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TECHNICAL TASK ORDER CONTRACT

FINAL TECHNICAL REPORT

June 1, 1983

RDM/W-83-375-TD

CLEARED
FOR OPEN PUBLICATION

SEP 16 1983

DIRECTORATE FOR FREEDOM OF
AND SECURITY REVIEW
DEPARTMENT OF DEFENSE

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DARPA TACTICAL TECHNOLOGY OFFICE
TECHNICAL TASK ORDER CONTRACT
FINAL TECHNICAL REPORT

In February 1983, the Defense Advanced Research Projects Agency (DARPA) Tactical Technology Office (TTO) contracted with The BDM Corporation (BDM) for BDM to provide quick-reaction research in support of DARPA/TTO programs. The objective of the effort was to provide informational research and analyses to DARPA/TTO on a quick-reaction basis across a broad spectrum of technologies pertinent to tactical technology. The program required to support the scope of effort included specific research and engineering analyses, information processing, and interpretive analyses. The accomplishment of the contract objectives were realized by the execution of several Technical Task Orders. The response times of these tasks varied from several weeks to several months, depending on the requirements of DARPA/TTO. Each task was essentially self-contained, describing the task approach. Upon completion of each task, a technical report and/or briefing was submitted to describe the results. This final technical report describes the technical research and findings of the total contract during the reporting period February 24, 1982 through June 1, 1983. Summaries of the work performed under each Task Order are presented consecutively by TTO number.

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TTO #1 BREAKTHRU

A. OBJECTIVE

The BREAKTHRU program concept focused on introducing high-risk, high-payoff technology into evolving combat vehicle design strategies. The concept envisioned utilizing DARPA's capability in advanced technology development to complement the TACOM Advanced Test Bed Program.

B. APPROACH

BDM's approach to performing this task was to:

- (1) Conduct a joint review of the BREAKTHRU concept vis-a-vis the DARPA Advanced C³ Program Plans and the Intent Driven Weapons System to define program commonality and key interfaces;
- (2) Prepare a prioritized menu of individual technology thrusts under the global BREAKTHRU effort for DARPA/TACOM review, revise their comments as necessary, and establish a prioritized plan for proceeding with the implementation;
- (3) Prepare a strawman outline to test and evaluate the prioritized BREAKTHRU technology initiatives in the context of the TACOM Test Bed Program; and,
- (4) Attend DARCOM Program Advisory Council (PAC) and Action Team meetings as required and directed by DARPA.

C. FINDINGS

Under this task, BDM conducted a series of efforts to identify BREAKTHRU technology initiatives for the advanced land combat vehicle of the future. These efforts consisted of reviews of the 1995-2010 battle-field, DARCOM R&D technology base, evolving ACV designs, and future ACV designs based on program development plans. A workshop on propulsion and

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BREAKTHRU technologies was held, constraints on future ACV designs and associated critical pacing technologies were identified, and a prospectus of required technology initiatives was proposed. These included the identification and development of prime power source technologies for power sources compatible with new weapon systems (i.e., with the pulse power requirements of likely-to-be-fielded directed energy systems), reliable, terrain-adaptable methods of locomotion, and self-protection: active (energetic armor, active defense) and passive (energy absorbing, dynamic control of signatures). BDM prepared a program plan consisting of an initial phase defining the most innovative technological approaches in vehicle design, a proof-of-concept phase for laboratory study of most promising concepts, system selection phase for full-scale technology demonstration, and a field testing phase.

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TTC #2 PRELIMINARY PLANNING FOR CRITICAL NODES EXPERIMENT

A. OBJECTIVE

This task focused on development of a preliminary plan for the conduct of the Critical Nodes Experiment. The plan encompassed addressing key planning and coordination elements; namely, data development methodology, test requirements, and planning coordination measures.

B. APPROACH

BDM's approach to performing this task was to provide information concerning the following:

- (1) Preliminary sensitive targeting data base development procedures and methodologies;
- (2) Coordination measures with SETD (MITRE) for planning the experiment as an integral part of the Node Breaker Program; and
- (3) Experiment test planning requirements (i.e., scheduling, briefings, and coordination in-theater).

C. FINDINGS

The identification of sensitive data base material, procedures, and methodology was limited to basic all-source data focused on operations associated with selected critical nodes located within 150km prescribed range. Also, a description of coordination measures that will be followed with SETD (MITRE) for integration of the experiment in the overall Node Breaker Program and a preliminary schedule of events showing milestones for planning events, briefings, and coordination in Europe was provided. These results were presented in an end-of-task briefing and final report.

TTO #3
ADVANCED C³

A. OBJECTIVE

The Advanced C³ task encompassed investigating new C³ technologies, and recommending promising technologies in need of development. Also, the recommendation of promising technologies included preparation of test and evaluation procedures for the demonstration of proposed system design.

B. APPROACH

The approach taken to perform the Advanced C³ task was to:

- (1) Review existing and completed studies having utility for the C³ battlefield. This concept included a review of studies on hardware and software for sensor management, visual displays for human interfaces, and architectures for communication management.
- (2) Analyze results of studies and requirements of the battlefield commander from the point of view of an expanded C³ battlefield environment.
- (3) Identify systems architecture concepts and new technologies in need of development.
- (4) Prepare an outline of test and evaluation requirements and recommendations for possible demonstration of the most promising system options.

C. FINDINGS

The efforts of this task resulted in the identification of the information needs of combat commanders from the tank commander level through the corps commander level. Additionally, performance criteria were established

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for possible demonstration of promising new technology systems. Finally, recommendations were made for future DARPA efforts on an advanced C³ program, supporting the Army's VISTA and VINT² concepts. All of the results of this task were presented in a comprehensive final briefing.

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TTO #4 PROGRAM REVIEW

A. OBJECTIVE

The objective of this task was to support new technology development by performing a review of specific existing programs. The Naval Warfare Office/Tactical Technology Office desired a review of program plans and status of SLINGSHOT, REGAL TORPEDO, OCEAN TACTICAL TARGETING, and SMASH current programs, and SIAM and AUSEX residual programs.

B. APPROACH

The BDM Corporation, through a consulting agreement, planned on utilizing Mr. N. L. Thompson to achieve the objectives of this task. Mr. Thompson was to review the plans and status of the necessary programs and recommend further documentation of program-generated technical information where appropriate. The results of this effort were to be presented in a final report and briefing.

C. FINDINGS

BDM, with the assistance of Mr. Thompson, reviewed the program plans and status of DARPA/TTO SLINGSHOT, REGAL TORPEDO, OCEAN TACTICAL TARGETING, and SMASH current programs, and SIAM and AUSEX residual programs. Specific recommendations on each program were made as well as program-wide recommendations for continual cross-fertilization of program technical issues and progress information among program managers.

TTO #5
TECHNOLOGY AND THEATER DETERRENCE
EXPANDED ISSUES

A. OBJECTIVE

The Technology and Theater Deterrence Expanded Issues task encompassed a research of additional material for inclusion in the TECHNOLOGY AND THEATER DETERRENCE REPORT. This material relates to specific new initiatives involving survivability of forces in the central battle zone, the components and cost of a close-in surveillance system, the cost of TNF modernization, and additional applications of cruise missiles.

B. APPROACH

The approach taken to perform the Technology and Theater Deterrence Expanded Issues task was to:

- (1) Research additional initiatives specific to each theater of interest and generally applicable to all major theaters addressed in the report.
- (2) Expand discussions on TNF survivability and security issues. This includes addressing the impact of range increases and new safety and security technologies on survivability, and address the implications of long-range TNF modernization on equal risk sharing within the European NATO countries.
- (3) Expand on unclassified discussion on targeting capabilities and estimate residence times of enemy forces when assembly areas and the time enemy forces are exposed while marching, versus the response times of weapons and C³I.

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C. FINDINGS

Estimated target dwell times for fixed and moving conditions were compared to the response times of C³I and weapon systems. These were found to be adequate under many conditions. In general, however, a main targeting problem lies in connecting sensors, combat commanders, and weapon systems.

Recommendations were made concerning further development of general new safety/security technologies that potentially permit less constrained TNF storage options. These options could significantly reduce TNF vulnerability. Similarly, range increases can decrease vulnerability by geometric increases in position location uncertainty. Also, costs were provided on changing the mix of TNF from predominantly short range to predominantly long range.

Detailed discussions were provided on the characteristics, organization, and cost of a close-in surveillance system in selected chapters of the TECHNOLOGY AND THEATER DETERRENCE REPORT.

Finally, rationale was provided concerning the importance of stationing weapons on allied territory other than Germany and Great Britain, an important reason for completing deployment of long-range TNF on such territory.

TTO #6
LAND WARFARE TECHNOLOGY IDENTIFICATION

A. OBJECTIVE

This task encompassed identifying high-payoff technology initiatives to meet (Air/Land 2000) land warfare combat operational requirements.

B. APPROACH

The approach taken to perform the Land Warfare Technology Identification task was to:

- (1) Gather information based on review of the following documents: Air-Land 2000, Sea War 2000, DSB Summer Study, ASB Summer Study, and the Army Long Range RDA Plan;
- (2) Develop requirements for successfully conducting future military operations under the Air/Land 2000 concept; and,
- (3) Assess projected initiatives for their relation to the major technology thrusts identified, payoff potential (military worth), potential users, IOC requirements, development risk, scope, and development time required.

C. FINDINGS

This assessment resulted in a prioritized list of high-technology initiatives which relate directly to projected military requirements and for which no current technology program exist. A set of briefing view-graphs depicting the results of the study and 10 copies of an annotated briefing book were developed and delivered under this task.

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TTO #9 AUTOMOTIVE PROPULSION REVIEW

A. OBJECTIVE

The objective of this task consisted of conducting a comprehensive review of advanced propulsion concepts and identifying technologies in need of accelerated development. This included placing special emphasis on automotive propulsion concepts which could have a significant impact on projectile system performance.

B. APPROACH

The following tasks constituted the program approach, in which BDM:

- (1) Assembled a review package of previous DARPA concepts for a free piston engine pump (FPEP)/hydraulic drive automotive system for armored combat technologies. This review was based on data from BDM, National Waterlift, and Pulsepower Systems, developed in the 1978-1979 time on this engine technology. The analysis stressed the utility of the concept as a modular power pack with zero idle fuel consumption and instant power start-up.
- (2) Assembled a prospectus of technologies appropriate for electro-mechanical propulsion for combat vehicles. This effort was based on on-site consultations with Dr. William Weldon at the Center for Electro-Mechanics at the University of Texas at Austin. Other power sources described in the literature, such as aluminum/water battery technology, were considered.
- (3) Prepared a review of the technology areas described above through more conventional development automotive propulsion technologies, including the TACOM adiabatic diesel and the USMC/Curtiss-Wright rotary engine for combat vehicles. Novel concepts for very high horsepower engine/generator combinations for low duty cycle application (EM gun) were also considered.

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C. FINDINGS

A workshop on automotive propulsion for land combat vehicles was held at BDM on July 8, 1982. The charter of the one-day workshop was to discuss technologies in prime power and locomotion for land combat vehicles and to identify the most promising technologies for development. Progress was made primarily in the area of prime power with recommendations for further development of the free piston engine for the near-term and a study of nuclear reactor-cryogenic systems for the far-term. BDM summarized the results of the workshop and made recommendations on the promising technologies to DARPA.

TTO #13
SPECIAL WARFARE ORGANIZATION

A. OBJECTIVE

The Special Warfare Organization task encompassed a survey of the RDT&E field as it pertains to the development of special warfare equipment and techniques, and the identification of a number of alternative ways to organize and administer a DARPA program to carry out special warfare research and development.

B. APPROACH

The approach taken to perform the Special Warfare Organization task was to:

- (1) Review existing and completed R&D efforts for special warfare and identify problem areas where a DARPA-sponsored program would be structured to overcome.
- (2) Identify and develop the composition and structure for special advisory groups. These groups will be made up of members from the special warfare communities and will meet with DARPA program personnel to formulate operational needs.
- (3) Identify and develop the internal structure of the special warfare program organization and define responsibilities. This effort will account for technical and managerial expertise required to run the day-to-day operations.
- (4) Define program review mechanisms and special procurement handling methods which could be used for experimental and field hardware.

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C FINDINGS

This effort offered a number of alternatives on how the DARPA Special Warfare Program can be organized and administered. Personnel assignments, composition of advisory groups, and relationships within the Defense community were developed. A final briefing presented the results of this task.

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TTO #15
ARMY EQUIPMENT UPGRADE

A. OBJECTIVE

The objective of this task was the performance of a mission area analysis, Army equipment identification, and a survey of DARPA technologies for identification of high leverage equipment upgrade opportunities.

B. APPROACH

The following tasks were accomplished:

- (1) Task 1 - Battlefield Requirements: Army functions and tasks were categorized by mission and assessed with regard to the importance of associated tasks and functions, and the capability for their fulfillment. Findings supported determination of what needs to be done, how it can be done, capabilities to accomplish missions, and possible areas for high payoff potential.
- (2) Task 2 - Army Equipment Identification: A survey of US-origin ground combat equipment was conducted to determine the number, location, and condition of such equipment by type. This included equipment which resides with the United States Army (active and reserve components), allies, and friendly nations who face a Soviet or Soviet proxy threat.
- (3) Task 3 - Survey DARPA Technologies: BDM updated and made current previous work in which DARPA programs have been identified and categorized. This update determined the applicability of DARPA technologies to ground combat equipment upgrade. DARPA offices were surveyed to determine the nature and results of current and recent-past programs.

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C. FINDINGS

BDM performed an indepth study of current Army equipment, threat and required capabilities, and relevant technologies. During the course of the study, BDM hosted a DARPA Senior Advisory Group conference in which senior experts discussed technologies and programs for recommendation to the Army. A program was developed for presentation to the Army by DARPA which recommended four separate but related upgrade efforts to be conducted for the Army by DARPA. They are:

- (1) M47/48 tank upgrade - fire control and armor;
- (2) M113 APC conversion to fighting vehicle;
- (3) M42 AA gun enhancement - fire control, ammunition; and,
- (4) 4.2" Mortar ammunition for antiarmor role.

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TTO #16 TARGET VALUE ASSESSMENT

A. OBJECTIVE

The Target Value Assessment task encompassed assessing the value of destroying a number of critical targets in terms of impacting the central battle.

B. APPROACH

The approach taken to perform the Target Value Assessment task was to:

- (1) Select twenty candidate critical targets and examine for consistency with current targeting concepts according to US combat doctrine,
- (2) Classify these targets into five functional categories according to Soviet organization, and
- (3) Assess the overall contribution to the battle and impact of loss or damage of each target category.

C. FINDINGS

All target categories were examined in detail and a single representation from each functional category was selected to portray the impact of its destruction on the battle. Results for each selection were provided in a briefing presented to DARPA.