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NBC Contamination . . .

MATERIEL SURVIVABILITY

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ABOUT THE COVER

The front cover, which is related to an article on survivability of Army materiel on the NBC battlefield, shows decontamination of an armored personnel carrier. The back cover is associated with an article on international armaments cooperation.

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NBC Contamination Survivability of Army Materiel

By Raymond H. Montgomery II and Stephen J. Demora Jr.

Introduction

Imagine a conflict in which nuclear weapons, biological agents, and chemical agents are being employed by enemy forces. The enemy attacks are localized in nature with both persistent and non-persistent chemical agents being used. Specific areas such as friendly rear area logistical installations, rail yards, air bases, and command, control, and communications centers are being subjected to heavy concentrations of persistent agents. Friendly nuclear, biological, and chemical (NBC) casualties were initially high due to the surprise nature of the attacks. However, NBC casualties are decreasing significantly as units adjust to operating in an NBC-contaminated environment.

Although personnel survivability has improved, decontamination of equipment such as radios and weapons systems exposed to chemicals, biological agents, and radioactive fallout continues to be a problem as units try to cope with requirements for decontamination with their limited assets. The units are decontaminating as best they can. However, the process is slow and not always successful. In many cases, decontamination severely degrades or destroys components (especially electronic) due to the corrosiveness of the decontaminates used. In general, decontamination is a major problem for friendly forces.

AR 70-71

The problem associated with decontamination of equipment faced by our hypothetical friendly forces is but one of the problems associated with survivability on an NBC-contaminated battlefield. Many of the problems have already been identified and corrective actions are being taken to remedy them. AR 70-71, Nuclear, Biological, and Chemical Contamination Survivability of Army Materiel, is one of those actions. It establishes Army policy and mandates procedures for the development and acquisition of materiel to insure its survivability on the NBC-contaminated battlefield.

Mission-essential equipment, i.e., that materiel necessary to accomplish the primary or secondary functions of the unit or the organization, must now be designed for use on a contaminated battlefield. This regulation insures that mission-essential equipment with characteristics such as loose-fitting doors, exposed electronic components, and unreachable areas and surfaces where contamination can accumulate will no longer be procured. Further, mission essential equipment already in the inventory must be retrofit to meet survivability specifications unless a waiver is granted. It is imperative that everyone understand and comply with the provisions of AR 70-71 in order to insure that the Army is ready to face the problems of NBC-contamination survivability on future battlefields.

The Goal

The overall goal of the Army NBC Contamination Survivability Program is to enhance the Army's ability to accomplish its mission in an NBC-contaminated environment. To achieve this goal, everyone concerned with development and use of Army mission-essential equipment must contribute their expertise to the objectives stated in AR 70-71. For instance, each of us must consider contamination survivability as early as possible in the development cycle of mission-essential equipment in order to maximize capability while minimizing cost of equipment. We must also enhance technical data bases to support design efforts associated with contamination survivability.

In consonance with these objectives, we must develop training programs to make personnel capable of operating on an NBC-contaminated battlefield. These, as well as other objectives, contribute to the overall goal. You can determine your responsibilities by reviewing AR 70-71. It clearly assigns responsibilities for each stated objective to an appropriate organization. In addition, AR 70-71 requires specific actions to be accomplished such as inclusion of NBC-contamination survivability criteria in requirements documents, operational testing to insure that criteria are met, and certification that the equipment meets stated criteria by materiel developers. Individuals not familiar with AR 70-71 must become knowledgeable of its contents in order to provide the Army with NBC-contamination survivable equipment.

To date, the Army NBC Contamination Survivability Program has produced results in consonance with stated goals. The operational capability of the Army has increased. Combat, combat support, and combat service support units are receiving and are using mission-essential equipment which has been designed for NBC contamination survivability. This improved operational capability translates directly into increased confidence in equipment, morale, and efficiency for personnel and units carrying out assigned missions.

Obviously, discussion of NBC topics throughout the Army has increased, especially in organizations which are not traditionally associated with NBC activities. These discussions not only lead to increased awareness, but generate a desire and/or need to learn more about the subject. The resultant dissemination of information through discussions and printed materials serves to better prepare the Army to accomplish its mission. The increased NBC-contamination survivability definitely impacts threat force NBC weapon usage planning in that these weapons will no longer produce the desired level of results. The Army NBC Contamination Survivability Program, through better equipment and active exchange of information, has definitely had a positive impact on the operational capability of the Army.

Early Identification

The key to this program is to identify NBC-contamination vulnerability early in the development cycle. All combat developers are required to identify deficiencies in their proponent areas through a process called Mission Area Analysis (MAA). Deficiencies are incorporated into a Battlefield Development Plan (BDP). Materiel developers can then respond to the identified requirements of the Army.

Combat developers must identify, as part of their deficiency analysis, NBC contamination survivability requirements. If these requirements have been identified early enough, the development process can accommodate them with minimal design/cost impact. If not identified early, and redesign or retrofit of equipment is required, the costs increase. One area of difficulty within this

process is the threat capability assessment. Each item of equipment seems to produce a different threat assessment even though it may be required to function on the same battlefield.

There are few general guidelines for engineers and planners which structure thinking about NBC contamination vulnerability. Similar systems should have similar threat assessments. Designing a system to meet all requirements has not always worked in the past and may well be impossible (perhaps due to cost) in the future. Rational, well-informed decisions must be made on general threats to types of systems and the level of risk that the decision makers are willing to accept. Failure to identify NBC contamination survivability requirements will result in costly delays in remedying identified deficiencies.

In order to accomplish a systematic resolution of deficiencies, combat developers and users must coordinate requirements with appropriate organizations such as the Chemical Research Development, and Engineering Center and the Chemical Center and School to produce realistic results. These and other organizations have expertise in threat characteristics, NBC equipment design characteristics, and alternative approaches to requirement solution.

Technology data bases are also being improved and expanded which will allow appropriate individuals and organizations access to the most current research and methodology which, of course, minimizes duplication of efforts, disseminates results of research, and expedites the process of finding acceptable solutions. In addition to specific equipment developed by the Army, there are many items of equipment destined for joint-service and potential allies usage. Inter-service and inter-governmental requirements must also be addressed during the early stages of development.

As indicated previously, the entire Army NBC Contamination Survivability Program is centered on mission-essential equipment. Identification of this characteristic as early as possible is mandatory in order to bring the item under program surveillance. This will insure that all organizations concerned with fielding or use of that item will be cognizant of the NBC contamination survivability demands associated with that item. The requirements determination and coordination work done early in the life cycle of equipment can only result in faster fielding of NBC contamination survivable equipment at less cost to the American taxpayer.

Cost Effectiveness

Although the goal and objectives of this program are certainly a positive step in correcting present deficiencies, the cost effectiveness of the program has been and will probably continue to be hard to demonstrate. The program does in fact increase costs associated with equipment development, acquisition, and/or retrofit of currently fielded equipment. There are, however, no tangible criteria by which the benefits can be evaluated.

It is difficult to demonstrate cost effectiveness for performance parameters or on the basis of what an enemy might do on the battlefield. For instance, it is impossible to quantify the cost effectiveness of deterring an enemy from using NBC weapons on the battlefield because he knows that these weapons will not produce the desired results.

The actual cost benefit of increased capability depends, of course, on the particular piece of equipment and the modification required to achieve the goal of the program. Those equipment items which have the greatest potential for increased operational capability should get first consideration for program funding. Obviously, difficult decisions will have to be made given the current fiscal environment, in order to maximize the relative benefit that is to be derived from the expenditure of funds.

In order to insure that the program produces desired, cost-effective results, each decision maker must realize that to obtain the required increased capability to operate on a contaminated battlefield, additional time and funds will be needed to develop, test, and procure the equipment necessary to achieve the capability. Project managers must be allowed sufficient leeway in order to accommodate additional costs and delays resulting from redesign, and delayed production schedules. Industry must be challenged to produce the equipment at the lowest cost possible. Army personnel must be given an opportunity to acquire the training and field experience with resultant new equipment.

Without a doubt, difficult cost effectiveness decisions will have to be made, but these decisions must not jeopardize the full implementation of the program. While cost effectiveness may be difficult to prove, the increased survival capability of mission-essential equipment is mandatory if the Army is to achieve its assigned combat missions.

Testing

In order to demonstrate that mission-essential equipment meets established contamination survivability criteria, it must be tested in a realistic manner. This suggests that the use of actual contaminants is required in order to verify equipment capabilities and effectiveness of decontamination procedures. Current legal restrictions prohibit this type of testing. Use of simulants is therefore the accepted approach to evaluating equipment capability. Whether this is sufficient to meet requirements associated with contamination expected to be found on potential battlefields has yet to be fully determined. A number of systems have received congressional criticism of their operational testing programs because the equipment was not subjected to anticipated threat environments correctly. Without doubt, there is still much to be done in the area of realistic testing to insure that equipment meets specified criteria.

Training

In addition to adequate testing, users must be trained in NBC contamination survivability characteristics of a particular item of equipment. Realistic training to enable individuals who operate the equipment to utilize the increased capability must be incorporated at all levels of training. The training itself also needs to be as realistic as possible so that the soldier becomes aware of the varied and difficult equipment and personal degradations inherent on a contaminated battlefield. If equipment users are not familiar with the capability or do not know how to use it under operational conditions, the program will have failed in its goal.

Hopefully, the Army will not have to actually prove whether its equipment and manpower can survive on the NBC-contaminated battlefield. However, each individual and unit must be trained to have a maximum capability to accomplish their assigned mission. The training requirement is not limited to the actual equipment users. All levels of the Army must understand the program and its implications. The success of the program depends on every level being aware of the importance of contamination survivability and how critical it is to maintaining operational capabilities on the battlefield.

The Army NBC Contamination Survivability Program presents unique security problems which must be addressed by all personnel. Equipment designs, tests results, and evaluations of personnel and units during field exercises, can be used by threat intelligence agencies to identify vulnerabilities which can be exploited. A strong operational security program and protective mechanisms must be established to insure that this exploitation does not occur, while at the same time allowing general information such as decontamination procedures to be available to users of the equipment.

Summary

The potential for the Army to have to operate on NBC-contaminated battlefields is real. The Army NBC Contamination Survivability Program, defined by AR 70-71, is therefore an essential program. All personnel must be familiar with the program, and to the best of their ability, accomplish assigned responsibilities if the program is to achieve its goal, i.e., an Army capable of performing its mission on an NBC-contaminated battlefield. Although much progress has been made, much remains to be done such as identification of mission-essential equipment and survivability criteria as early as possible, development of training programs, and realistic testing. If the Army fails to make this program a success, then the scenario outlined above becomes a possibility.

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Acquisition Streamlining in Practice

By Glen Buttrey

Background

Media and Congressional pronouncements in recent years have conveyed to the public a perception that something is wrong with the Army's materiel acquisition process. We do not intend to ignore these perceptions. But whether or not the perception is correct is not the central issue. We have introduced the Army Streamlined Acquisition Process (ASAP) primarily to increase the efficiency and effectiveness with which we develop and procure equipment. And, with today's budget constraints, streamlining is necessary to survive.

But have we really streamlined the process? Does ASAP really offer alternatives to traditional military business practices? Is ASAP for real?

The Acquisition Policy Branch in the Office of the Deputy Chief of Staff for Development, Engineering and Acquisition within the Army Materiel Command (AMC), hears these kind of questions every week. This article will show you that ASAP is, indeed, for real.

AMC Commander GEN Richard H. Thompson has taken the lead in spreading the word about ASAP at every opportunity. In fact, every workday brings us more evidence that the acquisition community is taking his initiative seriously.

AR 70-1, System Acquisition Policy and Procedures, has gone to press as guidance pending formal publication by HQDA. The AMC/Training and Doctrine Command (TRADOC) Materiel Acquisition Handbook, AMC/TRADOC Pam 70-2, will be distributed later this year. In addition, various other affected publications are on the street or soon will be.

A skeptic might say that these are mere words, right? Read Chapter 7 of AR 70-1 and ask yourself if it doesn't offer you a new and increased flexibility in the development and procurement process.

Also, GEN Thompson provided guidance that all new Army systems will consider some form of streamlining in their program planning. This was formalized in the Army guidance regulation on April 30, 1986.

AMC Commander GEN Richard H. Thompson has taken the lead in spreading the word about ASAP at every opportunity.

Flexibility

The key word in streamlining is flexibility. Perhaps the most important point I can make about ASAP (something many folks miss when first hearing or reading about it) is that it is not a separate process. It is the act of tailoring the traditional acquisition process (Life Cycle System Management Model), as identified at the outset of the program, in whatever way works best for a given program.

Nor does the AR offer a cookbook covering all possible ASAP milestones and events, but rather provides examples of many alternatives to the lock-step approach of the traditional acquisition process. ASAP is an umbrella term encompassing innovations in process (especially through the use of a Proof of Principle phase and hard-tooled prototypes), nondevelopment item (NDI) procurement, elimination of unnecessary and non-cost-effective specifications, standards and contract requirements. A primary focus is on early identification and pursuit of mature technologies with concurrent use of preplanned product improvements to satisfy our never-ending need to maintain a technological edge.

Where do you get a copy of the AR, you say? Ask a streamlining advocate, for starters. We have established a network of streamlining advocates which, along with the recommendations we see emerging from that network, has been one of the most useful innovations in providing substance to the initiative. These advocates are in the forefront in marketing the concept to those who will work with it each and every day. If you don't know who your closest advocate is, check the accompanying list.

Acquisition Strategy

Streamlining should and does begin with formulation of the acquisition strategy (AS) that is required for all Army acquisition programs; at formal milestone reviews a detailed strategy is documented as an annex to the System Concept Paper/Decision Coordinating Paper. This is the heart of program planning and sets the basic course of action. Prepared by the materiel developer, the acquisition strategy shows how that particular acquisition program will be tailored, identifies potential risks and plans to reduce risk, plus provides guidance to functional elements of the materiel developer and combat developer organizations.

Formulation and approval of a sound and workable acquisition strategy, as outlined in the Justification for Major System New Start or prepared as a companion to the Operational and Organizational Plan, provides the framework and decision authority for a streamlined approach. Although not all streamlining features can be applied to every program and additional tailoring will be possible for some programs, use of a streamlined approach will be a primary consideration in the acquisition strategy. Deviations from the streamlining strategy will be the exception, not the rule.

Materiel Acquisition Review Boards provide a check and balance forum to assure that streamlining principles are applied to specific systems and that requirements have been fully challenged. Is the requirement document generic or performance oriented, or does it assign point values as goals? Can we get an NDI system in the field sooner, while accepting trade-offs to be made through a parallel, preplanned product improvement program? Do other changes to the process make sense? The Materiel Acquisition Review Boards should consider these questions during deliberations.

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Some key elements of ASAP are:

- Requirements should be stated in operational terms/performance bands.
- Consider a scaled-down approach to Concept Exploration and Demonstration-Validation through a collapsed Milestone I/II, using practical demonstrations and experimentations to confirm both the operational concepts and system/technical approach.
- It features tight scrub and tailoring of specifications, standards and data requirements.
- It mandates early feedback on MANPRINT, Integrated Logistics Support and producibility concerns.
- The test and evaluation approach maximizes integration of user-developer testing and employs continuous evaluation, using shared data from a common test data base.
- ASAP provides for hard-tooled prototypes and limited production prior to entry into full-scale production.
- Emphasis on production prove-out during development provides for easier fielding of a quality product.
- ASAP establishes a one to two year goal from the beginning of production to First Unit Equipped.

These are just some of the major elements offered for consideration during drafting of the acquisition strategy. We're already seeing programs emerge with these and other elements of streamlining. What follows is a discussion of how various elements apply to a few of those candidate programs.

Army Tactical Missile System

Non-essential requirements of the Army Tactical Missile System (ATACMS) Required Operational Capability (ROC) were challenged. During the ROC preparation, review and approval process, requirements were continuously reviewed and changed as new information became available. Requirements were incorporated into the ROC to accommodate future growth potential (i.e. preplanned product improvement).

Unnecessary military specifications and standards were not used. The draft specification was reviewed by potential contractors and by the various major subordinate command functional organizations prior to final release.

Performance requirements are emphasized in the specification, rather than definitive direction concerning "do's and don'ts."

The contractor has been encouraged to use off-the-shelf or modified off-the shelf items to the fullest extent possible.

Draft Request for Proposals were released to the competitors for the Army TACMS full-scale development and contractors' comments were evaluated with appropriate changes incorporated into the final Request for Proposal.

All data items were reviewed and tailored where necessary to specify the minimum requirements.

Further steps have also been taken to reduce acquisition time: early testing conducted at component level should reduce the overall test program, including acceleration of the actual flight testing; finalization of the product design upon completion of test program (OT II to be conducted with production-like rounds); early user/troop participation in the test programs.

Perhaps the ATACMS streamlining innovations are best summarized as follows: try to keep everything as simple as possible; assure enough information so that there is no question as to what is required, but leave enough room for the contractor to find ways to make things work.

Family of Medium Tactical Vehicles

Another example where ASAP streamlining principles are being applied is the Family of Medium Tactical Vehicles (FMTV). In this case, the tailored acquisition approach consists of an assemblage of commercial or modified commercial (i.e. NDI) components integrated by the contractors to meet the Army's military requirements, with competitive prototype testing.

In addition, the program has few perceived technical risks. Mature technology is involved, and the competitive prototype testing minimizes what risk there is.

The FMTV performance specification takes a system approach to defining the technical requirements. The specification defines the performance envelope which is required to meet the operational requirements of the Joint Services Operational Requirement, and will be refined as a result of the market investigation and follow-on staffing with industry. The specification will be further tailored and updated based on the results of prototype testing prior to requests for production proposals.

Preplanned product improvements have been incorporated as part of the performance specification for consideration during vehicle design.

Other streamlining principles contained in the FMTV acquisition and contracting strategies are: test before you buy, obtain maximum amount of logistic support up front, and obtain early contractor participation in requirements building.

Other programs that have experienced a degree of success in streamlining specifications, standards and contract data items, and in staffing draft requirements documents and/or draft Requests for Proposal include the engine and airframe proposals for the Light Helicopter Family, the Advanced Anti-tank Weapon System—Medium, the 120mm Mortar System, and Mobile Subscriber Equipment (MSE).

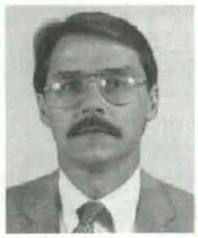
The 120mm Mortar System and MSE programs are also examples of an NDI acquisition strategy, as are the 9mm Baretta pistol and the Commercial Utility Cargo Vehicle. Of course, streamlining is only effective to the extent that we in the acquisition community can maintain control over the strategy and schedule of a program.

In addition to these programs, there are a number of future programs highlighted by our major subordinate command advocate network that promise to be prime examples of ASAP: Advanced Cargo Aircraft, Automated Pipe Line Equipment, Armored Family of Vehicles, Forward Area Air Defense System, and the Army Command and Control System, to name just a few.

Examples of systems that the Technology Integration Steering Committee have recommended for Proof of Principle troop demonstrations are: Enhanced M16A2 Rifle, Army Combat Identification System, Advanced Combat Rifle, Automated Target Recognition System, and the Light Weight Howitzer.

Beyond these examples, we must seize any and all future opportunities to introduce feasible streamlining techniques into the acquisition strategy.

In coming months we hope to provide instructional classroom modules to promote increasing community awareness of the principles of streamlining. As awareness and acceptance grow we foresee a growing number of systems which apply some degree of streamlining methodology, with the ultimate objective of making streamlining the accepted, indeed preferred, way of doing business in the Army.



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Technical Data Packages for Developmental Items

By John Hopfner

Introduction

The goal of competition is unmistakable in law and in DOD policy. "Buy smart," we are told, "and manage well. As agents who develop and support Army materiel, you must optimize competition in procurement." Our task is to gain access to as many sources of supply as the marketplace affords, by fostering an environment that inhibits reliance on single manufacturers.

For military equipment designed by a contractor through the R&D process, unrestricted ownership of Technical Data Packages (TDPs) is what normally lets us buy spare parts competitively. TDPs are the drawings and specifications that define our items of supply—what they are, how they function, how they are inspected and tested. Because there are no aftermarket suppliers that stock several brands of Abrams or Patriot or Apache parts, we seldom can avoid buying spares for such systems from the original sources unless we have TDPs that define for other manufacturers how the items must be made.

When the R&D process operates successfully, the contractor develops a new end item for us—an item whose configuration and some number of whose components were designed in-house by that one firm. So item design, although vital, is not our whole concern. Where the outcome of R&D is hardware that must be supported sole-source, we cannot claim unqualified success no matter how well the hardware does its job.

Ideally, when the R&D cycle is over, we want the end item and its parts defined in TDPs that are complete, and available, to support competition. The developer and his suppliers, with an eye to future business, would rather keep production buys sole source. Recognizing this, we need to manage requirements for system software as firmly as we handle requirements for hardware. For, regardless of whether the government's management happens in a framework of uniform policies or conforms to the press of each moment, the early decisions respecting technical data together form a competition road map that the end item must follow to a point well beyond initial fielding.

Developmental Environment

At no other time in the materiel life cycle will a system manager have fewer resources or less firm data to work with, yet be making decisions that shape more future activity, than during hardware R&D. The system manager is our field agent during this time. With a small support staff, he guides the developmental effort along toward the production decision, in an environment where almost every feature of the program is subject to change.

Because this situation is true, however, it is also true that at no other phase of the hardware life cycle is it so necessary for top management to have its priorities and expectations defined, so that the decisions made by each system manager are optimal for the command. The system manager will execute the policies of top management where such policies are clear. Where they are not clear, then he must formulate guidelines as he goes along, reacting to every problem in the context of that problem alone.

This reality becomes the more pointed when, as recently has happened, OSD directs us to secure competition for production buys earlier and more extensively during the life cycle. Top management looks to the readiness offices for action in the face of this direction, since the big savings from competition come from high-volume production contracts that are executed by readiness personnel. But, of course, no one has yet provided any readiness office with a magic wand to produce TDPs from thin air. Competitive TDPs for spare parts on developmental end items either come from the developing contractor, under priorities set by the system manager's office—or they come, much later on, from reverse engineering or data-rights negotiations. Early competition can be obtained during the readiness phase only where the groundwork for competition—the TDP—has effectively been established during R&D.

This coin, however, has a flip side as well. It is too often true that readiness personnel take an interest in R&D's actions only after the fact. Readiness interest in the status of the TDP goes from a low level to a peak once the major end item transfers to readiness management. But a usable TDP, if not substantially ready by the time of transition, seldom can be made ready for another two to three years. Consequently, readiness would do well to become involved in the TDP development process starting early during R&D.

True enough, in the abstract the system manager is responsible for system TDP considerations throughout development. But responsibility for taking and using the TDP belongs to readiness. Further, in practice R&D personnel are not primarily documentation experts. Their emphasis and their focus lie elsewhere. If a system manager brings his program in on time, within budget, and meets the system's performance objectives, no one—beyond a disgruntled readiness manager—will downgrade his efforts if TDP development is not as extensive or as far along as it might be.

Successful TDP management is not an important gauge of R&D program management, because R&D itself can proceed to a conclusion without ever having a production-quality TDP available. This latter type of documentation is essential only to readiness.

In fact, regardless of who has the "competition" mandate on paper during R&D, the fact often is that, below the organization's commander, there is no official in the R&D process with both mandate and practical motivation to be primarily a TDP advocate for purposes of competition. In a sense this is as it should be. The R&D people who initiate technical data preparation and the readiness people who use the data should be talking to one another throughout the hardware cycle, rather that relying on a logistics or engineering manager to do the TDP job alone. System managers are under constant pressure to take the near view—resolve the immediate problem, meet the current-year schedule. This means that readiness managers, who have no choice but to perceive the long view, must have interest and involvement in the shaping of R&D programs.

Such participation will better ensure a balancing of priorities during the R&D process, as a specification is translated into working prototypes. Moreover, such participation will ensure a longer, more consistent look at the nature of the contractor's evolving technical data. Do the contractor's specifications define the hardware well, or are there inaccuracies? Can the drawings be used by any DOD contractor, or are they specific to one firm? How many components must be purchased from one source because of inadequate test criteria or missing drawings? Are performance and durability factors cited in specifications, or are they buried in a mass of uncollated test results? Each of these questions can seem minor in the short run. Each, if treated as minor, can mean an inadequate TDP later on.

Again, we in DOD map a course toward competition by means of the TDP issues we do and do not emphasize during R&D. For the features of this competition map to be consistent with the command's competition goals, the following principles must be implemented by the buying activity.

Management Principles

Principle 1: Require Managers Who Will Live With the Results of a Decision To Participate In Its Review. When stated in the abstract, this principle seems self-evident. Yet it becomes less clear in an R&D/readiness activity divided into offices, each concerned with one part of the command mission. The tendency then is for each office to do its R&D or readiness job, with no required forum where perceptions are exchanged. This tendency fosters an "Us and Them" attitude where the differences between R&D and readiness are emphasized over their interdependence. The result is fragmented management that does not dovetail where it should, because the two halves of the process do not meet as parts of the same entity to review, discuss, and accept a program plan for new end items.

Although research and readiness are separate organizations, the basic decisions that occur during R&D should be matters of command interest, involving both readiness and R&D. System managers, as system experts, develop program strategies. But if the decision at issue is whether, for example, to compensate for reduced funding by delaying TDP validation, it is not one that affects R&D alone. The decision should therefore occur only after consultation with readiness managers, whether the end item in question is guided by a DSARC, ASARC, or local Materiel Acquisition Review Board forum.

This principle is of particular importance in program funding, crafting of the Acquisition Strategy, and in the review of proposed deviations from the approved strategy. The DOD purchasing environment includes many potential disruptions: budget cuts, reallocations, compressions of schedule, changes in customer requirements, and so on. The manager is tasked to react, but the reaction must represent a considered balance between expediency and the command's long-term interests. While expediency by nature seems paramount in the face of crisis, coordination with readiness experts better ensures an appreciation of what the proposed changes will mean five years—as well as five months—down the road. And on the readiness side, review of the changes that are proposed when priorities or funding shifts will mean a smoother, more informed transition once fielding begins.

Principle 2: Generation of a Good TDP Requires Continued Emphasis In-House. As a matter of routine, where we pay a contractor to develop hardware and document that hardware in a TDP, we prepare a scope of work to define our needs. But behind the contract must stand a customer, the government, that knows what it should be getting and acts on this knowledge by working with the contractor to ensure correct and timely performance. Included in this principle are consistent policies, management emphasis, and administrative review.

Consistent policies apply when we set out to define what we want and how we expect to get there. In the case of technical data, we want a comprehensive set of drawings and data. The TDPs must depict the exact hardware used in production, and so should establish what is needed—what materials, what processes, what tolerances and tests—for an exactly conforming item. The TDPs must cite a minimal number of parts requiring purchase from one source. Moreover, the data must be usable by any competent engineer.

Keeping these policies in mind, it follows that we must forgo the practice of allowing contractors to maintain R&D technical data to their own format standards until after the production decision. In the past we allowed this flexibility because designs can change several times during R&D as the contractor works to our system specification. Since configurations change during development, it seemed reasonable that we impose no specific requirements of drawing format or content until development had ended.

In effect, however, this practice traded off short-term efficiency against long-term delay. The question is not one of whether drawings and data are generated during R&D—the contractor must do that in some fashion to maintain configuration control—but whether these data will be kept in contractor or government format. A contractor's proprietary drawings often refer to requirements, sources, and processes by abbreviations and symbols that are not used industry-wide. Company X's engineer, at work on a proprietary R&D drawing, need only be sure that another engineer from company X can interpret it. He is not concerned about company Y's employees.

The government, however, must be mindful of company Y as we move through R&D with company X. If capable Ys in the market cannot produce good hardware from our TDPs, we have no access to meaningful competition. Unless we insist that R&D technical data be developed in our format, then as we enter production the only TDP available—the contractor's—is usable only by that contractor. Having paid for item development and owning rights in the TDP, we still must buy and support the item sole-source until the prime contractor reworks its TDP in our format and verifies the new TDP against production hardware.

Whatever the apparent sense in requiring our TDP only when development ends, we must question a procedure that pays a contractor twice for documentation: once during R&D, when he does it his way; again during early production, when he prepares the one to which we take useful title.

This conclusion becomes evident only if we review command operations consistently. In the past we have treated R&D data policies as a province of R&D—something without outside impact. The R&D activity in the command had no established means of hearing from readiness that delayed receipt of our competitive TDP, which occurs every time the contractor has to rework the TDP from his standards to our standards, was a problem. So the system manager had no reason to pay out RDT&E dollars to obtain immediate conformance to our data format and content standards. There are always other purposes to which R&D money can be put. If we could save some of it now by leaving the formal documentation effort until later, the system manager had every reason to do so.

The division of responsibility between development and readiness is why it does not suffice to say as a command that we favor increased competition. To make the policy work, we must verify that command procedures throughout the hardware life cycle ensure implementation. The practice of allowing hardware developers to ignore our data requirements during R&D was manifestly a hindrance, since where it was in place we had no opportunity to use competitive TDPs until roughly the third year of production. But while this perception is easily grasped when we adopt a command perspective, it is not necessarily obvious if we adopt the viewpoint of any one office within the command.

Management emphasis subsumes most of the elements in this article. It stands as a separate point to stress the need to shape local policies that reflect the importance of good TDPs. "Management emphasis" includes ensuring that enough funds are programed into the R&D budget to support timely development of the TDP. It involves a commitment to assign enough people at the right time to accomplish the actions detailed below under "administrative review." It requires that TDP development be treated as a keystone of R&D.

Administrative review means that the government must act, once the development contract is awarded, to verify that the contractor understands what we require in the way of TDP preparation, and progresses in accordance with his schedule. We cannot micromanage the R&D effort, but neither can we assume that contractors intuitively appreciate what we want done in every detail. Included in this activity are these elements:

- requiring a TDP development milestone plan with each proposal for a planned configuration item, and negotiating these plans along with other elements of performance;

- sending technical-data teams to the contractor's plant, as is now done for provisioning conferences, in order to provide guidance concerning TDP requirements and to review contractor progress;

- mandating incremental submission of technical data as generated in accordance with the contractor's development plan. By this technique, contractor errors and misinterpretations can be caught and corrected before they proliferate throughout the TDP;

- requiring periodic verifications of data against prototype hardware, both through mini-Physical Configuration Audits on subsystems, and through reviews to ensure that the results of prototype and component testing are integrated into the developing TDPs;

- obligating the contractor to obtain approval before making any component source-controlled, and programing sufficient RDT&E money to fund a testing program that will generate multiple-approved sources wherever possible for source-controlled items, and ensure that complete form, fit and function data are documented in source-controlled TDPs, as an aid to review of new components during follow-on production; and

- making a complete TDP—in government format—a requirement to be delivered by the end of full-scale development. While the government would normally not take configuration control of the end item at this point, we will be years closer to the ability to do so with this technique, which also makes us able to obtain early competition for stable repair parts.

Summary

The fostering of competition in contracting is one of our clearest policy goals. To meet that goal, we need a commitment that crosses functional boundaries at the contracting activity. The time to concern ourselves with inadequate TDPs is not during production, but before production starts: success in obtaining competitive production depends on data that are developed and released according to directions given during R&D. By focusing and coordinating its efforts, the command will better meet a competition goal that does not distinguish between development and readiness.

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The Army Medical Materiel Development Activity

By CPT(P) Lawrence K. Lightner

Background

The U.S. Army Medical Research and Development Command (USAMRDC), a Field Operating Agency of The Surgeon General of the Army, was established in August of 1958 with a mission to coordinate, direct, execute, supervise and review the U.S. Army Medical Department Research, Development, Test and Evaluation Program.

The command has always had an outstanding reputation in a variety of areas of basic medical research and has extensive facilities for the testing and evaluation of medical products, but not until recently has it been able to efficiently oversee the development of the numerous medical products emerging from the tech base.

Initially, it was conceived that a directorate of the USAMRDC HQ staff—the Development and Production Management Directorate—could oversee product development. However, recent Army thrusts in the areas of medical defense against biological warfare agents in addition to chemical agents, combined with DOD-directed changes in materiel acquisition policies, made it obvious that significant additional resources would be required for the command to meet its development mission.

In 1983, a task force consisting of individuals from the Production Management Directorate was established by MG Garrison Rapmund who was serving at that time as CG, USAMRDC, to study alternative methods and/or organizations for meeting this mission. Support was provided by MG John B. Oblinger from the Army Materiel Command (AMC) and from the Defense Systems Management College (DSMC).

The task force carried out an extensive examination of existing program and project management systems, which involved meetings with materiel developers of all services as well as experts from the DSMC. A decision briefing was presented to MG Rapmund outlining three options for the development, management, and acquisition of medical materiel by the command for the Army Medical Department. The options were: creation of a new activity, with a separate table of distribution and allowances (TDA) to provide centralized medical materiel development within the command; a "lead laboratory" option in which project management offices under separate TDAs would be situated in the command's subordinate laboratories; or the creation of a Materiel Development Directorate with a staff function under the HQ, USAMRDC TDA.

The task force recommended the first option. Under this option, the new activity would function as a matrix organization with TDA slots for the activity appropriated from existing command assets. This recommendation was approved by MG Rapmund with the provision that the new activity would ultimately transition to a "lead laboratory" concept.

USAMMDA Organization

As a result of MG Rapmund's decision, a Concept Plan for the formation of a new USAMRDC subunit was submitted to Headquarters, Department of the Army, on March 26, 1984. At this time, a provisional unit was established, composed of a small group of individuals from HQ, USAMRDC, to initiate program development actions on selected high priority projects. On March 17, 1985, Permanent Orders 7-1 from the Office of the Surgeon General of the Army were published and a TDA was approved for the U.S. Army Medical Materiel Development Activity (USAMMDA).

The mission of the activity, as outlined in these orders, is to manage execution of the development component of the Army Medical Department RDT&E materiel developer responsibility to achieve Department of the Army and joint service materiel system performance, schedule, cost, and logistic objectives. A concept of operations for implementing this mission was approved by the command on June 5, 1985, and USAMMDA became a bona fide subordinate activity of the Army Medical R&D Command.

The task force recommendation for the organization and staffing of the activity was based on discussions with individuals from the DSMC and AMC and was formulated based on the kind of products being developed by the command.

The USAMMDA commander is responsible for the command, control, management, and execution of the advanced development of medical materiel. He derives his authority from the commander, USAMRDC, to include authority to direct and control project managers. In this sense, he is the materiel developer's program manager for medical materiel.

Subordinate to the USAMMDA commander are three project management offices (PMOs): Biological Systems, Pharmaceutical Systems, and Applied Medical Systems. Each of these offices is headed by a project manager who oversees the execution of the advanced development of products in his general area of responsibility.

Ultimately, each PM will be chartered under the provision of AR 70-17, System/Program/Project/Product Management. All three PM slots are designated for Army Medical Department officers in the grade of 0-5 or 0-6. Within each PMO there is a Project Management Division and a Technical Operations Division. The chief of the Technical Operations Division in each PMO is a GM-14 who also serves as the deputy project manager. This configuration was established to maintain continuity within the project management office during rotation of the military PMs.

Each PM exercises authority over the allocation and utilization of all resources as authorized by the command for the execution of approved projects within his broad area of responsibility. Although the concept of operations outlines specific functions for each of the PMO divisions for managing these projects, currently each PMO is structured as a reflection of the management style of its respective PM.

In general, with a few exceptions, individuals within the PMO act as product managers or project officers for specific products, conducting all aspects of program management for those products in a functional matrix framework. This approach was taken in part due to the limited number of personnel in each PMO tasked to manage a large number of products and because the majority of products which were to be managed by the activity were already in various phases of development. The effect of this arrangement has been to accelerate the on-the-job training of individuals by exposing them to all of the elements of the acquisition process rather than specific sub-elements.

To conserve scarce and constrained manpower resources, many of the functions common to the three PMOs were centralized in a fourth office, the Project Management Support Office (PMSO). The support office serves as the focal point of expertise for business, financial, and logistical aspects of project management. Its responsibilities include Planning, Programming, Budgeting Execution System management, assistance to the PMOs in budget development, cost analyses, contracting matters, and logistics management and support. Additionally, the PMSO provides all administrative support for the organization.

As stated above, it was evident from the beginning that it would be necessary for the activity to function as a matrix organization because of the limitation on the number of people who could actually be assigned to the unit. The functional expertise necessary to develop and field a product is available to USAMMDA project managers from two primary sources: USAMRDC laboratories and extramural contractors. The Medical R&D Command has 11 subordinate activities: USAMMDA, the U.S. Army Medical Research Acquisition Activity (an activity responsible for command contracting), and nine research laboratories.

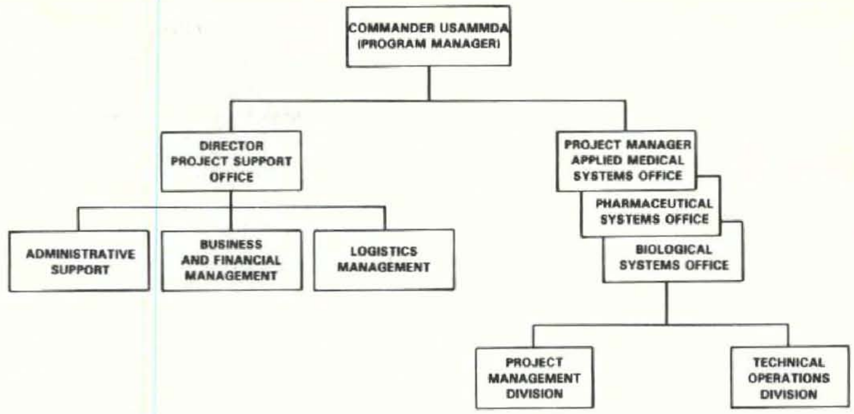
All research conducted by these laboratories is managed by research area directors who have responsibility for the five thrust areas of research conducted by the Medical R&D Command. The research area directors are staff officers of HQ, USAMRDC, and have direct access to the commanding general through the director of research programs. Additionally, the Walter Reed Army Institute of Research (WRAIR) has six special activities, five in overseas locations, all of which have the potential for use as field testing centers. Each of the command's subordinate laboratories is charged with specific medical research missions, however USAMMDA PMs may interact functionally with any laboratory depending on needs and available resources.

Although the research directors are ultimately responsible for all research programs and money (6.1-6.4 categories) for planning and budgeting purposes, PMs have the authority to require accountability for development program (6.3B-6.4) performance and production from the laboratory commanders. This requires continuous coordination among the research area directors, PMs, and laboratory commanders. A matrix structure is employed by the USAMMDA and the command.

All of the extramural contracting done by the command is administered by the Medical Research Acquisition Activity. The Advanced Development Contracts Branch, which is responsible for all contracts obligated with 6.3-6.4 money, is collocated with USAMMDA and is an integral part of its management matrix.

In addition to command laboratories and extramural contracts, USAMMDA PMs may obtain functional support from other Army or other federal laboratories. Current collaborations are in effect with, among others, the Army Materiel Command's Natick Research, Development and Engineering Center in Massachusetts and the Naval Research Laboratory in Washington, DC.

The net result of the matrix system is that PMs have a wide array of physical resources and functional expertise available. This allows for considerable flexibility in tailoring the strategy for development and acquisition of individual products.



U.S. Army Medical Materiel Development Activity Organization.

Medical Materiel Development Process

Army Regulation 40-60, Policies and Procedures for the Acquisition of Medical Materiel, was established March 15, 1983 to regulate the medical materiel acquisition process. Although it formally outlines the process in broad terms, it does not provide for a centralized, consolidated framework for the development and acquisition of medical materiel. As a result, few of the many products in development have reached the field in a reasonable time frame, fully operational and supportable.

Early on in the discussions of creating an activity such as USAMMDA, it was agreed that the medical materiel acquisition process should be brought more in line with the methods used by the Army Materiel Command in the development of materiel as outlined in AR 70-1, System Acquisition Policy and Procedures (March 15, 1984), and the Materiel Acquisition Handbook, DARCOM-TRADOC Pam 70-2, 1984. To accomplish this, the materiel acquisition process is being adapted to the development of medical items.

The formation of the Medical Materiel Development Activity has provided the necessary focal point for this adaptation. This is a logical sequence of events because the USAMRDC CG is also the assistant surgeon general for research and development and the surgeon general's designated medical materiel developer. He functions in this role much as the AMC commander does for the development of all other Army materiel.

Most of the principles of AR 70-1 are directly applicable to products managed by USAMMDA; however, there are some differences and some procedures unique to the medical acquisition process. For example, the Academy of Health Sciences, Fort Sam Houston, TX, is the combat developer (or in some cases the co-combat developer) and trainer for all medical products and the U.S. Army Medical Materiel Agency, Fort Detrick, MD, is the principal logistician.

Initiation of advanced development for medical items requires not only approval of an Operational and Organizational Plan (prepared by the combat developer with materiel developer assistance), but also approval of the Medical Systems Review Committee. This committee, chaired by the USAMMDA commander and composed of the command's area research directors, subordinate laboratory commanders, and USAMMDA PMs, ensures that only those products which are ready for advanced development will transition from the tech base to program execution management responsibility of USAMMDA.

At the present time, the three USAMMDA PMs have management responsibility for over 100 separate medical products, including such diverse items as skin decontaminants for chemical agents, medicated wound dressings, field sterilizers, refrigerators and X-ray units, anti-parasitic and anti-viral drugs, and vaccines against malaria and hepatitis. All of these products have been designated as In-Process Review (IPR) level programs. Because development of medical products is far less expensive than weapons systems, barring intense interest by DA or the Office of the Surgeon General, it is likely that most future programs will also be IPR programs. As such, the milestone decision authority is the materiel developer, i.e. the CG, USAMRDC.

Another major variation of the medical materiel acquisition process involves testing of biological vaccines and pharmaceuticals. Standard developmental and operational testing procedures are not applicable to these items. Instead, a series of phased human clinical investigations are substituted. Phase I is testing for safety and either pharmacology or immunogenicity.

Phase II is a challenge, when ethically possible, with the disease or illness-producing agent to see if the drug or vaccine is effective in a controlled laboratory setting. Both of these tests are done during the traditional Demonstration and Validation Phase of development.

The decision to begin Phase I testing is made at an In-Process Review, but is contingent on the product meeting all requirements of the Food and Drug Administration (FDA). This requires intensive pre-clinical testing in animals during Concept Exploration, resulting in an extensive document, the application for Investigational New Drug exemption, which is submitted to the FDA.

If the drug or vaccine is successful during Demonstration/Validation testing and passes a Milestone II IPR, Phase III field testing is accomplished during Full-Scale Development. This involves testing the drug/vaccine against the etiological agent under field conditions, somewhat analogous to operational testing.

Successful completion of field testing leads to a Milestone III IPR, preparation of another extensive document for the FDA, licensure of the product (when applicable), and production and fielding.

MG Rapmund recently stated that, based on pharmaceutical industry data, 90 percent of commercial products would fail to reach a Milestone III IPR. Other medical items impacting on human health, such as resuscitation fluids and medical devices, must also be in full compliance with FDA regulations. The overall significance of this situation is that medical products are generally developed under considerable conditions of risk and uncertainty which make long-range planning and budgeting a substantial challenge for the USAMMDA PMOs.

In addition to its responsibilities to the Army, the Medical R&D Command has been designated the executive agent for the medical aspects of chemical and biological warfare defense and the lead agent for research concerning combat dentistry and infectious diseases. Because of these additional responsibilities, a large number of USAMMDA programs are joint service in nature. At a minimum, these require coordination among the services; some projects involve extensive joint development efforts.

In order to avoid the interservice squabbles which often result from such programs, Memoranda of Understanding/Agreement have been initiated when applicable. This represents a significant step in avoiding the duplication of efforts in medical product development which have been common among the services in the past.

Summary

As might be expected with the formation of a new unit, initial interactions between the PMOs and the laboratories were somewhat hesitant and resulted in a few misunderstandings about the role of the Medical Materiel Development Activity within the Medical R&D Command. This could be attributed in part to the lack of familiarity with the matrix style of management and the inherent independence of the laboratories. However, relationships quickly began to stabilize and there have already been several highly successful collaborations. As more knowledge and experience are gained by USAMMDA personnel, these will increase.

Several steps are being taken to accelerate the learning process. To develop a base of trained individuals for the future, a Medical Materiel Acquisition Management career development training program is being established. It outlines specific Army and DOD courses in management and acquisition principles. An effort will be made to send newly assigned individuals to these courses.

In the short term, a medical materiel acquisition process handbook is being developed along the lines of DARCOM/TRADOC Pamphlet 70-2. The handbook will detail all of the various procedures, documentation and personnel/organizations involved in the medical acquisition process. Simultaneously, AR 40-60 is being revised to reflect the current approach to the acquisition of medical materiel. Both of these documents should be a considerable help to USAMMDA personnel, as well as to others both inside and outside of the command who interface with the activity.

The increased emphasis on efficient management and acquisition of all military materiel is being felt throughout the Department of Defense. By creating the U.S. Army Medical Materiel Development Activity, the Medical R&D Command is effectively providing this management for medical systems.

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Contract Calls for New Landing Craft

A recently awarded contract by the U.S. Army Troop Support Command, under the direction of the Army Amphibians and Watercraft Product Manager (AWC-PM), to the Lockheed Shipbuilding Co. of Seattle, WA, will allow the Army to take delivery of a new generation, utility landing craft (LCU).

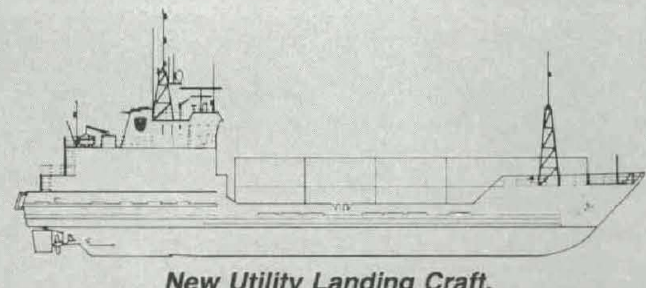
The new LCU will set a precedent because it will mark the first time that the Army has written its own specifications for a major watercraft system, according to a spokesman for the AWC-PM. Usually the Army purchases military specification vessels designed for and used by the U.S. Navy. This time however, the Navy did not have a vessel available that would meet all of the Army's needs and requirements.

A market survey conducted by the Belvoir RDE Center determined that the required operational capability for the Army's new LCU could be satisfied by modifying a commercial vessel design to meet Army requirements. This procurement method closely follows Army guidance of preferability of purchasing non-development items when available.

Like the other LCU's, the new 2000-class LCU has a Logistics Over The Shore mission and will work primarily by moving Army materiel from ship to shore and along coastal areas and inland waterways where no dock or port facilities exist. It will replace the older 1400-class LCU and complement the 1600-class LCU which is slated to remain in the Army inventory.

Built to specifications engineered by the Belvoir center, the new LCU is self deployable, having a 4,500 nautical mile range with a 25 percent fuel reserve. Neither the 1400- nor the 1600-class LCUs have this capability. It can travel to its long-range destination fully loaded with 350 short tons of cargo at a speed of 11 1/2 knots, and will carry enough onboard stores to sustain its crew of 13 people for voyages of 18 days. In addition, the new LCU can make its own fresh water for drinking, cooking, and bathing, since it has an onboard reverse osmosis water purification unit.

The LCU 2000 will be 174 feet long and 42 feet wide. It will also have a bow ramp 16 feet in width—wide enough to accommodate the Army's largest rolling stock. This size bow ramp will eliminate the need for cranes at both the ship and on the shore to land and off load large rolling stock.



New Utility Landing Craft.

The craft will have a beaching draft of four feet, and has the capability to extract itself from a beach in a fully loaded condition, with the aid of a 50 horsepower electro-hydraulic stern anchor winching system.

Propulsion power for the new LCU will be provided by twin V-16 turbo-charged diesel main engines, each capable of producing 1,250 horsepower. Electrical power will be supplied by two 250-kilowatt main generators and one 40-kilowatt emergency generator. A 300-horsepower bow thruster will be installed to provide better maneuverability while loading, unloading, beaching and operating in close quarters.

Human engineering has not been neglected in the new LCU. It will have a larger and more comfortable crew quarters and working spaces. The pilot house, for example, has an area of 390 square feet, about four times larger than that of the 1400- and 1600-class LCUs. The vessel will also include the latest communication, navigation and electronic equipment.

The first portion of the new LCU procurement program calls for delivery of seven vessels with associated technical data and training materials, over a two year period for approximately 34 million dollars. During the remaining three years of the five-year contract, 18 additional vessels will be delivered for a total of 25. The government also holds an option to purchase an additional 15 vessels at a firm fixed price during the term of the contract.

The new LCUs will be fabricated at Lockheed's Thunderbolt Shipyard in Savannah, GA. Following dock and sea trial testing, an Army crew, which is trained to operate the LCU, will accept and deliver it to Fort Eustis, VA.

Logistic Support Analysis . . .

An Integral Part of Materiel Acquisition

By Dave Morgan

Introduction

The Army is committed to developing, acquiring and fielding "total systems" which include support resources as well as mission hardware. This commitment makes the effort to develop support resources an integral part of the materiel acquisition process. The commitment is based on the knowledge that the effectiveness of a system can be limited as much by the availability of support resources as by the inherent technological capabilities of the system.

Even the most technologically advanced weapon system is useless if the resources required to operate and maintain the system are not available. Since the support resources must be available at initial fielding, the work effort to ensure the availability of these resources, commonly referred to as Integrated Logistic Support (ILS), must be performed during the materiel acquisition process.

While the concept of planning and developing support resources concurrently with other materiel acquisition activities may appear simple, it is complex in practice. This complexity stems from the highly interactive nature of the materiel acquisition process. To understand these interactions, let's look at some specifics using a developmental system as an example. First, functional logistic organizations must identify both the support-related design requirements and the support products that must be developed.

During the design process, many system engineering disciplines such as reliability, maintainability, safety, human engineering, etc., get involved in ensuring that support-related design requirements are designed into the item and in generating engineering source data for use in developing support products and planning factors. For example, the failure rates developed as part of the reliability program allocation, prediction, and demonstration effort and the maintenance task designs and times developed as part of the maintainability program allocation, prediction, and demonstration effort are essential source data for the maintenance planning effort.

The maintenance planning effort then uses this source data to determine what corrective and preventive maintenance tasks should be performed, when they should be performed, and what maintenance level should perform them. In turn, the resultant maintenance plan is the basis for developing technical manuals and training programs; for assigning source, maintenance and recoverability codes; and for identifying required support equipment.

Logistic Support Analysis

To do the ILS work necessary to develop and acquire the support resources for a new system in this highly interactive environment, a standard process must exist to help identify and control vital system engineering interfaces and ensure that essential information flows across these interfaces. This process must be well founded in logic and technically feasible. It also must allow for generating supportability unique data and for collecting, updating and managing this data so it can serve as source data for identifying and developing support resources.

This standard process exists today and is known as Logistic Support Analysis (LSA). The LSA standard is MIL-STD-1388-1A and it defines both the general and detailed requirements for accomplishing an LSA program. When an LSA effort is performed, as with any analysis process, a considerable amount of information is either generated directly or gathered from other system engineering efforts. Documentation of the resultant information is an inherent part of the LSA effort. The portion of LSA documentation that relates to the detailed identification of support resource requirements is referred to as the Logistic Support Analysis Record (LSAR). The LSAR standard is MIL-STD-1388-2A. This standard defines the applicable LSAR data elements and establishes formats for the LSAR data records, master files and reports.

The LSA standard defines 15 LSA tasks which are grouped into five task sections. These sections are generic groupings based on the nature of the work to be done. The 15 tasks encompass 77 subtasks which define the entire work effort required during the materiel acquisition process to provide support influence on the design, design the support structure, identify the required support resources, and develop and document the source data necessary to produce deliverable support products such as manuals, training, and provisioning technical documentation.

Only four of the 15 LSA tasks generate information that is documented in the LSAR. However, since the LSAR is being used to document support resource requirements and since it can take up to 89 data elements to document a single part application for provisioning purposes, the amount of information ultimately contained in the LSAR can be extensive. It must be understood that this information must be collected by some means since it is needed to do detailed support planning.

With the exception of a few data elements needed to control the LSAR data records, master files and reports, the LSAR contains only information needed to develop and field the support resources concurrent with the system. The attractive aspect of the LSAR is that it gives a standardized approach for collecting, storing and using this information in a consistent and integrated manner.

Contractor Efforts

Although there are portions of LSA that should be performed by the government, the majority of the LSA effort is normally performed by a contractor. When it is performed by a contractor, the LSA statement of work must be tailored to the specific acquisition strategy. This is where the LSA and LSAR standards show their mettle. Both standards are designed to make tailoring easy. In the task description entries in the LSA standard, subtasks are clearly identified along with required inputs and resultant outputs. In identifying the required inputs, government inputs are highlighted since some of them need to be addressed in the LSA statement of work. This gives the person preparing the LSA statement of work the capacity to identify and specify only the LSA work that needs to be done given the overall acquisition strategy for the system.

The LSAR standard contains an LSAR data selection sheet which gives the person preparing the LSA statement of work the capacity to specify only the essential LSA data elements required to be documented on the LSAR data record formats. The LSAR standard also contains tables which can be used to cross-reference LSA data elements to support related data item descriptions. This allows the person preparing the LSA statement of work to start with data products which are planned as deliverables and identify the LSA data elements needed to produce those deliverables. Both standards contain a "how to tailor" appendix for use by the person preparing the LSA statement of work.

LSA Plan

Since both the LSA and LSAR standards are essentially "what to do" standards as opposed to "how to do" standards, two of the LSA tasks contained in the LSA standards take on particular importance. These tasks are task 102, LSA Plan, and task 103, Program and Design Reviews. LSA task 102 requires the development of an LSA plan. When the LSA effort is contractual, the LSA plan will be prepared by the contractor to describe "how" that contractor will accomplish the required LSA effort. It is important that the government review this plan closely and require needed changes be made before accepting the plan. In effect, the LSA plan becomes the "specification" for the LSA work effort once it has been approved.

Program Reviews

LSA task 103, among other things, requires the contractor to hold LSA program reviews. Generally there is government participation in these reviews. It is through these reviews that the government can determine if the LSA work effort is being conducted in accordance with the approved LSA plan and make sure the LSA effort is producing the intended results. These reviews can also reveal where additional input is required from the government. Effective government participation in these reviews is essential for an effective LSA effort.

To enable automation of the data documented in the LSAR data record formats, the government has developed a set of Joint Service LSAR Automated Data Processing (ADP) routines. These ADP routines are available as government furnished information and can be provided to contractors performing an analysis which requires LSAR documentation in accordance with MIL-STD-1388-2A. Contractors may develop and use their own ADP routines for automating the LSAR as long as these ADP routines will produce the LSAR data record, master file and report formats as specified in MIL-STD-1388-2A.

Conclusion

Logistic Support Analysis is in place as the underlying process for accomplishing ILS objectives. As such, it is an integral part of the materiel acquisition process. While some may view LSA and the accompanying LSAR as unduly complex, it must be remembered that complexity is inherent to the interactive nature of the materiel acquisition process. LSA tries to take these complexities and put them in a process format which allows increased efficiency in identifying and developing support resources.

DAVE MORGAN is chairman of the Materiel Support Committee within the School of Acquisition Management at the U.S. Army Logistics Management Center, Fort Lee, VA.

ARO Technical Note . . .

Compact, Diode-Pumped Lasers

By Dr. Richard Wallace

Introduction

Compact, diode-pumped lasers, which hold significant promise for potential Army applications in target designation, ranging, optical radar, communications and remote sensing, are currently being developed with funding assistance from the U.S. Army Research Office (ARO).

These fist-sized lasers will be lightweight and rugged with immunity to shock, moisture, and temperature fluctuations. They combine the small size, simplicity, efficiency and reliability of laser diodes, such as those used in compact disk players, with the directionality and high peak power of full-size conventional lasers.

The Program

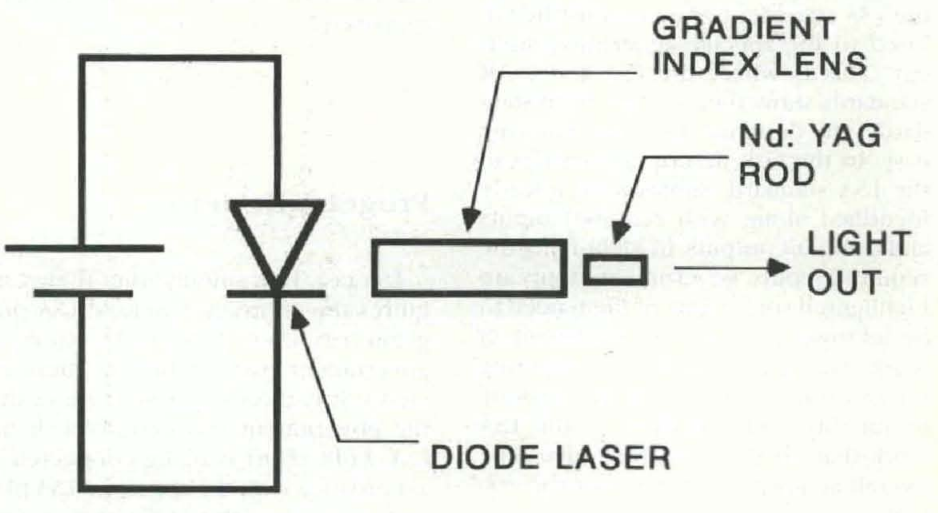
ARO has a long history of supporting advanced research. One such long term ARO-supported research program is conducted by Professor R.S. Byer of the Applied Physics Department of Stanford University. Dr. Byer's group has produced many laser and optical research breakthroughs. One recent result is a laboratory demonstration of the production of green laser light from a laser-diode-pumped infrared laser. One R&D effort to bring these lasers out of the laboratory is currently being conducted, under contract with ARO, by Lightwave Electronics Corp. The goal is to provide the Army with miniaturized laser devices.

The Technology

Laser-diode-pumped lasers consist of a laser diode, a small NdYAG crystal, and a lens which delivers the light from the laser diode to the NdYAG. NdYAG refers to a commercially grown garnet that contains yttrium and aluminum and is doped with neodymium. It has excellent lasing properties. The laser diode is tuned so that the energy it emits is absorbed in the NdYAG. This tuning is accomplished by controlling the temperature of the diode. The energy deposited in the NdYAG creates optical gain and, with mirrors to provide feedback, this leads to lasing.

If a NdYAG crystal with polished and reflective-coated surfaces is used, then the laser is complete with no need for external mirrors. Such a laser is called a monolithic laser. The crystal is typically a few millimeters long. The lasing region of the NdYAG laser occupies only a volume 0.1mm in diameter through the length of the crystal.

The output power of these monolithic lasers depends on the power of the laser diode pump source. Inexpensive mass-produced laser diodes deliver several milliwatts of power. High power laser diodes producing hundreds of milliwatts are now also available when



Laser-Diode-Pumped Laser

A simple laser-diode pumped solid state laser is shown in which the light from the laser diode is directed into the miniature Nd:YAG rod by a gradient index lens. The laser rod has polished and coated ends that form the mirrors of the optical cavity. The whole assembly is small, and the laser rod is typically a few millimeters long.

greater pump power is required.

Diode-pumped NdYAG lasers can convert more than 40 percent of the pump power into laser emission, and the overall efficiency of the system, from electrical power to coherent infrared radiation, can be near 10 percent. A flashlight battery powered unit can easily provide milliwatts of laser power. An important fact is that a one cubic millimeter miniature NdYAG laser can produce substantially more power than a one-meter-long helium neon laser.

The laser-diode-pumped NdYAG laser employs a laser to pump a laser. As with any energy conversion process, energy is lost. The advantage of the laser-diode-pumped NdYAG laser over the direct use of a laser diode is that the temporal coherence of the NdYAG laser can be thousands of times larger and the peak instantaneous power of the NdYAG laser can be thousands of times greater. Temporal coherence is a measure of how wide a frequency band is emitted by the laser—the smaller the frequency band the larger the coherence. These two attributes make possible the non-linear conversion of the infrared laser output into green light, conveniently at the peak of the eye's response curve.

Coherence and/or high peak power are also the keys to receiving a clear return signal from a distant target without the expenditure of a large amount of energy. These powerful, highly coherent lasers are hardly any bigger than the laser diode that pumps them, and are far smaller than lasers which are used conventionally to provide highly coherent, high peak-power, or visible light. The laser rod, laser diode, and lens weigh less than a few grams, and even with a battery and control electronics, the unit can be easily hand held.

A newly-invented laser resonator in the shape of a ring allows the excellent coherence of diode-pumped lasers to be extended to arbitrarily high powers, and also maintain this coherence in the presence of unwanted reflections back into the laser. Back reflections cause frequency instability in many lasers, including laser diodes. This limits their ability to send optical signals through long fibers at high data rates. Laser diode pumped NdYAG lasers have been built in which the cavity is a ring totally within the NdYAG, and the ring only oscillates in one direction, so that back reflections into the cavity are suppressed. Because the laser oscillates in only one direction it will oscillate at a single frequency even at high power levels.

Frequency doubling (equivalent to dividing the wavelength in half) to produce coherent green light may be of great value. Non-linear optical materials may be placed within the laser cavity to convert the infrared light to green light. By operating the doubler in the cavity, efficient conversion is possible without high power. There are a number of other possible ways to produce green in a diode-pumped configuration. We hope to find the most efficient and reliable technique. In the long run this technology should be of significant interest to the Army.

DR. RICHARD WALLACE is vice-president of Lightwave Electronics Corp. He works on laser developments.

Breakout Program Reduces Costs

Patriot Launcher Cost Reduced

The Army Missile Command (MICOM) has significantly reduced the cost of two components for the Patriot Weapon System Launcher Station through the Breakout program. MICOM had been procuring the two components—a Data Line Terminal Module (DLTM) structure and Launcher Electronic Module (LEM) structure—from the prime contractor since 1980. The unit price on the sole source contract was $43,000 for the DLTM and $40,000 for the LEM. A decision was made to break out these items and go Full and Open Competition for FY 86. The new unit prices are $5,834 for the DLTM structure, and $5,595 for the LEM, an 86 percent reduction in unit cost. The total projected cost avoidance for FYs 86 and 87 is $15.6 million.

TACOM Cuts Costs for Tank Components

The Army Tank-Automotive Command (TACOM) has developed competition through the Breakout program which has cut costs for Abrams tank components.

- TACOM had been procuring a bearing housing for the Abrams sole source since 1983. The unit price of the bearing housing was $1,050. Data was obtained to incorporate complete specifications in a competitive solicitation. This resulted in a new source receiving the contract at a price of $585 which represents a cost reduction of 44 percent. The total cost avoidance for FY 86 is $256,685 with projected savings for FY 87 of $94,862.

- A vehicular heater common to the Abrams, M60 tank, and M548 cargo carrier had been purchased sole source at $684.70. After competitive solicitation, a contract was awarded at a new price of $547.94—a reduction of 20 percent. Cost avoidance for FY 86 is $604,615.

- The price of shock absorbers was reduced by the same method. Last contract unit price was $1,228. An award made to a new source was $695 per unit—a reduction of 43 percent. FY 86 cost avoidance is $2,025,091 with an additional $1,811,755 for FY 87.

Windows of Opportunity . . . International Armaments Cooperation

By Bryant R. Dunetz

Introduction

Changes in international armaments cooperation policy is a subject of increasing importance. The following article addresses the numerous factors contributing to this policy, including legislation, organizational changes, program accomplishments and, most importantly, efforts of the Army's research, development, acquisition and logistics components.

Explicit language in the 1976 Culver-Nunn Amendment required the Department of Defense to field standardized, or as a minimum, interoperable equipment with our NATO allies. New legislation and policy requires the DOD to increase its emphasis on armaments cooperation within NATO. For example, the 1985 Quayle Amendment was a result of a DOD initiative to facilitate the partnership in the production phase of a NATO cooperative program. The main provisions of this legislation deal with procurement by the United States of an article or service from another government, and authorizes waiver of a number of provisions of law in formulating contracts and execution of the program.

The FY86 Nunn Amendment addressed the need for cooperative R&D and comparative testing in NATO and authorized funds to be expended in support of these efforts.

This new legislation urges and requests the president, secretary of defense and the U.S. representative to NATO to pursue diligently the opportunities for member nations to cooperate. Army leadership has aggressively supported the spirit and intent of the Nunn Amendment and has achieved early and beneficial results in its implementation.

Policy and Organization

Secretary of Defense Weinberger's June 6, 1985 memorandum to the services provides a strong statement of why we must capitalize on each opportunity for cooperation and is the policy foundation for current department activities. The secretary asked the services to take the following steps:

- Seek out opportunities to inform the Congress of the military importance of common and integrated military equipment within the alliance.
- Consider armaments cooperation in all new acquisition programs.
- Assure protection for shared technology.
- Consult with European counterparts on new requirements, and eliminate duplication of programs.
- Give special attention to nondevelopment items.
- Revitalize responsibilities of DODD 2010.6, Standardization and Interoperability of Weapons Systems and Equipment Within the North Atlantic Treaty Organization.
- Establish an education program to teach "alliance collective security through armaments cooperation."

The Army's response to these steps was immediate and direct. The Army vice chief of staff conducted a Functional Area Assessment on the subject Rationalization, Standardization and Interoperability (RSI) and the Army Materiel Command (AMC) hosted a U.S. Army Conference on NATO Armaments Cooperation, both occurring in January of this year.

On the organizational side, Weinberger established a steering committee on armaments cooperation under the deputy secretary of defense and a a special assistant for NATO armaments cooperation. The Army staff re-established an RSI policy office under the deputy chief of staff for operations, and AMC merged the Office of the Deputy Chief of Staff for International Programs with the U.S. Army Security Assistance Center to form the U.S. Army Security Affairs Command (USASAC) to enhance the capability of responding as a "single face" to NATO program requirements. The USASAC commander now has the responsibility to support and function across the entire spectrum of international programs.

USASAC is unique among the services in terms of mission, responsibilities, scope of activities, and most importantly, the ability to conduct business with countries on a broad front of opportunity areas. The ability to acquire equipment, services, and training; to enter into cooperative R&D, production or logistic agreements; or simply exchange information, and personnel, and to share in mutually beneficial technology will lead to improved cooperative security relationships and thereby enhance U.S. national objectives.

How Nunn Programs Work

As indicated earlier, the Nunn legislation deals with two aspects of NATO cooperation—cooperative R&D projects and comparative testing. Certain preconditions have been established to utilize the funds that have been appropriated:

• Each project must involve joint participation by the United States and one or more other NATO member nations.

• An international Memorandum of Understanding must be signed by the country participants.

• The project must enhance or contribute to the improvement of NATO's conventional defense capabilities.

• U.S. funds must be used in the U.S. only.

• The program must be approved by the secretary of defense and the Congress must be notified.

Comparative testing calls for items manufactured by other nations of NATO to be tested side-by-side with comparable items of U.S. manufacture. It states, "Testing should be conducted at the late stage of the development process when there is usually only a single United States Prime Contractor."

The last major provision of the amendment requires the services to prepare and submit a formal Arms Cooperation Opportunities Document for all Joint Requirements Management Board meetings and Justifications of Major System New Starts (JMSNS).

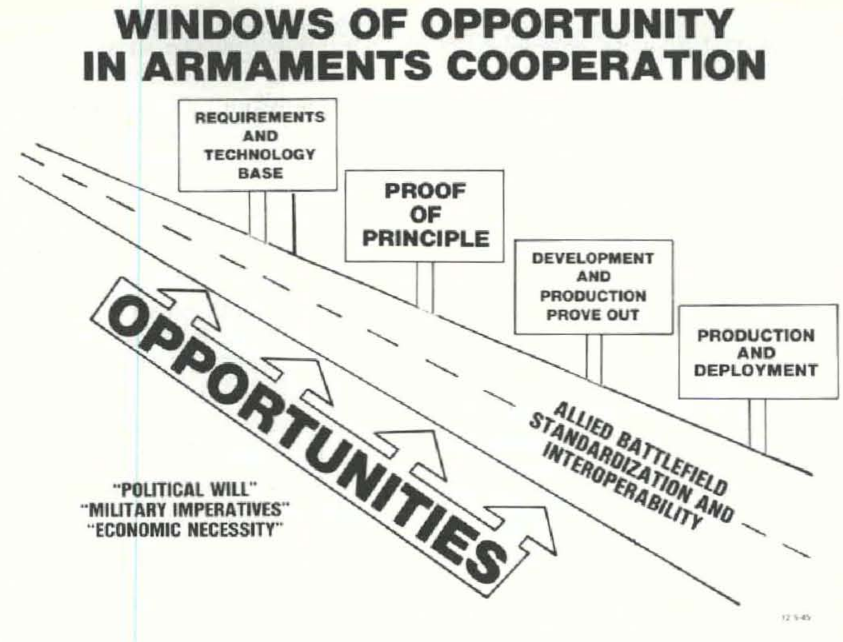
While the original Congressional proposals indicated that DOD would receive a total of $250 million in FY86, only $125 million was actually appropriated. Those funds nominally provided $25 million to each service and defense agencies for cooperative R&D projects and another $25 million to be shared in support of comparative testing. The Army's initial submission for cooperative R&D contained five proposals. The list of approved projects was recently expanded to six:

• Airborne Radar Demonstration System—to achieve compatibility of NATO radar platforms and ground stations in battlefield reconnaissance, surveillance and target acquisition;

• Autonomous 155mm Precision Guided Munition—an artillery-delivered autonomous hit-to-kill anti-armor munition;

• NATO identification System—identification friend or foe;

• Evolutionary SAM/Medium SAM—a replacement for Hawk;



• Army Tactical Missile System—a conventional deep attack missile system; and

• Hawk Mobility Enhancement—to replace the loader/transporter and to modify the launcher.

Relative to comparative testing, the Army is evaluating an NBC reconnaissance system, a mine detector system and an air-to-air missile for helicopters.

Since the Nunn Amendment provisions are expected to continue into the future, new program candidates should be considered for cooperative R&D and comparative testing. Nomination of candidate programs should be submitted to USASAC where they will be consolidated for submission to the Department of the Army and the Office of the Secretary of Defense for approval.

Windows of Opportunity

One of the purposes of the January conference on NATO armaments cooperation was to review the various "Windows of Opportunity" for armaments cooperation in the context of the new shortened acquisition process.

Requirements and Technology Base

During the first phase of the new acquisition process—the Requirements and Technology Base phase—battlefield deficiencies, which are contained in TRADOC's Mission Area Analysis and Battlefield Development Plan, are identified. Deficiencies are also systematically analyzed during bilateral staff talks. This phase is intended to lead to opportunities for cooperation, as evidenced by U.S. evaluation of nondevelopment items from several NATO allies.

Information exchange and shared technological concepts are also critical to the early phase of the development cycle. The Army accomplishes this under the Mutual Weapons Development Data Exchange Program and through various expert groups. The Army currently participates in more than 200 annexes with 17 countries. Scientific personnel exchanges with a number of NATO countries provide further enhancement in pursuit of cooperative R&D projects. Excellent opportunities exist for Army civilian and military scientists to work in a foreign country under this exchange program. Foreign laboratories, proving grounds, test facilities, and in some instances, industries have provided rewarding professional experiences while furthering the goals of the program.

The Army's research and technology programs continue to benefit from the availability of foreign technology. Sometimes referred to as Tech Base

Augmentation, technical information furnished through reciprocal exchanges fills critical gaps. In order to gain additional benefits from allied resources, foreign technologies are being given greater visibility and consideration as part of the planning and budget building process. By policy direction, the Mission Area Materiel Plans must consider foreign technology alternatives to meet battlefield deficiencies.

Proof of Principle

Several Opportunity Areas come into play during the Proof of Principle phase of the acquisition cycle. The formalized requirements to consider allied technology and systems are derived from OSD policy and Army regulations. Project managers are obliged to prepare formal RSI plans and, more recently, an Arms Cooperation Opportunities Document to gain Army Systems Acquisition Review Council and Joint Requirements Management Board approval for their programs. Availability of technology demonstrators/prototypes from allies is an important aspect of this phase when a development program is pursued.

In many instances, off-the-shelf items are available for evaluation from our allies and friends. Opportunities exist to furnish the needed hardware through no-cost loans, leases or direct procurement. Numerous foreign items have been acquired by the United States for evaluation and have a good acceptance rate in meeting U.S. requirements. For example, the 105mm British Light Gun was evaluated and type classified in a relatively short period of time.

Funds for these efforts are available under the Foreign Weapons Evaluation Program, the Concept Evaluation Program, Nunn-NATO comparative testing, and other individual projects.

Identification of off-shore systems is facilitated through the market surveillance/market investigation responsibilities of the AMC commodity commands and USASAC. A vast network of sources are accessible by request to USASAC.

Development and Production Prove Out

Cooperative R&D is the main Opportunity Area during the Development and Production Prove Out phase of the streamlined acquisition cycle. The well publicized phenomena that generates higher overall development costs as a function of the number of participating nations is not, nor should it be, a detriment to cooperative R&D projects. Matching funds and burden sharing will in fact reduce the overall impact and risk for a single nation while maximizing access to a wider cross section of engineering and scientific expertise and ideas and the economic benefits of higher production.

The Nunn program is the single largest source of R&D funds for international cooperation although other programs, such as Canadian Development Sharing, still offer the U.S. a significant Canadian investment on every dollar we invest in pure technology programs and cooperative R&D.

As mentioned earlier under the Nunn program, a formal Arms Cooperative Opportunities Document is required prior to initiating a new program. The Army Tactical Missile System was the first such system requiring this documentation and established the precedent for future programs.

Production and Deployment

In the fourth and final phase of the shortened acquisition cycle— Production and Deployment—the main Opportunity Areas are cooperative production and logistics. Coproduction is a proven instrument of armaments cooperation, in spite of the difficulties posed by requirements for industrial offset and technology transfer.

In the changing environment of the international market place, a popular acquisition alternative for allied countries is to coproduce or coassemble systems as compared to buying. With such programs, offset is required to compensate for inefficiencies in small production. Nevertheless, these are still opportunities from the standpoint of developing the country towards self-sufficiency and upgrading its defense posture. Defense industrial cooperation agreements in some instances provide the overall international policy umbrella for these programs. Coproduction programs, such as the Multiple Launch Rocket System (MLRS), Stinger, M483 Projectile, Common Modules and others to be negotiated, will continue to provide incentives for our NATO partners well into the foreseeable future.

Cooperative logistics concepts are also receiving greater emphasis within the alliance. While the U.S. Army has always contributed to funding the NATO Maintenance and Supply Activity, we have only recently entered into major weapon system partnership agreements for MLRS and Patriot. The assistant secretary of defense for acquisition and logistics, in a memo to the services, recognized the importance of these two agreements and called for greater use of the NATO Maintenance and Supply Activity.

Future Trends

During the 10 years that have elapsed from the early days of RSI to the present, significant progress has been made. Clear precedents and operating methodologies have been established and program objectives have been identified. Experienced personnel are now capable of structuring and and effectively negotiating a variety of armament cooperation program models to meet the needs of program and project managers. A recent innovation in meeting our NATO air defense needs drew upon various forms of cooperation to derive the U.S./Germany Roland/Patriot agreements. A combination of models proved successful in this case and provides guidelines for future armaments cooperation programs.

A strong consensus now exists within the alliance to achieve new levels of battlefield interoperability and improved armaments cooperation. Efficient execution of these initiatives can contribute greatly to a capable allied deterrent force.

BRYANT R. DUNETZ is the deputy for international plans and programs, U.S. Army Security Affairs Command, U.S. Army Materiel Command. He is a graduate engineer with a long career in AMC research, development and international programs management.

The Armored Family of Vehicles

Editor's Note: The following article describes the Tank-Automotive Command's efforts in development of a new family of armored vehicles. A related article on the materials technology aspects of this program appears on page 22 of this magazine.

The Research, Development and Engineering Center of the U.S. Army Tank-Automotive Command (TACOM), Warren, MI, has begun research aimed at developing an armored-vehicle family that would include a full range of vehicles with maximum component commonality.

The effort is in support of former Tank Program Manager MG Robert J. Sunell, who earlier this year became director of a newly established Armored Family of Vehicles (AFV) Study Group at Fort Eustis, VA. The group's objective is to develop and field an armored force capable of defeating battlefield threats in the 1990s and beyond, while concurrently reducing life-cycle costs through maximized component commonality.

Commonality is not a new idea; both U.S. and foreign automobile manufacturers have been relying extensively on standardized parts for many years to help keep developmental and production costs down. In Army combat vehicles, there are common subsystems such as engines, transmissions and electronics, and common chassis in such vehicle families as the M2/M3 Bradley. However, the AFV now envisioned at TACOM would represent a first for the Army.

The new armored family may include common chassis that could be used with any of various modules—each designed for a specific mission—to build a full range of armored vehicles. To build a tank, for example, there would be a module outfitted with a gun and a fire-control system. A recovery vehicle would have a module with a crane and winches. For an infantry vehicle there would be an armored module designed to carry troops.

With this much commonality, there would be important logistics benefits. For one thing, it would be much easier to train mechanics and drivers. Also, it would be cheaper to buy large quantities of parts common to the entire fleet than to buy small quantities of unique parts for each vehicle type. Thus, there would be a great potential for reduced overall vehicle sustainment costs.

TACOM is managing two Armored Family of Vehicles efforts, one of which is an in-house project and the other involves outside contractors. TACOM engineers have identified 29 specific armored-vehicle roles—28 manned and one robotic—which are either being performed now or anticipated in the future. They have also examined the vehicle requirements for each role and gathered pertinent subsystem technical data, which are now being used to create and evaluate computer models of AFV concepts for each role.

Development of these concepts will not simply be a matter of creating one design for each role and maintaining commonality, because there is more than one possible way to achieve the objective. One way would be to have a totally universal chassis for the full range of mission-specific roles, or there could be two or three common chassis. Also, the feasibility of performing each role with a wheeled, tracked or robotic vehicle must be considered. But that is not the end of it. For some concepts there are variants worthy of consideration. An air defense artillery vehicle on a light chassis, for instance, could have a missile or a gun, or it could be a hybrid concept with a combination of gun and missile.

The contractor effort involves essentially the same thing. On Feb. 28, TACOM released a Request For Proposal to some 75 domestic and foreign companies for conducting a one-year AFV concept study. Proposals have been received and have undergone a technical evaluation by a proposal evaluation board comprised of representatives from TACOM, other AMC subcommands and the user community. At the same time, a team of budget analysts evaluated each proposal from a cost standpoint. These efforts were completed by August, and on Sept. 15, TACOM awarded three AFV concept study contracts—one each to General Motors, Teledyne Continental Motors, and Armored Vehicle Technologies Associates (formed by General Dynamics and FMC).

The TACOM- and contractor-developed AFV computer models are expected to be completed by August 1987. Engineers will then identify the vehicle family offering the greatest potential by pitting each of them against projected 1990s battlefield threats in computer-simulated war games.

The next step will then be to build wooden vehicle mock-ups in 1988. These will be followed a year later by technology-demonstrator prototypes which will allow engineers to evaluate actual hardware. If all goes well, full-scale AFV development will get underway in 1990, with introduction of vehicles to troops possible during the mid-1990s.

If the introduction goes according to plan, it will represent a dramatic departure from the traditional way in which the Army fields new vehicles. Normally, vehicle series are developed and introduced independently and are uniquely designed to perform specific missions. But the aim of the AFV program is to field an entire family of combat vehicles together—the same way automobile manufacturers bring out their new-model lineups each year.

TACOM engineers believe that the Armored Family of Vehicles cannot be introduced individually but must be fielded as a fighting unit. It has been projected that the smallest unit which could be fielded that would include a combat force actually capable of fighting effectively would be a brigade. Moreover, it is hoped that TACOM could field a brigade each quarter and a division each year once introduction begins.

Equipping the entire Army combat force of eight mechanized divisions, seven armored divisions, one cavalry and one light infantry division with the new vehicles will involve buying approximately 39,000 vehicles over a 17-year period.

The preceding article was written by George Taylor III, a technical writer editor for the Army Tank-Automotive Command.

Materials Technology for the Armored Family of Vehicles

By CPT John N. Lesko Jr.

Introduction

The Senate Armed Services Committee has told the Army to go back to the drawing board and "undertake a systematic review of its acquisition plans for major combat systems. . ." The committee also told the service it will have to make do with its current generation of weapons because research and development (R&D) dollars will be hard to come by. . . "In some cases . . . such as the M1 tank, there is no immediate plan, only long-run objectives for modular fighting vehicles that would not be fielded until the turn of the century." (Army Times—*Defense Trends, "Senate Panel Tells Army to Review Weapons Plans," July 28 1986).*

So starts another media article challenging the Army's R&D centers to do more with less and to do it in a hurry. The Materials Technology Laboratory (MTL) in Watertown, MA, is up to the challenge. Known for producing "things that work," MTL focuses on the next generation of combat vehicles and the application of space-age materials into their armor, drive trains, and optics.

On May 2, 1986, MTL gave an information briefing to MG Robert J. Sunell, director, Armored Family of Vehicles Task Force, Fort Eustis, VA. MG Sunell is tasked with studying the feasibility of fielding the modular fighting vehicles designed to replace such existing armored vehicles as the M1s, M2/M3s, and M113s. These future systems are the next Armored Family of Vehicles (AFV). MTL's objectives were to tell who we are, what we can do, and what we'd like to do for the AFV.

MTL Capabilities

MTL is the Army's lead laboratory for materials, materials testing technology, solid mechanics, lightweight armor, and manufacturing testing technology. Its mission is directed by the U.S. Army Laboratory Command in Adelphi, MD, which is responsible for managing the corporate laboratories of MTL's parent command, the U.S. Army Materiel Command in Alexandria, VA.

MTL is not the builder of weapons systems prototypes, but rather serves as the Army's data base and research facility capable of reporting materials possibilities. In other words, MTL is in the business of studying the "stuff" from which Army materiel is made.

At MTL, one can find metallurgists, organic chemists, ceramists, mechanical engineers, operators of injection molding machines for plastics, manufacturing engineers, and many other materials experts. MTL houses the Army's experts in solid mechanics and materials science. By studying the materials' properties of penetrators and armor, MTL can recommend which is the best stuff from which to make such materiel as a bullet or shield. The same holds true for being able to recommend the best stuff from which to make tank track shoes or pads. MTL's goal is to put the right material in the right place at the lowest cost.

So, what are the materials possibilities for use in the Armored Family Family of Vehicles? They include the following:

- armor materials for the defeat of advanced kinetic energy penetrators across the board from 7.62mm to 120mm;
- materials systems (e.g., spall liners) for the defeat of high-velocity fragments;
- ceramic armor plate with improved shattering resistance;
- use of corrosion resistant materials in bearing and other critical parts;
- gun tube enhancements making cannons which last longer and allow for greater muzzle velocities;
- use of ceramic piston rings or heads to improve engine thermal efficiency; and
- processing technologies which allow for the cost efficient production of parts and subsystems made from advanced composites.

Continuing Research

Research in shock-impact mechanics is continuing at MTL in support of the M109 Howitzer Improvement Program and the Bradley Fighting Vehicle composite turret and hull tech-demonstrator. The results of this experimentation should establish the necessary technical data base for understanding how proposed armor designs will fair against threat weapons of various calibers. Novel armor systems designs and the integration of advanced materials into future fighting vehicle systems will greatly enhance crew survivability.

The question of spall blown off the back of metal armor when hit by a shaped charge is eliminated when materials such as fiberglass or Kevlar are used as structural and ballistic armors. Experimentation with advanced armor systems using hybrids of metals, ceramics, and plastics is continuing at MTL and in several cooperative research efforts with the Tank-Automotive Command (TACOM) in Warren, MI, the Ballistic Research Laboratory at Aberdeen Proving Ground, MD, and private industry. Armor and anti-armor initiatives are attacked from the most fundamental level of materials microstructures to the macroscopic response of materials in the most advanced armor/anti-armor designs.

The use of advanced materials in the Armored Family of Vehicles will result in significant weight savings. This means that either greater armor protection is afforded the crew (if designers attempt to stay in the existing weight envelope) or that smaller and sleeker vehicles can be produced (improving on the strategic deployability of a unit equipped with lighter systems which are comparable in survivability).

The ongoing R&D efforts at MTL should result in a technical demonstration of the first operational combat test vehicle, incorporating composite materials in the hull and turret structures. This vehicle will be ready well before the turn of the century.

Continuing research in elastomers, in conjunction with TACOM developmental testing, should result in M1 tank track life meeting and eventually exceeding initially the 1,500-mile durability specification and eventually the 2,000-mile durability goal. The use of test methods derived at MTL will soon allow field test data to be correlated with analytical methods such as finite element analysis and high speed, thermal photographic analysis of rubber ground pads. MTL's research continues up through the ground pads, into the track blocks, through the bushings, and so forth.

Life prediction and reliability mechanics go hand-in-hand with the understanding of the properties and characteristics of materials. As a matter of fact, due to the increased and projected analytical capabilities of MTL, materials' performance characteristics will be easier to model and, therefore, predictions of stress levels of candidate designs will be found in the "drawing board" stage of development and not in the more costly prototyping stage. Improvements in quality and structural reliability should naturally result.

The advances made in the areas of non-destructive testing and evaluation now allow for the checking of welds, fasteners, and the joining of dissimilar materials. MTL's non-destructive testing school provides certified evaluators to the Depot System Command and the numerous depots and industrial quality assurance personnel for these purposes.

If the manufacturing faults or errors in tolerance are found before materiel leaves the factory, then the lives of the soldiers who operate the vehicles are less likely to be placed in jeopardy due to a material's failure. Guaranteeing the quality of the materials used before manufacturing is insurance against future failure. Equally important is MTL's role in preparing and updating specifications for materials. If you can't specify it, you can't buy it.

The advances outlined above are attainable before the year 2000. In the short run, MTL can deliver materials expertise leading to:

- vehicle hull and turret protection against combined Kinetic Energy HEAT (High Energy Anti-Tank), and overhead threats with the high mass efficiencies needed for combat vehicles to survive on future battlefields;
- ceramic armor materials with a 25 percent increase in ballistic mass efficiency and a 60 percent decrease in cost per pound; and
- nearly a 100 percent reduction in the amount of spall during shaped charge attacks using proven and available spall liners.

Summary

In summary, MTL can provide the most advanced materials technology options available for the new Armored Family of Vehicles. MTL will do this by working closely with the Ballistic Research Laboratory, the Tank-Automotive Command, and private industry, as well as by focusing research efforts and concentrating those "hard to come by R&D dollars" on existing and emerging technologies.

CPT JOHN N. LESKO JR. is associate director of the Mechanics and Structural Integrity Laboratory at the U.S. Army Materials Technology Laboratory. He holds a B.S. degree from the U.S. Military Academy, West Point, NY

Career Management Personnel

The following is a current list of career managers for Skill 6T (Materiel Acquisition Management), and Functional Areas 51 (R&D), 52 (Nuclear Weapons), and 97 (Contracting and Industrial Management).

Proponency Managers:

- LTC Edward L. Oliver III (Skill 6T), HQ, AMC, AV 284-5076
- Hughes S. Hobson (Skill 6T), HQ, AMC, AV 284-5076
- Jo Laree Green (FA 51), HQ, AMC, AV 284-8537
- MAJ Johnie J. Wright (FA 52), Fort Leavenworth, KS, AV 552-2724
- MAJ Randy Elmore (FA 97), HQ, AMC, AV 284-8125

MILPERCEN Professional Development/Assignment Personnel:

- Barbara Head (Skill 6T Career Program Manager), AV 221-3125
- MAJ Ed Coughlin (FA 51 Assignment Officer), AV 221-3125
- CPT John Reidt (FA 52 Assignment Officer), AV 221-3116
- MAJ Donnie George (FA 97 Assignment Officer), AV 221-3125

Liquid Filled Projectiles . . . New Problems, New Solutions

By Miles C. Miller

Introduction

Considerable progress has been made recently in understanding and analyzing the flight dynamics of spinning projectiles having liquid chemical fills. The internal movement of these non-rigid fills can adversely affect the flight stability of chemical delivery systems and must be considered in their design and analysis. Theories related to the familiar resonance type instability associated with low-viscosity liquids have been extended in breadth and detail. In addition, an entirely new and unexpected form of flight instability has recently been identified which is caused by highly viscous liquid fills. This latter instability is extremely severe, causing the projectile to experience both a rapid growth in yaw angle and an abrupt loss in spin rate with a consequent degradation in range and accuracy. Unlike the low-viscosity liquids, this instability does not appear to be easily eliminated by small changes in payload geometry and could pose serious design difficulties for future chemical munitions.

A concerted research and development effort has been expended by the U.S. Army to support the evolution and validation of analytical methods to predict and prevent these instabilities. Special laboratory facilities were built to provide the experimental data base needed. New computational techniques were developed to determine the internal fluid dynamics and to evaluate the combined effects of the liquid payload and the external aerodynamics on the resulting projectile trajectory and flight motion.

The present goal is to replace existing limited theories with a "unified" theory, encompassing all payload configurations, projectile motion characteristics, and liquid properties of practical interest. These tools will provide design engineers with the ability to assess the detailed performance of advanced smoke and chemical munition systems.

Low-Viscosity Fluids

Flight instabilities of liquid filled projectiles have been recognized as a problem since World War I. However, up to and including World War II, projectile design had been totally empirical. In fact, it was not until well after the second world war that a theoretical description emerged which explained their erratic flight behavior. For a typical artillery projectile, a flight instability due to a low-viscosity fluid fill causes the nutational yaw motion to grow with time; but, the projectile spin is unaffected.

In 1959, K. Stewartson in Great Britain developed a theory which showed that the unstable motion was caused by inertial or pressure waves created in the spinning invisid liquid which were in resonance with the projectile nutation frequency. Further, the frequencies of these waves are a strong function of the payload geometry. A small change in length to diameter ratio of the payload compartment can shift these frequencies to values outside of the range covered in flight. In this manner, payload geometries can be selected to avoid this instability.

In 1966, E. Wedemeyer working at the U.S. Army Ballistic Research Laboratory (BRL) introduced a correction factor to the Stewartson equations to account for liquids having small viscosity. The effect of viscosity reduces the magnitude of the destabilizing effect, but causes it to occur over a wider frequency range. The resulting Stewartson-Wedemeyer theory has been the primary tool for the design of chemical projectiles ever since. This method has proven quite adequate because all of the chemical payloads of interest have been low-viscosity liquids. The most recent advance in this area occurred in 1983 when Sedney and Gerber at the BRL extended the Stewartson-Wedemeyer theory to include transient ef-

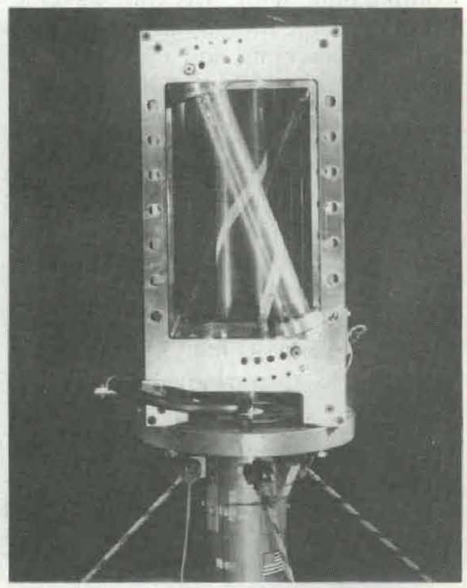


Figure 1. CRDEC Laboratory Test Fixture for Non-Rigid Payloads.

fects present in many actual flight conditions.

Non-Rigid Payloads

The flight stability problem experienced during development of the XM761, 155mm White Phosphorus (WP) Smoke Screen Round in 1977 came as a complete surprise to the aeroballistic community. Because of the round's semi-rigid payload composition, the creation of destabilizing inertial waves was not considered possible. Further, no problems were indicated during tests on the standard gyroscopic test fixtures available at that time.

The round contained a large number of cotton patio torch wicks immersed in WP. Upon expulsion from the projectile over the target, the WP saturated wicks were dispersed over a relatively large area on the ground. Each wick would spontaneously ignite providing a series of point sources of smoke, resulting in a rapidly formed, dense smoke screen of relatively long duration. At elevated temperatures, however, where the WP was in a liquid state, the projectile experienced a severe flight instability causing the round to fall short of its intended range. The unique feature of this instability was that both a large increase in yaw angle and severe loss in spin rate were suffered by the projectile.

The combination of cotton wicks and watery like liquid WP gave the payload a "wet mop" composition. Although it was realized that the flight instability was due to the relative motion of this payload inside the projectile and could be solved by restricting this movement, the degree of restriction required was not known.

A special laboratory test fixture was designed and built at the U.S. Army Chemical Research, Development and Engineering Center (CRDEC) in which actual, full scale 155mm payload assemblies could be screened for this instability. The apparatus simulates the simultaneous spinning and coning motions of the projectile and enclosed payload which occurs in flight as depicted in Figure 1 and duplicates the payload induced despin effect under controlled experimental conditions.

Candidate payload configurations were evaluated on the fixture, culminating in a successful smoke screening payload arrangement which satisfied both the desired functional and flight performance characteristics. The resulting round, designated the M825, replaced the cotton wicks with felt wedges, which provided tighter packing, and greatly reduced the payload induced destabilizing effect.

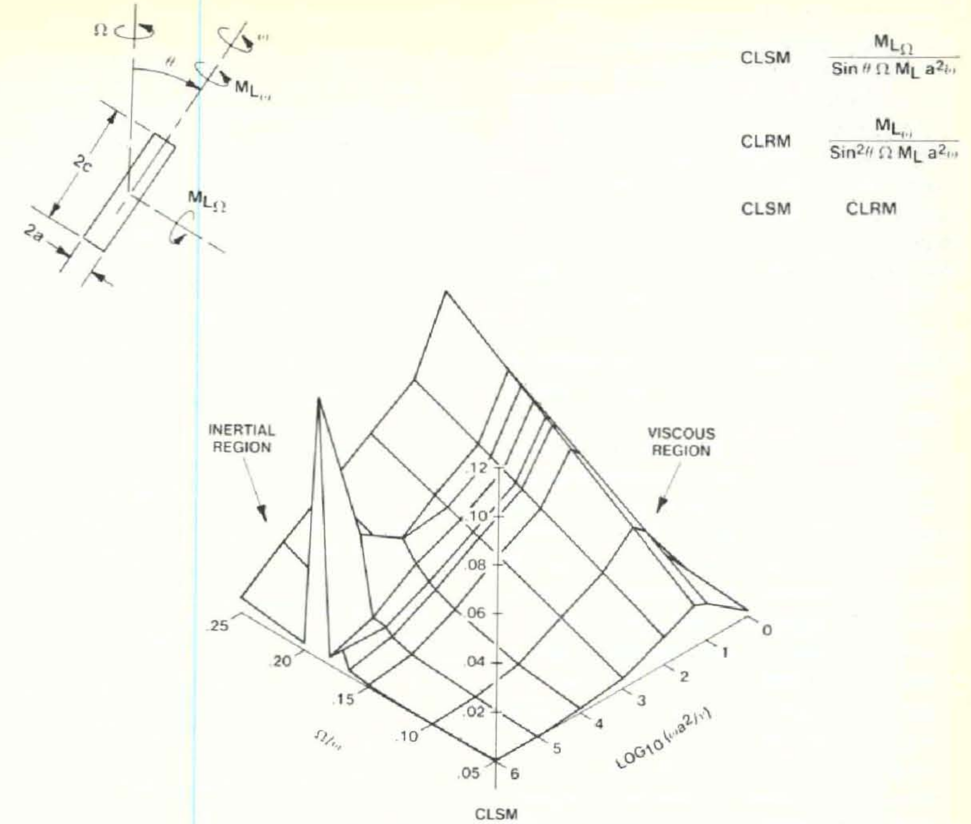


Figure 2. Three-dimensional Plot for Liquid Fill Induced Flight Instability.

High-Viscosity Liquids

With the immediate development problem solved, this author employed the laboratory test fixture in a series of experiments during 1978 to gain an insight into the basic characteristics and source of the instability. As a result of a suggestion by H. Vaughn of the Sandia National Laboratories that the wick/liquid WP combination behaved like a highly viscous liquid, payloads consisting of homogeneous, viscous liquids were tested on the fixture. The liquids evaluated ranged in viscosity from one centi-stokes (CS) to over 1,000,000 CS extending over seven orders of magnitude and encompassing all possible fluid payload conditions.

These data revealed that the despin moment, because of the viscous liquids, had characteristics similar to that of the general non-rigid payloads. It was also shown that the despin moment increases with the liquid viscosity, achieving a maximum value in the area of 100,000 CS (water has a viscosity of one CS), thereupon diminishing to zero at very large values of viscosity. In particular, the magnitude of the despin moment, measured for the canister filled with corn syrup having a viscosity of 200,000 CS, was found to be identical to that of the XM761 payload configuration. Accordingly, a projectile filled with corn syrup should experience a similar instability.

Subsequent instrumented flight tests of full-scale 155mm projectiles having viscous liquid payloads were conducted by W. D'Amico at the BRL and showed good correlation to the fixture results.

Thus, although the original intent of the homogeneous, viscous liquid experiments was to obtain a mathematically tractable model for the non-rigid type payload arrangements, the results indicated a serious concern for future weapon design in that chemical fills being considered for advanced munitions consisted of liquids having relatively high viscosities.

Analytical Solutions

To date, the scientific studies associated with liquid filled projectiles have been limited to either the very low-viscosity or the very high-viscosity fluid cases. In 1982, C. Murphy of the BRL, completed the boundary layer theory for low-viscosity (i.e., high Reynolds number) fills. His analysis is based on the linear Stewartson-Wedemeyer theory for a finite cylinder and incorporates all the pressure and viscous terms.

By extending this theory to lower Reynolds numbers, Murphy showed that the resonance condition side moment peak diminishes and its effective frequency band width increases as the Reynolds number becomes smaller. The resonance effect gradually disappears at extremely small Reynolds numbers, being replaced by a side moment which steadily increases with coning rate.

A closed-form expression for the liquid fill induced despin moment was developed by T. Herbert of the Virginia Polytechnic Institute (VPI) in 1984 which is valid over the entire range of Reynolds numbers of interest including those for highly viscous (i.e., low Reynolds number) fluids. His approach is based on an infinite cylinder with the equations expressed in the non-dimensional terms and linearized to facilitate the solution and interpretation of results. The resulting analytical expressions were then solved parametrically to provide an insight into the general characteristics of the fluid dynamic mechanism associated with the destabilizing phenomenon. The internal flow field he computed showed excellent agreement with numerical solutions of the complete three-dimensional Navier-Stokes equations developed by the Sandia National Laboratories. Herbert's results explained, for the first time, the physical reasons for various experimental observations.

Because of the presence of spin and the associated gyroscopic effects, the moment, induced by the liquid fill that actually causes the nutational growth, acts on the projectile in a lateral or sideward sense, and is referred to as the "liquid side moment." Murphy's theoretical analysis evolved non-dimensional coefficients for the liquid induced yaw (side) and despin (roll) moments. He further predicted that the side and roll moment coefficients were equal but opposite in sign. Confirmation for these results was demonstrated through the analysis of flight test data conducted by the BRL and laboratory experiments performed ad the CRDEC. This equality is important because it allows the destabilizing yawing moment to be evaluated by means of the relatively easy to measure despin moment and allows the despin moments computed by Herbert to be directly related to the yawing moment.

Numerical Solutions

A major accomplishment was achieved by H. Vaughn, W. Oberkampf, and W. Wolfe of the Sandia National Laboratories in 1983 with their numerical analysis of the internal flow of a highly viscous fluid in a spinning and nutating cylindrical container. This computational fluid dynamics program used a finite difference technique to solve the three-dimensional Navier-Stokes equations for this complex situation and provided the first detailed insight into the mechanism responsible for the instability.

This effort produced several significant findings which have been of great value to other theoretical and experimental analyses of the problem. Their use of an aeroballistic axes system allowed steady state solutions to be computed for the very low Reynolds number situations of primary interest and provided the first physical description of the internal flow field. Also indicated were the relative contributions of pressure and viscous shear to the various moment terms, thereby identifying the source of the destabilizing effect.

These values were then incorporated into a special Sandia-developed six Degree-of-Freedom (6-DOF) program which combined the effects of the projectile external aerodynamic characteristics and the viscous liquid fill to compute the resulting flight motion and trajectory. This work represented the first time that the unstable flight dynamics of any liquid filled projectile had been simulated on the computer and demonstrated the methodology which allows the detailed flight motion of any flight vehicle and liquid fill combination to be predicted.

Strikwerda and Nagel of the University of Wisconsin at Madison are currently developing a finite difference numerical code for studying highly viscous liquids in a spinning/nutating cylindrical container. It follows the same general approach as Sandia, but employs a more accurate and efficient solution technique.

Future Directions

Work is continuing by various Army research agencies to gain additional understanding and an improved predictive capability for phenomena associated with liquid filled projectiles. A major goal of this program has been to attract top technical experts in government, industry, and academia to work on various aspects of the problem. An open interchange of data and the personal interactions have played a key part in the significant results achieved. A detailed survey of the work performed in various areas of this technology was recently compiled by R. Sedney of the BRL.

In general, the U.S. Army Chemical Research, Development and Engineering Center has been involved in the experimental aspects of this program while supporting theoretical analysis through contracts with industrial agencies and universities. These data will be used to evolve and validate theoretical analyses associated with this technical area. The CRDEC laboratory test fixture has been extensively modified to provide increased performance and accuracy as well as more rapid data acquisition and reduction.

The U.S. Army Ballistic Research Laboratory continues to utilize gyroscopic test devices and has recently acquired a three-degree-of-freedom flight simulator for spinning projectiles. In addition to the experimental work, they are also performing and supporting theoretical and numerical analyses. Both the CRDEC and BRL, along with the U.S. Army Research Office, are sponsoring studies at universities involving experimental and theoretical work.

The liquid-induced instability characteristics for a particular payload aspect ratio can be presented in terms of the fundamental non-dimensional parameters in a three-dimensional plot as illustrated in Figure 2. This plot shows the liquid-fill-induced side moment coefficient (CLSM) as a function of the Reynolds number (Ra) representing the liquid characteristics and the ratio of coning to spinning frequencies representing the projectile motion for a given cylindrical payload container length to diameter ratio.

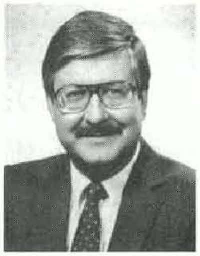
This approach graphically depicts the entire range of conditions including both the low and high viscosity regions corresponding to high and low Reynolds number, respectively. Of particular note is the presence of a large peak moment acting over a narrow frequency ratio range at the higher Reynolds numbers where inertial effects dominate and the large moment occurring over a broad frequency range in the viscosity dominated, low Reynolds number region. Sections through this plot represent trends for constant conditions. For example, for constant frequency ratios, the dependence of the liquid side moment coefficient on the logarithm of the Reynolds number is similar to the author's experimental and Herbert's theoretical results. The side moment coefficient, as a function of frequency ratio for constant Reynolds numbers, indicates trends similar to Murphy's theoretical results.

The current objective is to establish a single or "unified" theory which can be applied for all Newtonian fluid situations. This will be used, in conjunction with a simplified 6-DOF program, to design and analyze the flight performance of any flight vehicle.

While work is continuing on Newtonian fluids, studies have also been initiated to investigate the potential of non-Newtonian or visco-elastic fluids for causing similar flight instabilities. Visco-elastic fluids are being considered for future chemical fills because their unusual physical properties provide both optimum dissemination and dispersion performance. The first theoretical analysis into this effect was completed in 1985 by Rosenblat of Fluid Dynamics Internations Inc. who performed a finite element numerical analysis of the visco-elastic fluid dynamics in a spinning and nutating cylinder.

Of final note is the remaining problem of assessing the flight instability potential of general non-rigid fills, such as the partial solid/ partial liquid payloads of the XM761 and M825. Hopefully, the work on the highly viscous liquid fills will provide improved experimental methods and possibly an analytical approach to address these complex configurations.

MILES C. MILLER is the scientific area coordinator for basic research in fluid dynamics at the U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving , MD. He holds a B.S. degree in aerospace engineering from the Pennsylvania State University and an M.S. degree in mechanical engineering from the University of Maryland.



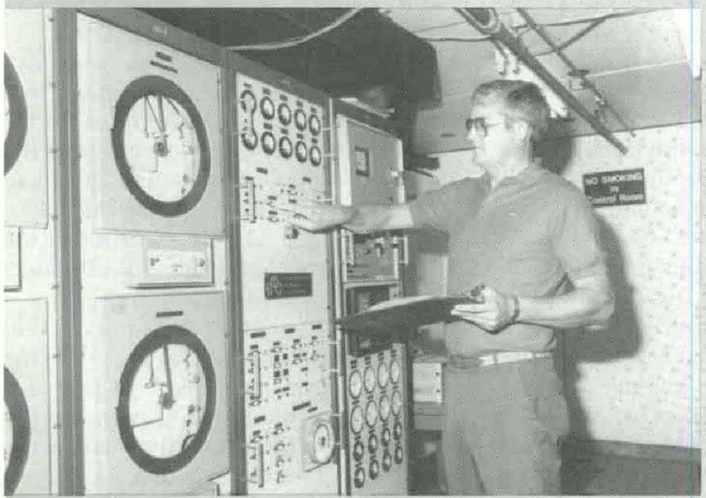
Climatic Chamber Permits Various Tests

Test facilities come in various sizes and shapes, and they have different capabilities. The U.S. Army Combat Systems Test Activity's new climatic test chamber provides three types of environmental testing and can rightly be classified as a significant test facility.

The chamber provides the capability to conduct hot, cold, and high humidity testing 24 hours a day, 365 days a year, according to Dean Phipps, an engineering technician who is in charge of the chamber.

Measuring approximately 75 feet long, 40 feet wide and 25 feet high, it can be used as one large test chamber or divided by partitions into two chambers, each section capable of operating independently.

"The climatic chamber provides us with the mechanism to regulate conditions. We can hold temperature in the chamber from minus 70 degrees Fahrenheit to plus 170 degrees Fahrenheit. We can also control humidity up to 99 percent. A great majority of the high-temperature, high-humidity tests run in 10- or 30-day cycles. We simulate temperature cycles in tropic regions such as Panama and determine high-humidity effects on test items to include determining if the items corrode and if paint peels," Phipps says.



Dean Phipps monitors operation of the refrigeration equipment at the climatic test chamber. The chamber provides the capability to conduct hot, cold and high humidity testing 24 hours a day.

Both automotive and general equipment are tested in the chamber. The vast array of automotive items runs the gamut from Bradley Fighting Vehicles to the Army's new family of trucks to the latest M1 tanks. General equipment tested in the chamber, according to Phipps, include generators, pumps, shelters and virtually any type of support equipment.

Included among the various tests conducted is the freezing-rain test. Phipps explained that during the test, an item is put into the chamber, the temperature is lowered below freezing and the item is sprayed with water. A functional test of the item is then conducted to determine any degradation of performance.

Solar-load testing also is performed in the chamber. Test items are conditioned to a certain temperature and a solar load is applied to simulate intense sunlight conditions that might be encountered in desert regions.

According to Phipps, the climatic chamber offers several advantages to the test community. "The primary advantage revolves around the mechanisms to control conditions. We are not at the mercy of the elements. No delays in test programs equates to time and money saved," he says.

He also points out the advantages associated with assessing research and development findings immediately. Inside the chamber, problems can be identified and corrected on the spot, ensuring a problem-free item when it reaches the field. This would not be possible with testing conducted in a field environment.

Letters . . .

The following letter was recently submitted to the Army Materiel Command's new production base advocate, Harrell R. Barnett, and to Army RD&A Magazine. It was written by John Larry Baer, president of International Management and Engineering Consultants. Barnett's reply to Baer follows at the end of this letter.

Congratulations New Production Base Advocate

Dear Dick:

Congratulations on your appointment as Army Production Base Advocate. Aside from the challenge of trying to define the job, I think you have a wonderful opportunity to not only enhance our Mobilization readiness posture, but also to strengthen our industrial base at the same time. I realize that you have some of the best people at AUSA and ADPA to advise you, but permit me to add my two cents.

In my business, advising U.S. and foreign manufacturers of commercial and military hardware, both large and small, I like the idea of a Competition Advocate. He can make sure RFPs that can be put out for competition are so advertised. I also appreciate having a Small Business Office (SBO) to champion the cause of the less than megasized firms. BUT, my heart is still with Army interests and the zealousness of the competition advocate and SBO are, in my humble opinion, frequently misplaced.

Too many times the guy who had the idea, the firm that built the first batch of prototypes and knows where to tweak the system to make sure it works (something you can't always put in the drawings or specs) or the experienced manufacturer who has been turning out a high quality product—all lose out for the sake of competition or to "give the little guy a chance."

Unfortunately, as we both know, too many times the Army and the soldier in the field are the big loser on these deals. All too often the new manufacturer defaults, goofs, stretches out promised deliveries or really doesn't know what he's doing.

Also, as I pointed out in my article in the May-June *Army RD&A Magazine*, foreign firms supply parts for virtually all American goods, both commercial and military. And even though, in theory we have security blankets like Machine Tool Trigger Orders and Production Equipment Packages, these are often pretty threadbare.

The Army, of course, is not alone in recognizing their dilemma. The Navy Industrial Base Program also recognizes the need to "keep vital facilities in business, to prevent the loss of critical skills, maintain properly balanced sources of supply, and to create or maintain the required domestic capability." The Air Force also published a long list of foreign supplied items, including many that were sole source, and has a compendium of critical machine tools and production equipment.

Ninety percent of our metal forming and metal cutting industrial Plant Equipment (IPE) is over 20 years old and 15 percent is over 40 years old! Even in the Basque regions of Spain, hardly what we think of as High Tech Country, they've replaced 10 old machine tools with one new computer controlled, flexible machine that does the work of the 10 old ones and with only ONE skilled machinist. Remember, the guys who used to run those old machines have either retired or died and most machine tool operators now don't know how to tease work out of balky old dogs.

Fifty five percent of our mechanical test and measuring IPE is over 20 years old; which means in this day and age of laser measurement and a demand for high precision and accuracy, they are probably worthless or, worse yet, could give us false readings. We've got enough problems with military hardware that isn't made right the first time around and then takes four times as long to repair or make it right. Only in the United States do we stand for a company that makes 13 weld passes and THEN inspects it, only to find there's a void on the third pass and you have to grind it all out and fix it.

Now to the other side of the coin—our suffering American Machine Tool Industry, which is operating so far below its capacity that we're losing old time builders right and left. YOU can simultaneously enhance our Mobilization Readiness AND give a shot in the arm to National Machine Tool Builders Association and its members.

Let's quit counting anything over 40 years old as being useful in producing military hardware. Junk it and replace it with new, modern IPE with the potential for better productivity and at the same time for turning out a product of assured quality. That way we not only stop kidding ourselves into thinking we can crank up our cold base in six months (remember it took 18 at the time of the Korean Conflict) but we'll get state-of-the-art equipment which can probably crank out commercial products more competitively while awaiting its call to the colors if the red balloon goes up. Then go after the 30 year old clunkers and those over 20, until you've got a truly viable mobilization base.

Now, a word of caution! As you know, over 40 percent of the machine tools purchased in the U.S. last year were imported versus 25 percent in 1981. Part of the reason for this eggregious influx is that on average the imports were 40 percent cheaper than ours. SOOO, in order for our guys to compete they will have to build smarter and trim their costs without cutting corners. Part of the answer, of course, is that a good many of the parts, maybe even including the mandated 20 year supply of spare and repair parts, will be coming from more cost effective off-shore suppliers.

But YOUR action as Production Base Advocate will save the day for our Readiness Posture AND our machine tool industry and thus save jobs and reduce our horrendous trade deficit. How fortunate you are to have this opportunity. Yes, it will cost some heavy bucks and will mean that we'll have to reduce short term ammo, tank and gun purchase plans. But, once the IPE is in place, we'll be able to produce enough to make up AND to do it at a lower unit cost, thanks to the newer, more productive machine tools.

The Under wants private industry to clean up their own act, but a drowning man needs a life preserver if he's going to survive. You have the opportunity to throw the U.S. machine tool industry that life ring.

Good luck, Mr. Production Base

John Larry Baer, P.E.

New Production Base Advocate's Reply

Dear John Larry,

Thank you for your letter concerning my appointment. I believe the issues you raise are among the key concerns which prompted General Thompson to establish a Production Base Advocate. I look forward to working with you, various industry associations, and others who voice concerns for the present state of American industry and the industrial readiness of the Army.

I also share your concerns for the age and condition of the production equipment that industry and the Army must rely upon for industrial preparedness. We are focusing on the continued need to utilize or retain forty year old equipment. However, realities of the Army's budget lead us to bridle our expectations that vast resources will soon be made available to purchase large amounts of new, modern production equipment. The Army must focus instead upon acquisition strategies for weapon systems which stimulate and encourage industry to invest and modernize. These strategies must have the duel purpose of providing the best prices while also enabling industry to provide industrial capability for both peacetime and mobilization.

Clearly, a real challenge lies ahead for the Production Base Advocate and the Army acquisition community. I thank you for your interest and support.

H. R. Barnett
Production Base Advocate

Depot Installs New Filtration System for Helicopters

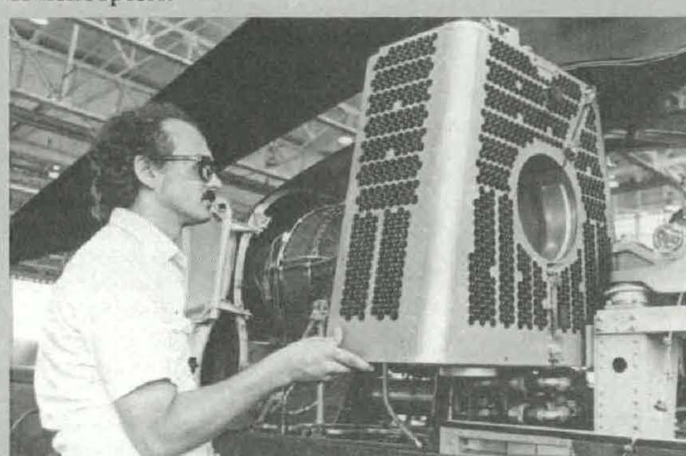
Since April, Corpus Christi Army Depot's (CCAD) Special Projects Section has worked to modify a Fort Bliss, TX, AH-1S Huey Prototype Cobra helicopter with a new filtration system. This project had its beginning 8,000 miles away.

During joint U.S. and Egyptian maneuvers in 1981, American-made Cobra helicopters, used by both forces, filled the air. Military commands in both countries were pleased with the maneuvers, that is, until many of the helicopters' engines began to lose power. Performance fell short of the expected. Sand and dust in the desert environment were eroding engine parts, causing abnormal wear.

The depot's job has been to install a new system developed by the Paul Land Marine Corp. of Tampa, FL. The system replaces the original filtration system used in the Cobra. The system uses an airbleed to extract the sand and particles that cause wear.

To allow for increased engine flow, the helicopter's engine doors have been modified and made larger. This brings more air into the filter system.

Should the Army decide to modify and install a large number of new filtration systems, Emil Ulbrich, chief of the depot's Special Project Section, believes the depot will be assigned the work. CCAD is the Army's only facility dedicated to complete depot-level maintenance, repair and overhaul of helicopters.



John Pendarvis, aircraft sheet-metal mechanic, installs a newly developed filtration system into an AH-1S prototype Cobra helicopter.

From The Field . . .

Study Looks at Mobile Power Sources

A program to reduce the quantity and size of generators in the Army inventory is underway at the Belvoir Research Development and Engineering Center.

Designed to lower investment and operational costs while improving mobility through use of fewer and smaller generators, the program is being conducted by the center's Systems Assessment Team for the defense project manager for mobile electric power.

Its goal is to insure that users of mobile electric power sources have the right power system to do a job, including the right size, right number, and right type of generators, power distribution equipment and power conditioners.

To assess the power needs of systems already in the field, the team is gathering data under realistic operating conditions. The Special Sample Data Collection program at the Army Development and Employment Agency has been expanded to include the acquisition of electrical parameters for power consuming equipment in the 9th Infantry Division. Data being obtained during field training exercises at Fort Lewis, and the Yakima Firing Range include identification of power using items, basic voltage and frequency data, power consumption characteristics, equipment use, and application problems.

The data are recorded on site and then stored on magnetic media for transmittal to the center. The data will be used for many purposes. One is to reinforce the development of a new automated data base on power-consuming equipment. Another is to uncover application problems with the Army generators and to reduce the sizes and quantities of generators where feasible.

Quality Circle Scoops Up Savings

A quality circle at Red River Army Depot, TX, an activity of the Depot System Command, scooped up some big savings by coming up with a better way to pack ammunition into cans.

Circle members designed a scoop that automatically places two bandoliers of 7.62mm round into their shipping cans. The scoop is made of stainless steel to prevent rusting and to enable the bandoliers to slide easily into the cans.

Before the scoop was designed, packing the ammo was an awkward and time-consuming task requiring five people to complete. By using the scoop, which neatly fits the bandoliers into the cans, two people are able to do the same amount of work. The quality circle effort led to a savings of over $35,000.

Awards . . .

Green, Schumacher Receive Army PM Awards

COL Charles S. Green Jr., project manager of the DOD Mobile Electric Power program, and COL William J. Schumacher, project manager of the Hellfire/Ground Laser Designators program, recently received Secretary of the Army Awards for Project Management. The awards were presented during ceremonies at the Army Project Managers Conference in Norfolk, VA.

COL Charles S. Green Jr.

COL William J. Schumacher

Green was cited for outstanding performance during the period July 1985 through June 1986 in directing and coordinating activities of a complex, multi-service program, interfacing the development, production, and fielding of generator systems, power unit configurations and environmental conditioning units. According to the award citation, Green's direct leadership and superior knowledge of planning, programming, and budgeting have resulted in the initiation and implementation of an evolutionary approach towards modernization of the DOD generator fleet.

COL Green placed emphasis on quickly fielding lower risk nondevelopment items to reduce the vulnerability of forward displayed units to acoustic detection; greater involvement of the generator industry in DOD planning and acquisition; and the use of testing programs to pace the urgent type classification and fielding of quiet, reliable generators.

COL Schumacher was also recognized for outstanding performance from July 1985 through June 1986. His award citation read, in part, as follows: COL Schumacher directed and coordinated activities of a complex, multi-level program, interfacing the development, production, and fielding of the Hellfire missile and launcher, and a family of Ground Laser Designators. This direct leadership and superior knowledge of planning, programming, and budgeting have enabled COL Schumacher to set precedence in introducing successful contractor competition in the acquisition cycle. His exceptional distribution of resources and assignment of priorities has assured the successful concurrent fielding of Hellfire to FORSCOM; Ground/Vehicular Laser Locator Designator to USAREUR and EUSA; Modular Universal Laser Equipment to the U.S. Marine Corps; and Navy transport of Hellfire to the Marine Corps.

CERL Receives 1986 URISA Award

The Urban and Regional Information Systems Association (URISA) has recognized the Army Construction Engineering Research Laboratory's (CERL) Geographic Resources Analysis Support System as an exemplary system in government. The award was presented earlier this year at the URISA 1986 Annual Conference in Denver, CO.

Developed by CERL's Environmental Division, the analysis system provides automated data management support to Army environmental planners and land managers, allowing them to analyze, store, update, model and display landscape data quickly and easily. Data files can be developed for large or small geographic regions at any scale desired within the limits of the original source documents and the storage capacity of the hardware. Analysis and display operations can be performed for an entire geographic region, or for any user-defined area within the region.

James Westervelt of CERL's Environmental Division accepted the award on behalf of CERL and made a brief presentation on the system at the association's special plenary session.

The Geographic Resources Analysis Support System was one of 15 systems nominated for awards this year. URISA's primary criteria to identify an exemplary system were:

- the evident benefits of the system, both to governmental programs and to citizens;
- the sophistication of the system as compared with previous accomplishments in the field; and
- the quality of the system description presented in support of the nomination.

Personnel Actions . . .

Russell Becomes MRDC Commander

MG Philip K. Russell recently became the 14th commander of the U.S. Army Medical Research and Development Command (USAMRDC) at Fort Detrick, MD. Russell succeeds MG Garrison Rapmund, who retired from active duty after 29 years of service, seven of them as commander of the Medical R&D Command.

Russell has served as deputy commander of USAMRDC since April 1986. From 1983 to 1986, he commanded Fitzsimons Army Medical Center, and in 1979, succeeded Rapmund as director, Walter Reed Army Institute of Research (WRAIR).

A native of Syracuse, NY, Russell completed his medical degree at the University of Rochester School of Medicine. He entered active duty as a captain in the Medical Corps in 1959, assigned to WRAIR. In 1964, he completed an internal medicine residency at University Hospital, the University of Maryland. After returning to WRAIR for a year, Russell served in Bangkok, Thailand, where he was a virologist with the U.S. Army Component, Southeast Asia Treaty Organization.

Russell returned to WRAIR where he served as chief of the Department of Virus Diseases, then as director of the Division of Communicable Disease and Immunology. He was appointed deputy director in 1976, and director in 1979.

Russell has authored or co-authored numerous scientific papers on infectious disease, including one which received the Paul A. Siple Award as the outstanding paper presented at the Army Science Conference in 1974. His professional memberships include Alpha Omega Alpha, the Royal Society of Tropical Medicine and Hygiene, and the American Epidemiology Society. His military awards and decorations include the Legion of Merit, the Army Commendation Medal, and the "A" designator for professional excellence.

Hintz Assumes Command of CERL


COL Norman C. Hintz

COL Norman C. Hintz, former assistant chief of staff, engineer, U.S. Forces-Korea and Eighth U.S. Army, has assumed new duties as commander and director of the U.S. Army Construction Engineering Research Laboratory, Champaign, IL.

A registered architect and registered professional engineer, Hintz holds bachelor and master of architecture degrees from the University of Illinois, and is a 1986 graduate of the Executive Program, Colgate Darden Graduate School of Business Administration, University of Virginia. He is also a graduate of the Industrial College of the Armed Forces, the Army Command and General Staff College, and the Armed Forces Staff College.

His earlier assignments included commander, Seattle (WA) District, U.S. Army Corps of Engineers; assistant director of military programs, Office of the Chief of Engineers, Washington, DC; and staff officer, Office of the Deputy Chief of Staff for Operations and Plans, Department of the Army.

Hintz is a recipient of the Legion of Merit (two awards), Bronze Star Medal, Meritorious Service Medal (three awards), Air Medal (three awards), and the Army Commendation Medal (four awards).

Lee Named New WES Commander


COL Dwayne G. Lee

COL Dwayne G. Lee is the 24th commander and director of the U.S. Army Engineer Waterways Experiment Station (WES) in Vicksburg, MS. He replaces COL Allen F. Grum, who returned to his position as head of the Engineering Department at the U.S. Military Academy in West Point, NY.

Prior to his assignment at WES, Lee served as commander of the U.S Army Corps of Engineers Louisville District. He has also served previously at Fort Bragg, NC; West Point, NY; Washington, DC; and in Vietnam, Okinawa and Thailand.

A 1964 graduate of the U.S. Military Academy, West Point, NY, Lee holds a master's degree from the U.S. Air Force Institute of Technology, Dayton, OH, and is a registered professional engineer in Virginia.

Capsules . . .

Contracts Call for Minefield Detector

The Belvoir RDE Center has awarded contracts for prototypes of a highly mobile, remotely controlled Minefield Reconnaissance and Detector System (MIRADOR).

MIRADOR will be a multi-sensor system designed to detect metallic and non-metallic mines, both on and off roads. Contracts for the prototypes have been let to Gould Inc. of Glen Burnie, MD, ($4.8 million) and Foster & Miller Inc. of Waltham, MA, ($4.3 million).

The system will be used by both forward and rear area units to locate enemy minefields. In operation, it will be employed in high risk areas as either a self-propelled system remotely operated from a parent vehicle or mounted on a remotely-controlled tactical vehicle. It could also be manually operated in low-risk areas during routine operations.

The eventual system will be employed by combat engineer, infantry and armor units in support of maneuver force operations. During offensive operations, it will be used to search known or suspected areas to detect mines and minefields. For counter attacks, it will be used to detect hasty minefields employed by the enemy for flank protection. This will enable commanders to select alternate routes or take other actions to keep their forces moving.

The prototypes will be delivered in November 1987 for side-by-side "proof of principle" testing at Aberdeen Proving Ground, MD. The tests are scheduled to be completed in early 1988.

Conferences & Symposia . . .

Natick Hosts Science Symposium

The U.S. Army Natick Research, Development and Engineering Center, Natick, MA, held its first Science Symposium with "Technology for the Soldier" as its theme. Presented papers reflected research and development programs at the center directed toward protecting, sustaining, sheltering and resupplying the soldier on the battlefield.

Established by Dr. John A. Sousa, the center's associate technical director for technology, the symposium was aimed at recognizing and encouraging scientific and engineering talent, demonstrating excellence in research and development, and stimulating the interchange of ideas among scientists and engineers at Natick as well as attendees from other Army commands, universities and the private sector.

In this regard, the symposium was a great success as evidenced by the quality of the 24 papers representing efforts of 59 researchers and five directorates.

A panel of 15 judges consisting of 12 senior Natick scientists and engnieers, as well as a representative from the Army Research Office, the Aviation Systems Command, and the Human Engineering Laboratory, named Alfred L. Allen and Mark T. Holtzapple first prize winners for their project, "Heat Exchanger Designs for a Portable Microclimate Cooling Unit."

Second prize was awarded to the team of Jack L. Briggs, C. Patrick Dunne, Maryann Graham, Finar Risvik, Armand V. Cardello, Ann Barrett and Irwin A. Taub for their presentation, "A Calorically Dense Ration for the 21st Century."

Two papers tied for third place. Janet E. Ward and Walter Koza collaborated on "Hi-Tech Fibers for Improved Ballistic Protection" while the team of Florence E. Feeherry, Donald T. Munsey and Durwood B. Rowley presented "Thermal Inactivation and Injury of Spores of Bacillus Stearothermophilus."

Because of the excellence of the papers and the stimulating follow-up discussions, plans are already in the mill to continue the symposium on a regular basis in the future.

Upcoming Conferences

• The Army Aviation Association of America's National Convention will be held April 8-12, 1987 at the Tarrant County Convention Center in Fort Worth, TX. For additional information, contact Lynn Coakley (203)226-8184.

1986 Index of Army RD&A Magazine Articles

This index is a headline listing of articles published in the Army RD&A Magazine during 1986.

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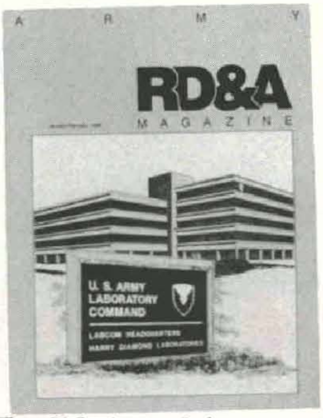

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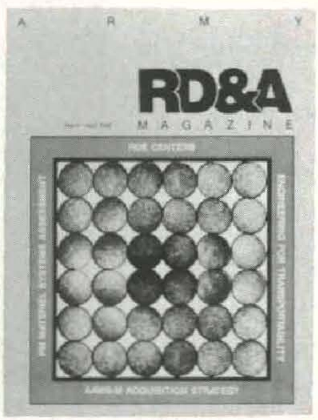

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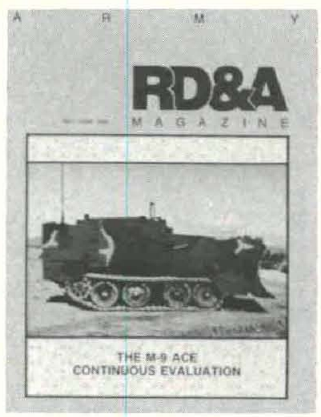

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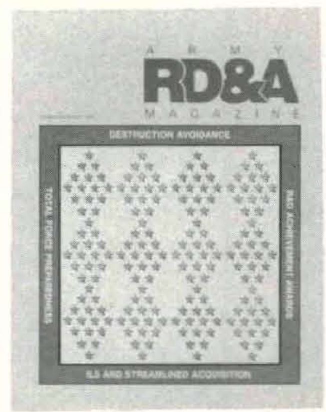

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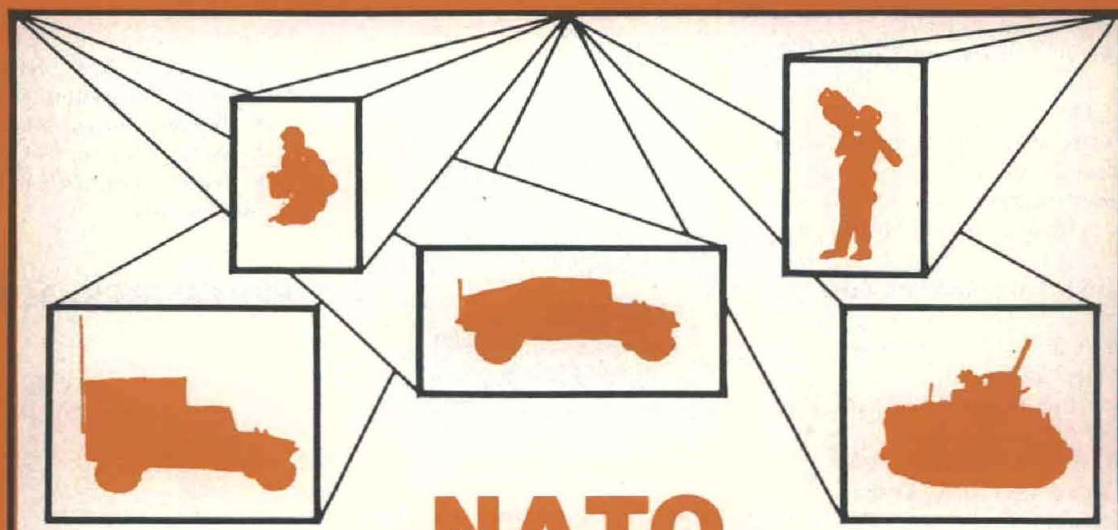

NATO ARMAMENTS COOPERATION "WINDOWS OF OPPORTUNITY"