of the overall weapon system. In order to fulfill its mission, IOD required research, analysis and evaluation of proposed changes to the Multiple Launch Rocket System (MLRS) launcher and carrier. This research effort concluded with a detailed analysis of the impacts of proposed changes on the current manufacturing processes and life-cycle support activities that were currently in place within the MLRS Project Office.

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GARY A. MADDUX
Print or Type Name

Gary A. Maddux 31 JAN 00
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PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. The purpose of this report is to provide documentation of the work performed and results obtained under Delivery Order 9 of AMCOM Contract No. DAAH01-98-D-R001. Mr. Gary Maddux was the principal investigator. System Studies and Simulation, Incorporated, who served as a subcontractor on this effort, provided significant technical support. Mr. Doug Johnston, Industrial Operations Division, Engineering Directorate, Research, Development, and Engineering Center, U.S. Army Aviation & Missile Command, provided technical coordination.

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Prepared for: Commander
U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898

I have reviewed this report, dated January 2000 and the report contains no classified information.

Gary A Maddux

Principal Investigator

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1.0 Introduction

The Industrial Operations Division (IOD), Engineering Directorate (ED), RDEC, AMCOM has the mission and function of providing technical management and engineering analysis as they relate to design changes for AMCOM supported weapon systems. This management and analysis ensures that design changes are incorporated only after a systematic technical evaluation and review of the cost of the change is conducted. The systems engineering analysis evaluates the long-term life cycle consequences of the change, to include impacts on the manufacturability, maintainability and supportability of the overall weapon system.

In order to fulfill its mission, IOD required research, analysis and evaluation of proposed changes to the Multiple Launch Rocket System (MLRS) launcher and carrier. This research effort concluded with a detailed analysis of the impacts of proposed changes on the current manufacturing processes and life-cycle support activities that were currently in place within the MLRS Project Office.

2.0 Objective

The objective of the work performed under this task order was to research, evaluate, analyze and develop recommendations as to the impacts of proposed design changes to the MLRS launcher and carrier. These recommended design solutions required close interaction with the MLRS Project Office, their prime and subcontractors, and other Government agencies. Solutions were presented to the MLRS Project Office and the IOD in the form of briefings and other detailed presentations as required by the project office.

3.0 Statement of Work

The statement of work, as outlined in delivery order 9, was as follows:

3.1 UAH shall research, review, evaluate and analyze design changes related to the systems, subsystems, and components on the MLRS launcher and carrier, including:

3.1.1 Azimuth Drive Unit (ADU), including use and limitations, static and dynamic braking requirements, and emergency stopping.

3.1.2 Launcher hydraulic and mechanical systems.

3.1.3 Launcher/carrier components that are the subject of reported field problems.

3.2 UAH shall work closely with the International Partnership Office, MLRS Project Office to perform the following research and analysis:

3.2.1 UAH shall review and evaluate requests from Memorandum of Understanding (MOU) Partner nations for Production Support Order (PSO) requirements.

3.2.2 UAH shall provide technical input on preparation of PSOs IAW DA/DOD policy.

3.2.3 UAH shall provide technical and project management advice on closure and disbursement of PSO funds and proper documentation IAW DFAS regulations and policies.

3.2.4 UAH shall provide technical input to co-production/cooperative program MOUs on recoupment/financial arrangements and third party sales policy and regulatory requirements.

3.3 UAH shall provide engineering and technical expertise to evaluate and provide solution options related to spare parts procurement problems.

3.3.1 UAH shall analyze the producibility of the MLRS weapon system and subsystems. The analyses shall be performed on parts specifically identified by the government. UAH shall analyze TDP data (listings, engineering documentation and changes thereto) to advise the government if the present baseline and/or detail drawings are adequate for competitive procurement and/or manufacture. UAH shall, during TDP analysis, document any costs reduction opportunities in the TDP, using value engineering methodology as a generally accepted practice of cost analysis. UAH shall provide a written report for each TDP analyzed. The report shall detail any deficiencies and provide recommended solutions. UAH shall provide recommended TDP updates where applicable.

3.3.2 UAH shall perform an engineering analysis on producibility problems identified during the procurement cycle of MLRS secondary items. The analysis shall require review of drawings, specifications, and related materials pertaining to the identified problem. UAH shall determine and recommend solutions to the producibility problems(s) and provide rationale to support recommendations. UAH shall during engineering analysis, document any cost reduction opportunities in the TDP, using value engineering methodology as a generally accepted practice of cost analysis. Results of the analysis shall be prepared and furnished in a written report.

4.0 Analysis of the MLRS System

The following presents a detailed listing of tasks performed under this effort.

- **ECP MI-C1853, Discontinuance of M39015, RTR22, and RTR24 Series Trim Pots, 17 July 1998** – ECP revised the parts substitution list to add M39035, RJR24 series trim pots as an acceptable alternate. Reviewed and submitted recommendation.

- **Production Support Order PSEA058** – Provided technical input and assistance in developing PSEA058 for the European share of TACOM System Technical Support Contract with United Defense Limited Partnership and General Dynamics Defense System for the period 1 Jun - 31 Dec 99.

- **Production Support Order PSEA057** – Provided assistance in implementation of PSEA057 that provides European share of our IES contract for CY 99, period 1 Apr 99 - 31 Mar 00.

- **Production Support Order PSEA015** – Assisted in funding reconciliation and closure of PSEA015.

- **RDT&E Funds from FMS Sales** – Supported calculations and disbursement of approximately $6M in RDT&E funds to our partner countries from FMS sales during CY 98.

- **IFCS Capacitor Interchangeability Suitability Study** – Defense Logistics Agency (DLA) offered twelve capacitor part numbers for evaluation as substitutes for twelve Improved Fire Control System (IFCS) capacitor part numbers. The IFCS capacitor part numbers did not have National Stock Numbers (NSNs) assigned. Approval would alleviate the need to create new NSNs. Recommended approval of three as substitute capacitors.

- **MLRS Mission Timeline** – Developed MLRS Mission Timeline Crosswalk. Reviewed timeline requirements of various requirements documents and reconciled differences.

- **Travel Lock Actuator** – Current travel lock actuator requires five (5) seconds to extend/retract. Tasked to locate a source for an actuator that requires less than two (2) seconds to extend/ retract. Located source capable of 0.5 second response time.

- **ADU Launcher Level Qual Test Review** – Reviewed and provided comments on the qualification test plan.

- **Request for Deviation; Gear Rack Bolts** – Reviewed standards for tolerance on multiple level of hole locations. Provided recommendations on guidelines for units to be accepted/rejected.

- **Windshield Wiper Motor Installation** – Assisted in the installation and check out of a new MLRS carrier windshield wiper motor.

- **MLRS M270 Incident Reports** – Updated, categorized, and coordinated incident reports.

- **MLRS M270A1 Hardware Delivery Schedule** – Reviewed delivery schedules, validated requirements, and developed a consolidated hardware delivery schedule.

- **ADU Life Cycle Cost Review** – Performed independent review of prime contractor's analysis of life cycle costs of old and new Azimuth Drive Unit. Identified numerous inconsistencies and biases and provided written report.

- **M270A1 Cost Proposal** – Conducted extensive detailed independent review of the labor hours and material cost of the prime and major vendors cost proposals. Identified numerous excessive labor hours and vendor quotes. Provided written report which led to a negotiated reduction of 50% of the proposed labor hours.

- **ECP 1823; PWB Measling/Crazing** – Reviewed ECP and provided comments on the appropriate limits for acceptance.

- **ECP 1842; EU Obsolete Parts** – Reviewed and provided comments on obsolete parts for the Electronic Unit.

- **ECP 1846; Resolver Mounting/Shaft Mod** – Reviewed and provided comments on the proposed modification to the resolver and shaft.

- **ILMS Risk Assessment** – Conducted independent review of and provided comments on the prime contractor's risk assessment of early procurement of ILMS hardware.

- **Cost Performance and Schedule** – Updated the ILMS Cost Performance and schedule and provided report.

- **ECP 1810; Cage Hoist Carriage and Boom** – Reviewed and provided comments on the rear rollers.

- **ECP 1871; Cage Dimension, Limit Switch, and Duffel Bag Box** – Reviewed and provided comments on the ECP.

- **CR 0683; W125 Electric Cable Assembly** – Reviewed the proposed Change Request and made comments on the proposed engineering changes.

- **13025224 First Article Rejection** – Reviewed the Contactor Assembly first article rejection and recommended changes for an acceptable article.

- **13212904 RFD/RFW** – Reviewed the Roller, Flex Conduit RFD/RFW and provided comments.

- **ECP 1691R2** – Reviewed and provided comments on the SIE for NVMM.

- **LIDAS Failure Analysis** – Reviewed historical records of LIDAS equipment and conducted phone interviews with users to determine high failure modes and shortcomings of the equipment. Provided recommendation for future actions.

- **CR 639R1** – Reviewed the Request for Change for the M446 Fuze and provided comments.

- **CR 700** – Reviewed the Change Request and provided comments.

- **Change Request List Reconciliation** – Reviewed NAMSA and LMVS list of CRs and reconciled differences.

- **M270 Environmental and Vibration Requirements** – Reviewed the environmental requirements for the top of the cab and interior for potential installation of remote self-defense system on the MLRS launcher.

- **MIL-S-13949 vs IPC-4101** – Compared MIL-S-13949 and its replacement, IPC-4101, for suitability for application to the MLRS.

- **M270A1 Pod to Launcher ICD** – Reviewed and provided comments on the mechanical Interface Control Document for the rocket pod to launcher interface.

- **Digitized Cell ICD** – Performed an in depth review of the Digitized Cell Interface Control Document for electrical interfaces. Compiled the comments of other reviewers and submitted a consolidated report.

- **Digitized Cell PRF** – Performed an in depth review of the Digitized Cell Performance Specification. Compiled the comments of other reviewers and submitted a consolidated report.

- **Power Distribution Breakout Box** – Reviewed the Technical Data Package (TDP) for the power distribution break out box. Identified short falls and means of correcting the TDP. Identified potential sources for procurement of the test equipment.

- **OSCR Program** – Provided support for the OSCR Program.

- **Turret Cracks** – Reviewed historical records of cracks in the heat affected zone of welds in the MRLS turret. Assisted in collecting test data to determine the internal stress associated with the welds. Completed first phase of a continuing investigation to determine a suitable course of action for the MLRS rebuild program.

- **Resolver TDP Issues** – Reviewed azimuth resolver switch TDP and provided comments.

- **LAR Reports** – Reviewed and evaluated Logistics Assistance Representatives (LAR) weekly reports of engineering related issues. Provided periodic updates of issues.

- **LAR Reports, Engine Failures** – Carrier engine failures were identified as a major issue in Logistics Assistance Representatives weekly reports. A special study was conducted to identify the cause. The cause was identified as inadequate quality control at the contract repair facilities due to inadequate contractual requirements and coordination.

- **IFCS Obsolescence** – Provided support in the review of IFCS obsolescence issues.

5.0 Conclusion and Recommendations

During the time frame allocated by the delivery order, members of the UAH Systems Management and Production Lab, with the cooperation of representatives from AMCOM Engineering Directorate and the MLRS Project Office conducted an engineering analysis of the MLRS launcher and carrier. It is recommended that the Project Office continue to monitor the configurations of its equipment to ensure the MLRS remain cost effective and high quality.