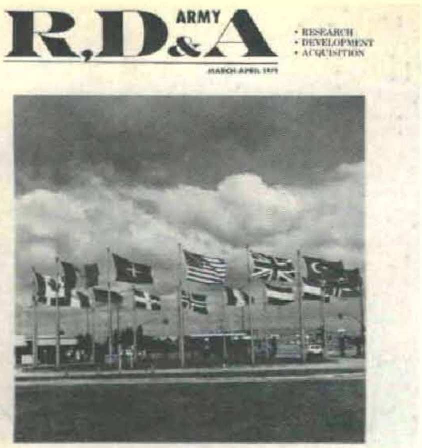
ARMY R,D&A

• RESEARCH
• DEVELOPMENT
• ACQUISITION

MARCH-APRIL 1979

NATO's 30th Anniversary



NATO's 30th Anniversary

ABOUT THE COVER:

The cover photographs were taken by Mr. P. J. Pfeiffer, a member of the DARCOM Office of International R&D, during a recent visit to NATO HQ in Brussels. Mr. Pfeiffer, an amateur photographer, captured this fine view of all 15-member nation flags on their masts in front of the NATO HQ building. The magazine extends its thanks to Mr. Pfeiffer for permission to use the photographs. The flags are purchased by NATO HQ, are of a uniform size appropriate to the length of the staff, and are flown daily from sunup to sunset. Individual flags are lowered to half mast at the request of individual nations. Rarely, but occasionally, the Secretary General will direct all flags to half mast, as was done with the death of the Pope. The U.S. flag was lowered recently in honor of former VP Rockefeller.

Editor . . . . . L. VanLoan Naisawald
Associate Editor George J. Makuta
Assistant Editor . . Harvey Bleicher
Staff Assistant Mrs. Thelma Heisler

Published bimonthly by the Development and Engineering Directorate (DRCDE), HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA, in coordination with the DARCOM Public Affairs Office, the Office of the Chief of Engineers, the Office of the Surgeon General's Medical R&D Command, and the Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ Department of the Army, to serve all elements of the U.S. Army Research and Development and Acquisition community.

Grateful acknowledgement is made for the valuable assistance of Public Affairs Offices within the Army Materiel Development and Readiness Command, Office of the Surgeon General, Office of the Chief of Engineers, Army Health Services Command, Army Training and Doctrine Command, Army Forces Command, and related activities. Use of funds for printing of this publication has been approved by Department of Army, 23 Dec. 1975.

Purpose: To improve informal communication among all segments of the Army scientific community and other Government R,D&A agencies; to further understanding of Army R,D&A progress, problem areas and program planning, to stimulate more closely integrated and coordinated effort among Army R,D&A activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

Picture Credits: Unless otherwise indicated, all photographs are from U.S. Army sources.

Submission of Material: All articles submitted for publication must be channeled through the technical liaison or Public Affairs Officer at installation or command level.

Bylined Articles: Primary responsibility for opinions of bylined authors rests with them; their views do not necessarily reflect official policy or position of Department of the Army.

ARMY R,D&A

Vol. 20 No. 2 **March-April 1979**

FEATURES

DEPARTMENTS

POSTMASTERS: Controlled circulation postage paid at Mechanicsburg, PA. This publication contains no advertisement.

DISTRIBUTION is based on requirements submitted on DA Form 12-5. Army agency requirements must be mailed to the U.S. Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.

Distribution on an individual name basis is restricted to members of the U.S. Army Atomic Energy, R&D, and Procurement OPMS programs and to USAR Mobilization Designees in these fields. Otherwise, distribution is made only to the Army installation, office or organizational element to which the requester is assigned.

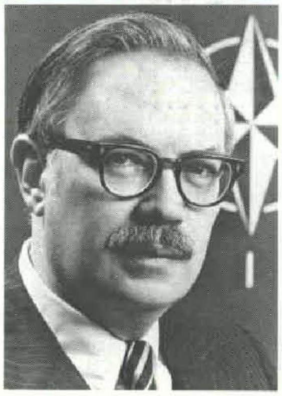
CHANGE OF ADDRESS for R&D and AE Officer Program enrollees should be addressed to U.S. Army Materiel Development and Readiness Command, ATTN: DRCDE-LN, 5001 Eisenhower Ave., Alexandria, VA 22333. Telephone: AUTOVON 284-9587; commercial-AC 202 274-9587. Mobilization Designees should report changes of address to Commander, USARCPAC, ATTN: AGUZ-CMD-M, P.O. Box 12167, Olivette Branch, St. Louis, MO 63132.

OTHER GOVERNMENT AGENCIES' requirements should be submitted directly to U.S. Army Materiel Development and Readiness Command, ATTN: DRCDE-LN, 5001 Eisenhower Ave., Alexandria, VA 22333.

ALL NON-U.S. GOVERNMENT agencies, firms and organizations must obtain this publication through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Single copies: domestic—$1.25, foreign—$1.60. Subscription rates (6 issues annually): domestic, APO and FPO addresses—$7.50; foreign mailing—$9.40.

FOREWORD

By John B. Walsh
Assistant Secretary General for Defence Support, NATO



Over the past thirty years, Western Europe has reforged itself and today stands prosperous, strong and free. This achievement is due in no small way to the collective defense which is provided by the North Atlantic Treaty Organization.

Today, NATO's shield stands erect and powerful as it continues to meet a challenge which has continued to grow over the years.

NATO Allies are working closely together in many areas to insure that the deterrent continues to remain credible. Certainly, one area of critical importance is cooperation in the development and acquisition of armaments. Armaments cooperation warrants and is receiving increased attention today because of its significant payoffs.

This cooperation can result in more efficient ways to employ the resources which Europe and America now expend, often on duplicative efforts. Reducing the duplication will permit NATO to field equally effective weapons at less cost and to use the saving to undertake projects which will further combat effectiveness.

Cooperation is also necessary to continue to improve equipment interoperability which directly influences military effectiveness. Interoperability includes both the ability of data systems to interface as well as the ability of equipments to use common consumables such as fuel, ammunition and spare parts.

Cooperation is not easy, and there are no panaceas. Individual, government, and industrial ingenuity and compromise are required to accommodate the always present and often opposing operational, economic, and political forces. Those of you who constitute the U.S. Army Research, Development and Acquisition establishment have an essential role to play as we pursue our goals of cooperation.

During the period in which we evolve modalities for extensive cooperation, we must not lose sight of the immediate need for fielding interoperable equipments, which is essential to coalition war-fighting.

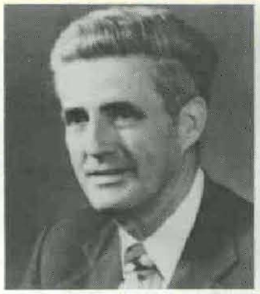
At the same time, we must continue to seek and implement ways to develop both better, and to the extent possible, common equipments in order to reap the benefits which can accrue in development, production and support.

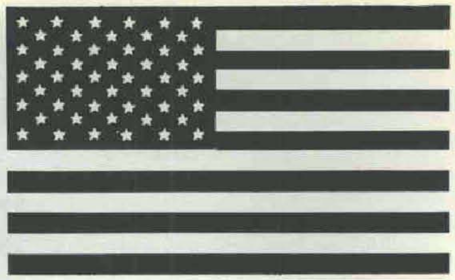
As we proceed, many vexing management problems will occur; unaccustomed dependence by traditionally independent producing nations will be necessary, government and industrial responsibilities will have to be realigned, with attendant economic and political opposition, and new ways will have to be found to maintain the advantages of competition.

Faced with this growing challenge, I am confident that NATO will continue to meet it with the spirit of determination and cooperation that has prevailed during the first thirty years.

An Analysis of:
The Importance of RSI

By Dr. W. B. LaBerge
Under Secretary of the Army





This article discusses an analytical process through which the Army scientific and technological communities may better understand the importance of Rationalization, Standardization, and Interoperability (RSI) to the European theater. Those temporarily frightened by integral calculus should read on—the arithmetic ratios are explained in layman's language.

The United States Army is preeminent among the members of the Department of Defense in the implementation of Rationalization, Standardization and Interoperability with our NATO allies. This issue of the *Army RDA Magazine* will demonstrate to all who read it the very dramatic progress made in recent times toward effective total use of NATO Alliance resources which is the underlying reason for RSI.

The remarkable accomplishments already attained are joined by several other equally prominent Army initiatives to ensure that the U.S. and its Allies will continue to work closely together. Forces in the field have greatly increased their joint training, both in command post exercises and full deployment. As a result, they have had the chance to improve substantially their procedures and techniques for conduct of a coalition war.

Similarly, the individual Army staffs of the Alliances have initiated extensive soldier to soldier talks. These talks have resulted in codifying many important doctrines of how to fight together.

This leading of DOD by the Army is entirely appropriate, not only because it is an Army tradition to lead in all the tough and important tasks, but also because it is the Army which has more of its people inexorably committed to the success of its Allies in any engagement in Europe. These actions are truly important and I wish to express my personal thanks for them and to relay the appreciation of the senior members of DOD who share the recognition of this job well done.

However, because of the very great operational implications of RSI it does seem appropriate for the Army to continue to try to improve the effectiveness of its cooperation without Allies. The area of improvement which seems of most potential utility to the Army is that of better early interchange of technology and better planning together of experiments and preliminary designs by the Army with its Allies. Personally, I do not believe we do well enough in this front end technology cooperation and hence I have chosen to discuss that aspect of RSI in this article.

Because of the belief by many technologists that no article is worth reading unless it contains some integrals, exponents and vectors, I have elected to formulate, arithmetically, the importance of early participation by technologists to the successful implementation of RSI. In order to not wholly turn off the non-technologist reading public, I will offer subsequent to the presentation of the integral relationship, a layman's explanation of the arithmetic.

It is the contention of this article that the Second Law of Thermodynamics, as applied to warfare, RSI, and international cooperation, can be approximated as follows:

For programs whose dollar value is large, the rate of change of the amount of RSI in any one program is:

$$\dot{A}_{RSI}(t,l) = \frac{d}{dt} A_{RSI}(t,l) = \frac{k_s\, 10^{-N_{DSARC}}}{S_R/S_C}\, i_{RSI} \int_0^{+} \frac{e^{K \cdot \vec{p}(t)}}{V_{ai}}\, dt$$

when $l \neq l_{HASC}$, and

$$\dot{A}_{RSI} = A_{RSI} = 0$$

When $l = l_{HASC}$

Where:

$\dot{A}_{RSI}$	=	Rate of change of international cooperation
A_{RSI}	=	Amount of RSI in a program
k_s	=	A Service-determined interest measure: $k_{Army} = +1 \quad k_{Air\ Force} = 0 \quad k_{Navy} = -1$
N_{DSARC}	=	Defense Systems Acquisition Review Council milestone number
i_{RSI}	=	Intrinsic military importance of RSI
S_R	=	Proximity to the Russians in miles
S_C	=	Proximity to the Congress in miles
K	=	Ambassador Komer interest variable—always a very big number when non-zero
$\vec{p}(t)$	=	Dr Perry's interest vector $\vec{p}(t) = 0$ when $t <$ time when USDRE finds out about program $\vec{p}(t) = 10^3$ when $t \geq$ time USDRE finds out about program
V_{ai}	=	Dollar value of the program (in units of $\$10^{+6}$)
l	=	Location of the program prime contractor facility
l_{HASC}	=	Location of districts of House Armed Services Subcommittee members

To better understand the importance of this relationship, one may make some first-order observations. Before beginning this analysis, though, it is important to note that the expressed RSI relationship is complicated and frequently analytically intractable. It should not be used unsupported in discussions with the Office of Manpower and Budget or either House of Congress.

Nonetheless, it should be obvious to any engineer within the Army R&D organization that the following gross conclusions can be drawn from the preceding formulations:

a. That for the case where $l \neq l_{HASC}$, e.g., when the program does not lie in the district of any HASC member, the time rate of change in the amount of RSI ($\dot{A}_{RSI}$) is—

(1) Proportional to the first power of i_{RSI}, the military importance of RSI, showing that the importance of RSI does increase with time. However, one can also see that the military importance of RSI is only linear, whole other factors in RSI implementation are expressed exponentially and exercise far greater impact.

(2) Uniquely dominated by k_s, the attitude of the Service involved. Service attitudes have been determined to be constant, and not affected by time, the program under consideration, or the level of OSD exhortation.

(3) Inversely dependent (exponentially) on the stage of commitment, as measured by its numerical progress through the DSARC process. Because of the negative exponential relationship, almost no increase in RSI can be expected after DSARC 0 (Program Initiation), where $N_{DSARC} = 0$.

(4) Inversely proportional to the ratio S_R/S_C, the decision maker's distance from the Russians divided by his distance from the Congress. This impression clearly relates the construed source of program jeopardy, i.e., the closer to the Russians the more RSI, the closer to the Congress the less RSI. This expression explains why commanders in Europe accomplish much more in RSI than those in the Pentagon.

(5) Proportional to the time integral of interest of the OSD RSI principle. This OSD interest is expressed as to the product of

e^{Kt}, where K is the Komer variable (always a very big number, the closest approximation being $K = \infty - \frac{t}{\infty}$), multiplied by a binary function representing the state of Dr. Perry's interest. Experimentally, the Perry interest vector has been found to be 0 when Dr. Garber has not told him of an explicit program opportunity, and 10^3 when it has been divulged.

(6) Inversely proportional to the number of dollars which might be contracted to American industry. This shows the empirically derived reluctance of American industry to forego profits.

The above conclusions are valid only for the case $l \neq l_{HASC}$, the case where the location of the program is not within the locus of points defined by the geographical limits of the congressional district for any member of the HASC.

For the case where $l = l_{HASC}$, a much simpler formulation exists. For this case, where the corporation executing the program under consideration lies within the district of a HASC member, the time rate of change in the amount of

RSI ($\dot{A}_{RSI}$) is—

$$\dot{A}_{RSI} = \frac{d}{dt}A_{RSI} = 0$$

Or, more simply put, RSI has no chance to succeed for political reasons after it has been assigned by DOD to an industrial contractor in the district of a member of the HASC.

To members of the Army scientific and advanced technology communities, as the Under Secretary of the Army, I present the above RSI formulations for your consideration.

What this formulation says is perhaps what we already know, namely, that the greatest chance to ensure the best use of alliance resources comes by working toward that end from the earliest moments of program inception.

If the formulation is accurate, then we all have an obligation to ensure that this early work gets great emphasis. However, to my mind it is in the early stages that RSI emphasis is least not greatest.

To many of you who are the scientists and preliminary designers of the Army RDA community, the reading of this article will be the longest protracted period in your careers devoted to consideration of the importance of RSI,

If that is the case for you who read this article, this analytical treatment may well be of some use to you. It will be useful, not because the preceding analytical hocus-pocus makes any sense in itself, but rather because it may force you to admit that you have not given RSI the attention it warrants.

If nothing else, I hope this discussion makes you, the advanced technologist, seriously consider to what degree the project on which you are now working really does have important NATO-wide RSI implications.

That commitment to try and understand RSI, if made, is the most crucial thing this article can achieve for the Army RDA community. If each of us comes to an informed opinion on what is militarily important and necessary in RSI, we in the Army will have made great progress in our military capability.

In a sense, the formula I make in jest is not too far wrong. The Army advanced technology community is a long way from the Hundsfeld Gap. That is where the fighting Army now faces a Soviet force which can attack at any time with local force ratios of perhaps 6:1. Neither does the front-end technology community get frequent chance to see at the political border the barbed wire and electrified wall—so stark and foreboding.

That wall between East and West Germany, to us who have seen it, is completely incomprehensible. It is not within our culture to restrict our people as do our adversaries.

The wall separating east and west shows how little we really understand the value system of our adversaries. It also shows how little we can gauge the possibilities of peace and war, and therefore how NATO has little option but to be a strong alliance and a credible deterrent.

The Army advanced technology community lives almost entirely inside the U.S., far away from Europe. It is also part of a closely-knit green suit community whose very closeness tends to lessen dependence on allies who exist only far outside that community.

Because of these local pressures we tend, as described by my formula, to accede to what is easiest to sell to Congress rather than fighting for the interdependence which might be the greatest help in deterring war. Because Europe is so far away, we have a tendency to think of our potential war as "across the river" rather than across the ocean. This is really not the case.

Those of you in the research and preliminary design parts of our Army R&D organization have very little opportunity to realize the extent of our commitment to Western Europe. You also may not be aware that one out of every 200 American citizens is living somewhere in Europe.

We fail to realize that because of our "people investment" in Europe, not to be able to successfully deter or win a European war is a concept incredible in our time. It is hard for the Army laboratory community to feel the urgency of commitment to this place so far away.

Nor do we in the stateside RDA Army always realize that today the U.S. provides only 25 percent of the soldiers, 25 percent of the aircraft, and 20 percent of the airmen in Central Europe. Our U.S. forces protect only 170 miles of a 600 mile Central European front.

We provide only two corps of the nine corps allied force distributed from Bremen to the Austrian border. Nor do we seem to admit in our hearts the consequences of the knowledge that, despite what reinforcements we bring, we are as inexorably committed to the capabilities as our allies as they are committed to ours.

If we do put our attention to these thoughts, it is inevitable, I think, that we concede we can only act as an alliance. For any of us in that alliance to succeed we all must succeed. In my view, the Army R&D technology and preliminary design community at the working level has not faced up to these issues of cooperative warfare RSI.

It is regrettable that I conclude that a great many of the scientists and preliminary design engineers who read this article have yet to put in as much time in the formulation of their views on RSI as I have done in fabricating the nonsense which introduced this article.

To me, the manifestation of the lack of awareness of the importance of RSI, at the very early stages of concept development, is that none of the seemingly obvious things that encourage RSI get done automatically. The STOG and Future Systems Planning List do not treat satisfactorily the importance of RSI or demand its consideration in system formulation.

Additionally, the Army ROCs and MENS do not yet speak adequately to RSI. Concept development RFPs put out by the Army still frequently do not oblige RSI understanding.

DSARC 0s do not yet examine, thoroughly, programs for RSI, although this is now coming about. And lastly, operational tests and evaluations of new concepts do not yet test for acceptable interface with our allies.

We, the Army—on our Hellfire or TOW developments, for example—did not automatically, diligently inquire as to what our allies' requirements might be so that they might commit to use our designs. We do not have a program addressing form, fit, and function with our allies so as to make interoperability come about automatically.

We do not use the same electrical connectors or even have adaptors to mate different connectors, nor the same launching

(Continued on page 29)

DARCOM
&
Rationalization, Standardization, Interoperability (RSI)
GEN John R. Guthrie, DARCOM Commander

GEN JOHN R. GUTHRIE assumed command of the U.S. Army Materiel Development and Readiness Command in 1977, following a 2-year tour of duty as commander of IX Corps, U.S. Army Japan. From 1973-75, he was Deputy Chief of Staff, U.S. Pacific Command. Graduated from Blair Academy, Blairstown, NJ, he holds an AB degree from Princeton University (ROTC). His military schooling includes the Army Command and General Staff College, and the National War College.

April 1979 marks the 30th anniversary of the founding of the North Atlantic Treaty Organization. Despite many trials and tensions during its history, NATO has succeeded in its major purpose—maintaining peace in Europe. This is a record of which we can be proud, but it is also one which we must work to preserve.

* * *

From the very beginning, the achievement of this peace has required the cooperation and dedication of all the NATO member states. And while it is true that no coalition can survive solely on the power of its military forces, neither can it survive if its military preparedness is insufficient to deter aggression. Recognizing this, and cognizant of the relentlessly growing military strength of the Warsaw Pact nations, NATO defense leaders in May 1977 agreed to a goal of an increase in their annual defense expenditures in real terms in the region of 3% in order to strengthen their respective military forces. Allied Heads of government and State indorsed this aim at their NATO Summit in Washington last May and approved a Long-Term Defense Program in ten vital functional areas to meet the challenge of the Warsaw Pact military buildup.

Of course, how this money is spent is quite important. Separate developments, or uncoordinated ones, while perhaps strengthening one national force, could conceivably weaken the coalition overall by making concerted action more difficult to achieve. The modern vagaries of economics such as inflation, currency fluctuations, and availability of energy and raw materials also influence the strength of the alliance. Hence, a reasonable and reasoned balance, one which faces the magnitude of the military, economic and political efforts needed, must be devised and implemented so that required military systems can be fielded. One approach to achieving this needed coordination of effort is what we call Rationalization, Standardization, and Interoperability (RSI).

Of course, the ideas of RSI is not new. As early as February 1950, the Templer-Burns agreement on the "Exchange of Classified Information with the United Kingdom and Disclosure to Certain Other Nations" sought to establish, in the words of then Secretary of Defense Louis Johnson, "new arrangements" which would "facilitate military cooperation" with those nations whose security interests paralleled our own.

But it was not until the scarcely noticed Culver-Nunn Amendments to the 1976 and 1977 Defense Authorization Acts that the United States formally and forcefully declared our policy to be "that equipment procured for the use of personnel of the Armed Forces of the U.S. stationed in Europe. . .should be standardized or at least interoperable with equipment of other members of NATO." The 1977 Amendment also provided specific direction and guidelines for the Secretary of Defense in implementing the policy declared by the Amendment.

DARCOM, as the Army's materiel developer, producer, supplier, and maintainer, is responsible for executing a significant part of the RSI policy guidance from the Department of Defense and Department of the Army, particularly that guidance involving interoperability and standardization of materiel. Since I assumed command almost two years ago, DARCOM's commitment to RSI has not slackened. We are endeavoring to assure that RSI becomes an integral part of our daily routine; it must be included in every phase of our activity. On the other hand, it must not become simply routine.

The necessity to consider carefully the impact of RSI in all our activities has been an integral part of most of my articles and speeches over the last twenty-three months. Many of these, to the ADPA, AUSA, industrial planning conferences, and to military audiences both within and without DARCOM, have been reported in *Army RDA Magazine*. But this topic is, in my view, so very important and so much a facet of enlightened military and economic self-interest—our very survival, if you will—that it bears continued emphasis in all fora.

The emphasis which I see required now is not directed toward the philosophy of RSI or even the general policy behind and commitment to the concept of RSI in the Army and in DARCOM. Nor am I interested, at this juncture, in recounting the success which we have had since the renewed interest in RSI prompted by the Congressional actions I mentioned above. We have had, particularly in the area of interoperability, some success. Yet for all the work and words which have been expended so far, the Army has not succeeded in accomplishing as much as I believe could have been done. The basic reason for this situation is, in my judgment, the lack of firm guidance to the operating levels which would permit application of the policy in the "real world."

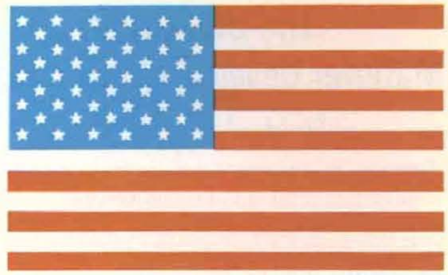
RSI is troublesome because policy has not been reinforced by the clear-cut complementary procedures and mechanisms needed to carry it out. The acquisition of domestic weapon systems and equipment is prescribed as a sequence of specified phases of program activity and decision events. Its milestones are clear. Its objectives are straightforward. By comparison, RSI involves a labyrinth of knotty and complex relationships in the military, political and economic spheres—not as separate entities, I might add, but all stirred together in the RSI cauldron. While relationships between like military services or between individual commerical enterprises might be obviously beneficial to those concerned, the combination, together with political pressures, often results in too little accomplishment too late. In general, there is simply a failure to comprehend the difficulties of day-to-day problems of implementing RSI.

One major problem lies in the differing procurement policies and objectives of the United States and our allies. In the United States, the competitive approach is preferred above all other means of selecting an appropriate organization for awarding a contract. We rely on the give and take of the marketplace to help set the price for the quantity and quality of products.

(Continued on page 30)

A Synopsis of
The U.S. Army's

Materiel Development Process



By LTG Donald R. Keith
Deputy Chief of Staff for Research, Development & Acquisition

SOURCES OF A REQUIREMENT

- ***Identification of a new capability by a potential adversary***
- ***Need to remedy an existing deficiency in equipment***
- ***Technological advances***

To the soldier in the field it is often difficult to explain why he does not have every item he believes he should have. Much of the answer rests with the lack of enough money to buy all the things the Army believes it should have. Costs are now the dominant factor in the materiel acquisition business. As a result, the Army has derived a very careful, deliberate selection process. The process is designed to ensure that only those systems needed the most are given the go-ahead for development, and that once developed, they do the job they were intended to do, can be maintained, and can be operated by those who must use them.

As is the case with most armies, the identification of a requirement for a system is the first step in the process of acquiring it. A prime mover for a new requirement is the threat. Identification of a new or projected Soviet capability may precipitate a development program whose intensity would, of course, depend on the seriousness of the danger the enemy capability poses.

Unfortunately for us, the closed, totalitarian nature of Soviet society permits the development of major weapons under cover of almost impenetrable secrecy. The first indication of a new development may be its appearance in Moscow parades, or even in quantity in operational units.

A second source of requirements is more common and less urgent than the first. It consists of a desire to remedy deficiencies in existing equipment. The Army's present UH-1 helicopter series is an adequate—even excellent—system. Its usefulness, however, is inhibited by state-of-the-art limitations existing at the time of its development in the 1950s. The new Black Hawk helicopter, its replacement, is easier to maintain and considerably more capable. It is also much less vulnerable to ground fire.

Other sources of requirements are the opportunities which advancing technology sometimes presents to us. In this case, a scientific or engineering breakthrough might provide a quantum leap in a particular technology or combat area or even an entirely new capability. The most famous U.S. Army R&D project, the Atomic Bomb, is a spectacular example of this category.

A requirement achieves semiconcrete form after an analysis and validation by the U.S. Army Training and Doctrine Command (TRADOC) (representing the Army user community). This analysis examines factors such as present capabilities, threat, state-of-the-art, tactics, and doctrine.

Based on such an examination, a general determination might be made that there is a deficiency in, say, antitank, weapons. Following such a determination a document called a Mission Element Need Statement (MENS) is prepared.

The MENS, in this case, would describe the need in moderately broad terms. It might state that an antiarmor weapon was required, and what its operational capabilities should be. However, the MENS would avoid specifics on whether the weapon should be a gun, guided missile, free rocket, or whatever.

The next step in the requirements process for a "major" system (the criterion being a projected expenditure of either $75 million in R&D or $300 million in procurement) is the approval of the MENS by the Secretary of Defense after staffing throughout the Army.

Following this approval, a special task force from TRADOC and the U.S. Army Materiel Development and Readiness Command (DARCOM) explores alternative system approaches to the problem and identifies possible sources from which the systems might be obtained.

These sources may be commercially "off-the-shelf," from an ally, a product improvement program, or a new development. During this process, a project manager is designated and begins to build a development team and assume administrative control.

End products of this task force are two documents. The first is an LOA, or Letter of Agreement, between TRADOC and DARCOM. It defines, with some specificity, the type of system required and broad performance bands. These determinations are arrived at on the basis of both operational requirements and comparative costing. The LOA also serves as a verification that the requirement is a solvable one from both a technical and fiscal standpoint.

The other document produced by the task force is an OAP, an Outline Acquisition Plan. This sketches out all proposed acquisition strategies, management considerations, and program milestones, and is understandably only a "best estimate" at this stage.

At about the some time the LOA appears, an important document called a DCP or Decision Coordinating Paper is produced by DARCOM. The DCP is a formally structured presentation of key portions of the OAP. It is a decision document, and serves as a commitment by the Army on the proposed performance parameters and system costs.

After the program is reviewed by the Army Systems Acquisition Review Council (ASARC), the DCP is forwarded to the Defense Acquisition Executive to support the review of the program by the Defense Systems Acquisition Review Council (DSARC).

The DSARC can give a red or green light to the proposed system, or it may re-

(Continued on page 6)

The U.S. Army Materiel Development Process

(Continued from page 5)

direct it. Its approval, however, in no way implies a commitment of funds to the program. Such commitments are made through normal budgetary channels. The possibility always exists that a system will receive the blessing of the DSARC yet fail to qualify for funding when competing with all other demands for funds in the budget process.

Retracing steps for a moment, after the LOA between DARCOM and TRADOC is approved, concepts to satisfy the need expressed in the LOA are solicited from industry. Emphasis is placed on innovation and the competition. It should be noted that most contractors are aware of the requirements and are working on their proposals long before the formal Request for Proposal is issued.

A decision is then made as to what concepts (and contractors) should be pursued during Advanced Development. In most cases the competition is reduced at this point to two or three firms. The Army has learned, from experience, that by turning the forces of free-market competition loose against each other it derives the greatest benefit in terms of system performance and cost. Costs of the competitive phase are inevitably returned, with dividends, during the production and service life of the system.

There are cases, however, where a system is so complex and costly that a single source must be designated because a competition would be financially prohibitive. Patriot is an example, as are other items such as antiballistic missile (ABM) systems.

Competing contractors construct prototypes and submit them to Development and Operational Test I (DT/OT I). On the basis of such testing, which is conducted not only by technicians but by typical Army troops, a Source Selection Board makes its recommendation as to the winning contractor. The contractor is ultimately selected by the Secretary of the Army or his delegated Source Selection authority.

The project manager is not always a member of the board. He does, however, report to the ASARC and DSARC at Milestone II on the continuing feasibility of the generic approach to the requirement. Generally he would assert (if it were the case) that either contractor could accomplish the mission with his equipment. The DSARC then grants permission to continue with the program.

During this time frame the DCP is refined and made more specific as problems and solutions become clearer. An Acquisition Plan is developed, and the final Army requirements document, the Required Operational Capability (ROC), is prepared. This document, in effect, formalizes the Army's need for the system in question and asserts its commitment to fill it.

KEY DOCUMENTS

Needed to Move from Idea to Item

MENS - **Mission Element Need Statement. Describes need in broad terms.**

LOA - **Letter Of Agreement. Contract between DARCOM & TRADOC w/some specificity as to what is desired**

OAP - **Outline Acquisition Plan. Sketches out proposed acquisition strategies, etc.**

DCP - **Decision Coordinating Paper. A decision document elaborating on *OAP*, representing Army commitment on proposed parameters & cost.**

ACQUISITION PLAN - **Elaborates on the *OAP***

ROC - **Required Operational Capability. Formalizes need for final system.**

The Source Selection Board considers a variety of factors before choosing a winner. Among them are the technological merits offered by the competing contractors, development and production capabilities of each contractor, life cycle costs of the systems, and the now emphasized ramifications associated with personnel requirements for its operation of Rationalization, Standardization and Interoperability (RSI) possibilities, Integrated Logistic Support (ILS), and finally political considerations.

After the successful competitor is selected, an engineering development contract with initial production options is usually negotiated. These options help minimize the effects of the so-called "buying-in" ploy. By using this ploy, a contractor is willing to take a loss on the R&D work—and thereby underbid his competitors—in the expectation of "getting well," or charging high production prices.

The Army, in addition, retains the right of awarding follow-on production contracts, and, in fact, does award production contracts to firms other than the original developer. In this manner competition can be extended throughout the system's production life.

After the award of Engineering Development contracts, the contractor usually begins to build and test production-type prototypes, correcting in them the deficiencies discovered in DT/OT I. There are often major difficulties to be overcome in this phase.

The initial Advanced Development prototypes are often entirely handmade and wired, and may conceal problems that only become apparent when attempts are made to build the item in production line quantity. Major redesign work is sometimes required.

The phase also requires the confrontation of complex problems in setting up production lines and plants, providing trained personnel, training manuals, establishing pilot lines, and dealing with a host of minute but critical problems that inevitably arise at this time.

At the same time these activities are in progress, testing of production model prototypes is conducted by the Army and contractor. This is achieved under supervision of the Operational Test and Evaluation Agency (OTEA) and DARCOM in DT/OT II.

Following this phase, ASARC/DSARC IIIs are conducted, a new DCP is approved, and the production contract is signed after warranties have been negotiated.

Warranties normally cover defects that are discovered. Assembly lines begin rolling shortly thereafter, but "first article" testing continues as the items are produced. After production is soundly underway, and initial delivery to the field has been effected, the project manager's office is disestablished and system responsibility shifts from the development to the readiness side of DARCOM.

The Army is about to enter the largest equipment modernization era in its history. In the next 5-10 years the Army will introduce a new tank, infantry fighting vehicle, three helicopter systems, four air defense systems, and a new communications net (more than 42 significant new systems).

The Army staff has recently increased its emphasis on the early preparation and distribution of a Materiel Fielding Plan. This document instructs the various

Army agencies and components on their responsibilities relative to the fielding of the new system.

The Office of the Deputy Chief of Staff for Personnel, for instance, prepares force structure requirements. Installations where new equipment will be located are notified of any required modifications to roads and buildings (for instance), and logistics and fuel requirements are disseminated, etc.

All of this indicates the increasing emphasis we are placing on early planning and a true "system" approach to materiel acquisition. The Army is increasingly aware that decisions early in the development process involve billions over the service life of the system. In the case of many weapons this is as much as 20 years.

It has been estimated that by the time engineering development commences, nearly 85 percent of a system's life cycle costs have been established. Equipment designers are now actually taking into account disposal problems associated with equipment that is still seven or eight years away from production.

Life cycle costing techniques, while still not perfect, are improving. Decision-makers are now being given a much better basis for "go" or "no go" decisions that may involve several billions of dollars.

Design to cost has likewise become a reality. These thresholds, established in the DCP, have assisted in controlling costs in the systems for which they have been established.

There are many efforts underway to control costs. We have found over the past decade that in our efforts to field superior combat hardware our major problems often are economic not technological. Hence, we welcome managerial breakthroughs as much as we do those that emanate from our labs.

Rationalization, Standardization and Interoperability with our allies—always a wise course to increase combat effectiveness—holds at least some promise for cost savings. This is why our emphasis on RSI is becoming institutionalized. All project manager charters, for instance, outline RSI responsibilities. RSI responsibilities are also delineated in the primary regulation dealing with Army materiel acquisition: AR 1000-1.

In addition, Ambassador Komer has a permanent seat on the all-important DSARC. More than lip service is being paid to the concept. It appears to promise considerable savings—several hundred million dollars in R&D costs on our Roland program alone.

The increased flexibility allowed by "tailoring" the acquisition process to special needs also promises economies. Abandoning the rote achievement of milestones in the classical management model provides savings in time, testing, and paper drills. This, of course, means cost savings. If technological or other factors warrant, Advanced Development and Engineering Development may be combined into one phase, eliminating Milestone II.

Competition, RSI, flexibility, cost-consciousness, affordability assessments, and streamlining are the current watchwords of U.S. Army materiel acquisition. There is, however, still much work to be done to improve the process. The growing power of our potential adversaries leaves us no choice but to examine every management option to keep our Army strong and affordable.

LTG DONALD R. KEITH is U.S. Army Deputy Chief of Staff for Research, Development, and Acquisition. A 1949 graduate of the U.S. Military Academy, he holds a master's degree from Columbia University and has completed the Army Command and General Staff College, the Industrial College of the Armed Forces, and the Armed Forces Staff College.

Methodology for NATO Small Arms Trials

On 14 July 1976, Public Law 94-361, Department of Defense Appropriation Authorization Act, 1977, was enacted. It established national policy that equipment procured for the use by U.S. military personnel in Europe, under the terms of the North Atlantic Treaty, be standardized, or at least be interoperable, with equipment of other NATO members.

Under Grant No. DAHCO 4-74-G-0164, for the period 1 June-31 July 1974, the DOD and the U.S. Army Research Office supported a research program for the continuation and extension of the applications of statistical information theory concepts to problems of statistical inference.

Results of this research program were described in Solomon Kullback, *The Information in Contingency Tables*, Final Technical Report, U.S. Army Research Office, Durham, NC, Grant No. DAHCO 4-74-G-0164, September 1974.

The U.S. Army Operational Test and Evaluation Agency (OTEA) has adopted the techniques described in the final technical report for application to the analysis of data stemming from Army activities.

Over the past year or so there have been a number of meetings among NATO representatives relative to an agreement on a methodology for using the NATO Small Arms performance data, and the analysis techniques to select a NATO round/weapon.

At a meeting in London in September 1977, a panel of experts accepted a proposal by the OTEA to provide a statistical method of comparison of the weapons and ammunition. This method incorporates a procedure for analyzing multidimensional contingency tables as described in the final technical report mentioned above.

Data to be analyzed will be arrayed into a number of multi-dimensional contingency tables based on combinations of the following factors and levels.

FACTORS	*LEVELS*
System	7
Riflemen	6
Range	6
Firing Position	2
Burst Size	3
Vegetation	2
Target Contrast	2
Target Mode	2
Gasmask	2
Results	2

Test performance data will be generated in two types of small arms trials: technical trials, and military trials. By combining the lethality data and hitting data from the technical trials and military trials, suitable data reflecting incapacitation can be obtained for analysis as multiway contingency tables by the methods proposed and accepted.

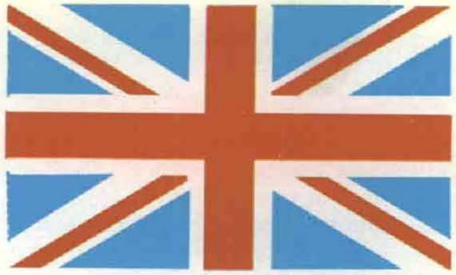
Details of the proposed methods, including computer programs, have been presented to a panel of technical experts and statisticians representing the NATO countries involved at two workshop sessions, respectively of one day and five day durations.

Questions raised during the workshops were answered to the satisfaction of the panel members. A test run of the computational procedures with live data was held at OTEA in November 1978 with members of the NATO panel attending.

Equipment Procurement in Britain

(with emphasis on Army equipment)

By Brigadier Jonathan Dent
Director of Munitions
Defense Equipment Staff
British Embassy



The term "Procurement," as used in the British Ministry of Defence, covers all aspects of equipment acquisition from R&D to the production of equipments, spare parts and modification sets. It does not cover the in-service management of equipment.

Equipment procurement is eventually controlled by the government, subject to the will of Parliament, through the allocation of national resources to the defence budget. However, the more detailed subdivision of defence resources between the three Services and, lower still, between equipment and everything else is not debated in Parliament. It is decided by the Secretary of State for Defence (SofS), advised by the Chief of the Defence Staff (CDS), the Civil Service head of the Defence Department (the Permanent Under Secretary (PUS)), the Chief Scientific Adviser (CSA), the Vice Chief of Defence Staff Personnel and Logistics (VCDS (P&L)) and the Chief of Defence Procurement (CDP). (See Fig. 1).

The Chief of Defence Staff, through a Chiefs of Staff's Committee, resolves the various conflicts of single Service requirements and represents the joint military view to the SofS. Nominally, the SofS conducts business by means of a Defence Council on which sit the CDS, the Single Service Chiefs, PUS, CSA, VCDS (P&L), and CDP, but in practice the Defence Council rarely sits.

Apart from his role as coordinator of the Single Service views, CDS heads a central staff comprising a Vice CDS (VCDS) and five branches: Operations, Policy, Intelligence, Signals and Operational Requirements. It is with the last that we are concerned in this context; the head of the branch is entitled Deputy Chief of the Defence Staff (Operational Requirements) (DCDS (OR)).

MEDIUM GIRDER BRIDGE. Under evaluation by the U. S. Army, the bridge can be erected by 25 men without the use of cranes. Shown above, the bridge spans 30.5 metres (100 ft.), supporting a Chieftan tank that weighs 52 tons.

Each Service has a chief and a vice chief, in the Army's case the Chief of the General Staff (CGS) and Vice Chief of the General Staff (VCGS). The VCGS has under him the elements of the Army Department (AD) that are responsible for the formulation of Army equipment policy, namely the staffs of the Assistant Chief of the General Staff (Operational Requirements) (ACGS (OR)), the Director of Combat Development (DCD), the Director of Army Staff Duties (DASD) and the Director of Army Training (DAT).

The PUS's main responsibility is for financial advice on all aspects of defence policy. To achieve this he has representatives working with and integrated in the Central Staff, the three Service Staffs and CDP's organisation which is called the Procurement Executive (PE). In this way, financial monitoring and advice is available down to the lowest levels from staff who have dual responsibilities, to the head of the staff on which they work and to PUS.

CSA is responsible for giving scientific advice to all aspects of defence policy for which purpose he provides scientific advisers and staffs on the Central and three Service Staffs. Single Service scientific advisers have double-hatted appointments as they also coordinate research in the PE R&D Establishments as will be covered shortly.

VCDS (P&L) is responsible for central staff advice on administration and logistics coordinated from the three Service views. His Army representatives are Quartermaster General (QMG) and the Adjutant General (AG). From an equipment point of view, the QMG is responsible for the procurement of clothing and general stores, personal equipment, fuels, lubricants, etc. However, he is also responsible for the in-service management of all equipments. The AG is responsible

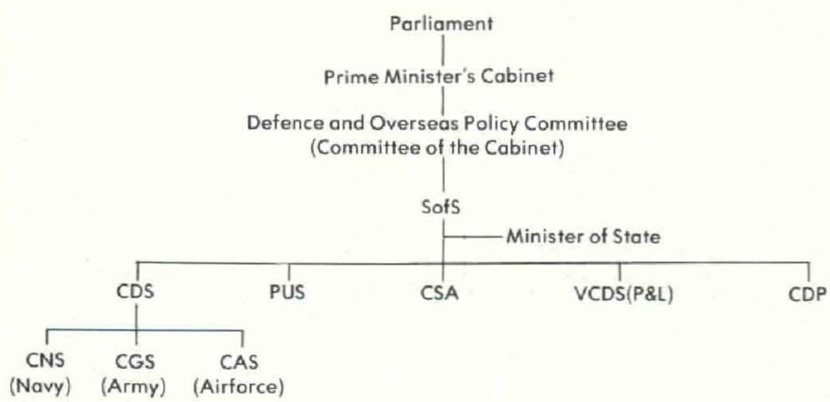


Figure 1

SofS

(Minister of State)

	CDS	PUS 2nd PUS	CSA	VCDS(P&L)	CDP
Central Staffs	VCDS ACDS(Ops) ACDS(Pol) DCDS(OR) DGI ACDS(S)	DUS(P) DUS(PL) DUS(CM) DUS(FB)	DCA(PN)	ACPL DGSC	HDS DUS Pol(PE) CER DUS(PMS)
Navy Dept	CNS VCNS	DUS(Navy)	CS(RN)	CNP CFS	CofN
Army Dept	CGS VCGS	DUS(Army)	CS(A)	AG QMG	MGO
Airforce Dept	CAS VCAS	DUS(Air)	CS(RAF)	AMP AMSO	CA
Responsibility	Policy & Operations	Financial Advice	Scientific Advice	Administration & Logistics	Equipment procurement

Figure 2

for manpower and manning aspects.

The PE controls the budget for research, development and production of equipment for all three Services (except those items which are the responsibility of the QMG). It is organised fundamentally on an environmental basis dealing with projects as sea, land and air systems under respective system controllers, namely Controller of the Navy (CofN), Master General of the Ordnance (MGO) and Controller Air (CA).

In addition, there is a Controller of R&D Establishments and Research (CER), Managing Director of Royal Ordnance Factories (MDROF) (Government owned and run factories) and the Head of Defence Sales (HDS).

These then, with their staffs, are the warp and weft of the defence procurement organisation and the matrix of interlocking staffs and responsibilities are shown in Figure 2.

Let us now take a closer look at the Procurement Executive organisation and in particular that of the Controller R&D Establishments and Research (CER) and the land systems controller, the Master General of the Ordnance. CER has three deputy controllers who each coordinate and supervise the activities of those Government R&D Establishments which work chiefly in the area of one of the Systems Controllers. Thus:

CER

DCER A — Naval R&D Estabs

DCER C — Air R&D Estabs

DCER B — Army R&D Estabs

Specifically, the R&D Estabs in DCER B's area are:

Royal Armament Research and Development Establishment (RARDE)

Military Vehicles and Engineering Establishment (MVEE)

Propellants, Explosives and Rocket Motors Establishment (PERME)

Atomic Weapons Research Establishment (AWRE)

Chemical Defence Establishment (CDE)

However, any Systems Controller can use any R&D Establishment as required by his projects. Each of CER's Deputy Controllers also acts as the Scientific Adviser for the relevant Service Department and so DCER B is also Chief Scientist (Army) (CS(A)). Similarly, down one level, DCER B has a Director General Research B (DGR B) under him who doubles as DCS (A), and so on.

MGO as indicated, reports direct to CDP, but he is also a member of the Army Board (the senior Army Department committee) and thus helps to make the Army equipment policy, which, wearing his PE hat, he will have to execute. He has three Director Generals: for Fighting Vehicles and Engineer Equipment (DGFVE), for Weapons (DGW(A)) and for Guided Weapons and Electronics (DGGWL).

He has his financial adviser (AUS(Ord)) who also has responsibility to PUS and he works closely with the relevant staff of CER who are double-hatted members of the Defence Scientific Staff as the previous paragraph explained. He also has a Contracts Adviser (PDofC(Ord)) who has Directors of Contracts working for each of the Directors General. Similarly each Director General has his own Director of Quality Assurance and his own Financial Adviser. Thus a skeleton diagram of MGO's organisation is shown in Figure 3. This shows how at each level, financial, contracts and QA advice is available and indeed this is extended down to Project Manager level.

Before describing the procurement cycle and procurement documents it is advisable to outline the system of committees that consider equipment projects at each major stage of the cycle. There are two central staff committees concerned in the cycle: the Operational Requirements Committee (ORC) and the Defence Equipment Policy Committee (DEPC).

The ORC is responsible for keeping under review military equipment requirements involving research, development and production, with particular emphasis on the validity of the operational requirement, overlap or duplication of other Service requirements (shades of Blood-

(Continued on page 10)

COMBAT ENGINEER TRACTOR, shown carrying metal trackway, can also lay the tracks, tow and fire the Viper minefield breaching device, and operate the rocket-propelled anchor, in addition to carrying out the normal task requirements of a battle group vehicle. It is being evaluated by the USAF.

Equipment Procurement in Britain

(Continued from page 9)

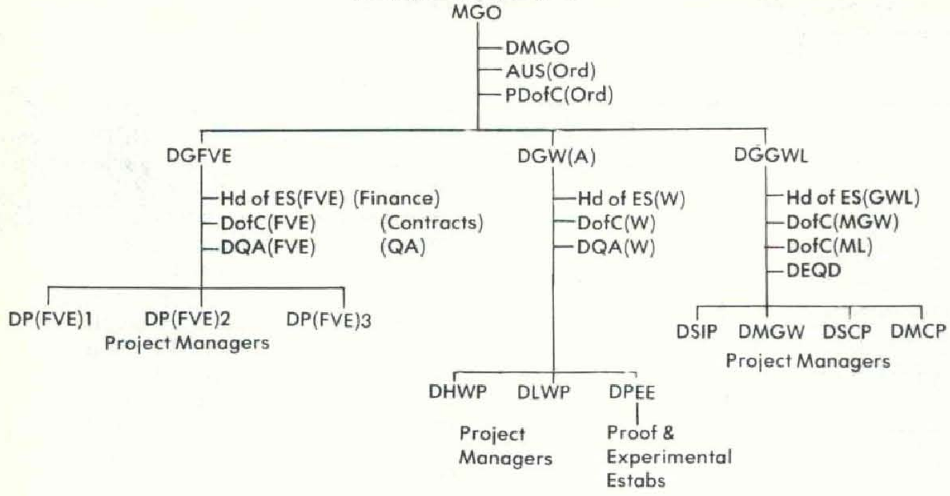


Figure 3

hound (Army), Thunderbird (RAF) and Sea Slug (Navy), all SAGW) and affordability of production. The composition of the ORC is:

DCDS (OR) Chairman) ACDS(Pol))	Central Staff
ACNS (OR) Navy) ACGS (OR) Army) ACAS (OR) Air Force)	Single Service heads of Operational Requirements branches

ACSA (P) Defence Scientific Staff (Projects)

ACSA (S) Defence Scientific Staff (Studies)

AUS (OR) PUS's representative, works in CDP's staff

The DEPC is responsible for advising SofS which major projects should be included in the development programme to meet operational requirements endorsed by the ORC, secondly, for re-examining major projects in the light of significant changes in cost, timescale, performance or of any changes in operational requirements endorsed by the ORC or in the availability of resources within the development programme as a whole. The committee comprises:

CSA	Chairman
DUS (Pol) PE	Deputy Chairman
DUS (P)	PUS's representative
DCDS (OR)	Chairman ORC
DCA (PN)	Defence Scientific Staff
HDS	
CER	
CofN	)The three PE Sys-
MGO	)tems Controllers
CA	)

There is usually a representative of the Treasury present also.

There are three main Army equipment committees (not necessarily repeated in the Navy and Air Force Departments).

(1) The Weapons and Equipment Policy Committee (WEPC). (2) Army Combat Development Committee (ACDC). (3) Army Logistic Development Committee (ALDC).

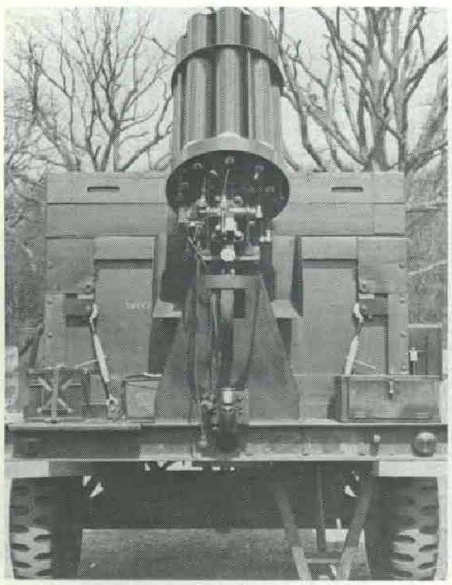
The ALDC is mainly concerned with logistic concepts, doctrine and capabilities and is thus mainly the province of QMG, but it is attended by ACGS(OR), DCD(A), DCS(A), and a member of MGO's staff. The ACDC is concerned with tactical concepts, doctrine, etc., and is chaired by VCGS, and attended by his main directors, the arms directors and representatives of CDS, QMG, AG, MGO, PUS, CSA, Int, HQ UK Land Forces and British Army of the Rhine (BAOR) and the Commandants of the Staff College and the Royal Military College of Science at Shrivenham.

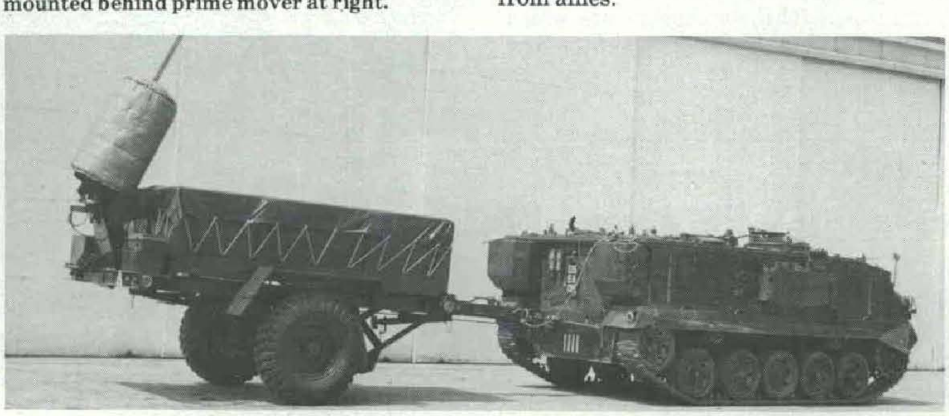
However, from a procurement cycle point of view, the WEPC is the most important, as it has the task of deciding Army policy for weapons and equipment on behalf of the Army Board and of formulating views on naval and airforce equipment of concern to the Army. It is chaired by VCGS who has his main directors present and representatives of PUS, QMG, MGO and CSA.

The British procurement cycle follows the usual routine of preliminary, concept or feasibility studies, project study or project definition, full development, development and user testing, acceptance and approval, production planning, initial or pre-production, troop trials, full production, defect modification and product improvement.

It is not possible to define the origin of an idea for new equipment. The idea will crystalise from a constant interplay of military and civilian staffs engaged in defence work, amongst themselves and with industry.

The focal points will tend to be in Combat Development (CD), Intelligence, Arms Directorates and Schools, R&D Establishments and, above all, in the General Staff (Operational Requirements) branches who are in constant contact with all the others. Some of the factors which contribute towards the emergence of the idea are: Technical advances, CD concepts, Enemy capabilities, Obsolescence, Experience in operations or training, and Information from allies.





GIANT VIPER mine-clearing device. Explosive-filled line is propelled by rockets mounted at rear of line-carrying trailer. Rocket device is shown at left; system mounted behind prime mover at right.

Once an idea has been identified and appears to be worth pursuing it is sponsored by a suitable Operational Requirements staff branch. This branch is known as the Equipment Sponsor.

In the case of major projects the Equipment Sponsor will invite the procurement executive (PE) to carry out a preliminary study to give an indication of the practicability of the idea in terms of technical possibilities and cost.

The study should be no more than a mind clearing exercise to assist the Equipment Sponsor to draft a staff target. The study is normally carried out in an R&D Establishment without any special allocation of funds.

Once a favourable preliminary study report has been received the Equipment Sponsor prepares a General Staff Target (GST). This states the user's requirement in broad terms, giving the task of the equipment and the key characteristics, with emphasis on the effect required rather than the means of achieving it, so as to allow full consideration of alternative solutions.

The GST provides the basis for a feasibility study (FS). The GST must be approved by the Deputy Chief of the Defence Staff (Operational Requirements) (DCDS(OR)) and in some cases the ORC. The criteria for reference or otherwise to the ORC are financial.

When the GST has been endorsed by the ORC or DCDS(OR) it is passed by the Equipment Sponsor to the appropriate Director General in the PE for him to arrange the FS. This may be carried out by an R&D Establishment, or by industry under the supervision of an R&D Establishment.

Contracts are sometimes given at this stage to a number of firms to carry out independent studies. The firm producing the most acceptable result may well be awarded the development contract. The objects of the FS are: To assess in terms of technology, cost and time the feasibility of meeting the GST; To state the alternative solutions, showing the advantages and disadvantages of each in these terms, and identifying the key problem areas; and To produce an outline development cost plan (DCP), including a network, and an estimate of the cost of unit production.

The study is normally entirely theoretical although in some cases, particularly where advanced techniques are proposed, experimental work may be needed to confirm the theory. On the basis of the FS report, ACGS(OR), in consultation with the relevant Director General (PE), takes the decision whether or not to proceed with the project and chooses a preferred solution if alternatives are proposed. If a decision to proceed is taken, ACGS(OR) then initiates a GSR based on the preferred solution.

The General Staff Requirement (GSR) provides a detailed statement of the characteristics and performance expected of the equipment, based on the selected feasibility study solution. It has two purposes:

(1) To provide a justification of the requirement, and a statement of estimated costs, technical factors and timescales as a basis for the decision to proceed.

(2) To provide the designer with details of the exact requirement in sufficient detail for design work and against which the performance of prototype equipment can be measured.

The GSR is used to initiate the next stage in the cycle, project definition studies, but before these can be undertaken, financial approval is required. As with the GST, the level of approval is dependent upon the cost and complexity of the project, and whether questions of policy are involved.

Should the approval of the ORC and the DEPC be required, a supporting paper is prepared in addition to the GSR, which sets out the technical, financial, employment and deployment aspects of the whole project in detail, in order to argue the case for proceeding. In common with all Army submissions to the central equipment committees, both the GSR and supporting paper require the prior approval of the WEPC.

The overall object of project definition studies is the refinement of the plan for development until the element of risk is reduced to an acceptable level often by practical work on key problem areas. Another important object is to explore possible trade-offs between performance, time and cost, and to establish the best balance, and for this purpose a flexible relationship must exist between the specification and the operational requirement.

The end product will be a detailed development cost plan (DCP), which will give the time and cost for each development step. The DCP should be in sufficient detail to justify a decision to proceed to full development, with a high degree of assurance on the outcome in cost and performance terms.

The length of the project definition studies and the stages into which they may be divided, depend upon the complexity of the project and the degree of technical uncertainty. For major projects, definition may be undertaken in two or more stages. At the completion of each stage the project may be reviewed by the appropriate committees to see if the definition has proceeded far enough to warrant a decision to move into full development.

Once full development of the project has been approved, design development and manufacture of prototype equipment starts at once and development continues until ideally, after successful trails, acceptance and approval are received.

In practice, various problems are likely to arise and these have to be referred for re-endorsement to the central equipment committees if development is delayed by more than a year, or expected costs of development or production increase outside approved margins. The Treasury is notified of all cost increases and has the right to insist on a re-endorsement by the central committees.

Development trails are of two categories: (1) Technical trials. (2) User trials. Technical trials (sometimes called development trials in this narrow sense) are aimed at establishing that the design is technically satisfactory and that it will meet the requirements of the GSR. Trials of components for incorporation in the complete equipment are also included in this category, as are trials to evaluate the success of modifications made to an original design.

Where explosives are involved, the Ordnance Board (OB) will be consulted and will normally arrange its own trials or be formally associated with jointly agreed trials arranged by the R&D authority. However technical trials are often conducted with equipment that is not typical of production standard, whereas Ordnance Board trials are normally conducted with production standard equipment.

The Ordnance Board is an inter-Service independent advisory body providing impartial appraisal of the safety of weapons and those parts of weapons systems and stores within their fields of operation in which explosives are used, and for providing advice on their suitability for service.

As an authority without direct responsibility for development or production, the OB is in a strong position to advise impartially, though not to decide, on the acceptability of such shortcomings as may be revealed.

The User Trial differs from a technical trial in that the former is intended to explore the performance of the equipment in a Service environment. User trials also give the user and logistic support services early experience of the new equipment to allow the preparation of drills and training techniques which will be required when the equipment comes into service.

User trials are initiated by the equipment sponsor and are undertaken by Arms Schools or by Trial and Development Units based on Arms Schools, often in parallel with technical trials. They are conducted on prototype equipment which is as nearly as possible representative, at least in all functional aspects, of the production equipment and the trial is planned on the basis of the appropriate Arms School tactical doctrine.

After a satisfactory result to user trials, formal Acceptance is normally given by the equipment sponsor, very often subject to the rectification of minor defects which

(Continued on page 22)

Design and Development of a French Weapon System

By LTC André Bastien
Bureau of Future Developments
Office, Chief of Staff, French Army

The French Army works in close cooperation with the Ministry of Defense level agency—"Délégation Générale de l'Armement" (DGA), during the design, development and production of weapon systems needed to carry out its mission against a potential enemy equipped with increasingly sophisticated materiel. This article describes briefly the acquisition process of new weapon systems and the relationship between the French Army and DGA which is responsible for weapons development and production for all of the French armed services.

Development of increasingly complex and expensive weapon systems spreads over a long period of time. The need to constantly make trade offs between military requirements, technolgy resources and allocated funds requires a well structured organization for managing the acquisition process.

Based on a few principles, guidelines governing the weapons systems acquisition process have been established. Description of this process heareafter is limited to its initial phases including prototype testing. Actually, putting these guidelines into practice is not always easy since some perturbations may occur while the program is progressing, calling for changes.

Basic Principles. Three basic principles have been used to define the guidelines governing development of weapon systems by DGA for the French Army. They are as follows:

• Decentralization of research and development efforts which becomes necessary because of the increased number of technical and technological areas involved. Decentralization allows a more efficient use of the Army's and the nation's intellectual resources by distributing the effort among DGA laboratories and arsenals as well as private industry.

• Centralization of decision and control which is the mandatory consequence of research and development decentralization and is a must because of severe financial limitations.

• Uninterrupted dialogue between users and developers, demanded by the increasing impact of technology on the characteristics of the materiels.

These three principles are ever present during the whole weapon system acquisition process and more particularly, during its design and development.

The Acquisition Process. Summarizing briefly, development of materiel from design to manufacturing and testing of prototypes consists of three phases. The first is that of defining the requirement. This phase is under the responsibility of the Chief of Staff, French Army (Chef d'Etat-Major de l'Armée de Terre—CEMAT).

The Chief of Staff must define, within the missions he assumes, his tactical needs and express them in military requirements. This is achieved by presenting an assessment, as accurate as possible, on the potential enemy, and a good knowledge of research conducted within scientific and technical fields.

Definition of military requirements results from confrontation of various factors: military imperatives decided upon to meet the tactical concept; logistics limitations; and the available technical possibilities.

Such a confrontation does not confine itself to the Army Headquarters. It usually involves outside personnel and technical advisers belonging to working groups and permanent consultative committees, the objectives of which are to obtain the best cost/effectiveness ratio.

The preliminary phase ends with the approval of a list of military specifications by the Chief of Staff, French Army. This document states the employment, and associated operational, logistics and training limitations of each new item of materiel.

The second phase is that of research and development. This phase is the responsibility of the Chief of Staff, French Army, and the Délégué Général pour l'Armement (DGA). It begins with the technical definition of the materiel in accordance with the list of the military specifications, and the establishment of the program of production.

(Continued on page 17)

155mm GCT Self-propelled Gun. The weapon, with a crew of 4, uses a completely automated loading system, built around a combustible cartridge case, allowing a burst rate of 8 rounds per minute. The system is now in final stages of development.

VCAC Renault Antitank Vehicle armed with HOT missiles. When armed with 20mm automatic cannon, it also may be configured as an antiaircraft close-defense vehicle or as an infantry combat vehicle capable of carrying 11 men.

Federal Republic of Germany Defense Equipment R&D and Procurement

By Hans Eberhard
Armaments Director, Federal Ministry of Defense

In the Federal Republic of Germany, the whole complex of administrative tasks which must be accomplished to provide the Army, Air Force and the Navy with defense equipment is centralized in the Armaments Division of the Federal Ministry of Defense. The Federal Ministry of Defense, in turn, is directly responsible to the Executive fφr all matters pertaining to the ambit of the defense equipment establishment.

The Defense Equipment Establishment: Responsibilities and Organization. The Armaments Division is a civilian unit. It is the top agency of the defense equipment establishment which comprises the Federal Office for Military Technology and Procurement—a nationwide federal authority—and about 20 armaments agencies in Germany and abroad, including research institutions, test, procurement, and liaison, agencies, naval arsenals and other types of technical agency. The Armaments Division:

- Provides advisory assistance to the civilian and military executive staffs.
- Assists in Bundeswehr (Army) planning.
- Processes research and future technology projects.
- Prepares research, development, and procurement, programs.
- Participates in project planning.
- Exercises executive authority and technical control in respect of the Federal Office for Military Technology and Procurement in all matters pertaining to the implementation of development, procurement and maintenance projects.
- Participates in equipment development phase decisions in keeping with its own responsibilities for the technical and economic requirements to be met by a project.
- Processes matters of technical-economic and technical domain.
- Is responsible for international cooperation in the areas of defense technology and economics.

The Federal Office for Military Technology and Procurement, with its agencies, is responsible then, for the development and procurement of armed forces equipment. It acts on the basis of policy directives issued by the Armaments Division.

The top-level of the Armaments Division comprises the Heads of the Armaments, Defense Technology, and Defense Economics Divisions. The Head of the Armaments Division is responsible to the Executive and thus makes decisions necessary to fulfill the tasks assigned to his domain, especially where matters of policy are concerned.

The Armaments Division Head is flanked by the Heads of the Defense Technology, and Defense Economics Divisions, both vested with power to make top-level decisions—the former mainly in the technical, the latter in the economic sphere.

This structure is patterned on the industrial management model and guarantees integrated processing of economic and technical matters by organizational uniformity and coherence.

Working elements of the Armaments Division comprise two Commissioners and eight Branches (see Figure 1) with altogether 62 Sections. It has a staff of 450. The Commissioner for Planning and Programs and his staff (Beauftragter für Planung und Programme, Rustüngsabteilung = RüPl) are tasked with coordinating planning activities, and elaborating R&D, and procurement programs.

The Commissioner for Defense Research and his Staff (Beauftragter für Wehrtechnische Forschung, Rüstungsabteilung = RüFo) are responsible for defense research in the forefield of concrete equipment projects. Areas of responsibility of these branches are as follows:

Branch Rü I processes matters of central policy while Branch Rü VIII processes general economic and legal affairs. Branch Rü II is responsible for the armaments relations with other countries. The other five Branches—Rü III through Rü VII—are responsible for providing the Services with defense equipment in the proper sense of the word, in particular for processing matters pertaining to future technology, execution of experimental

(Continued on page 14)

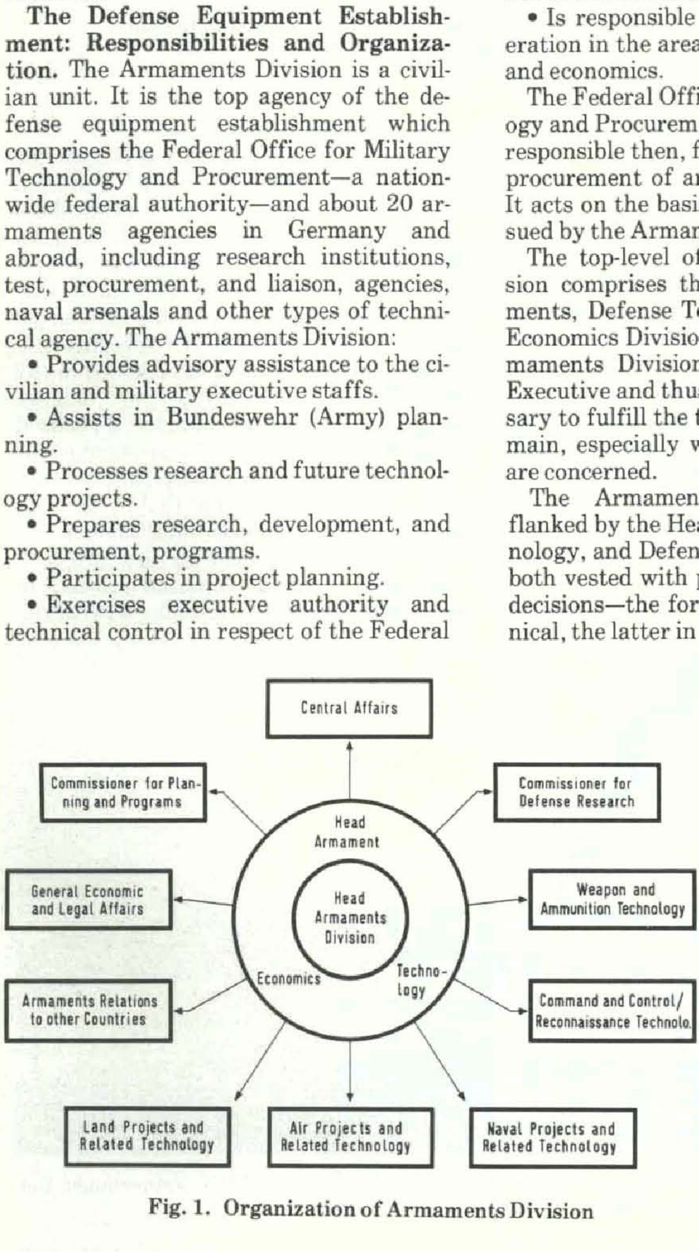
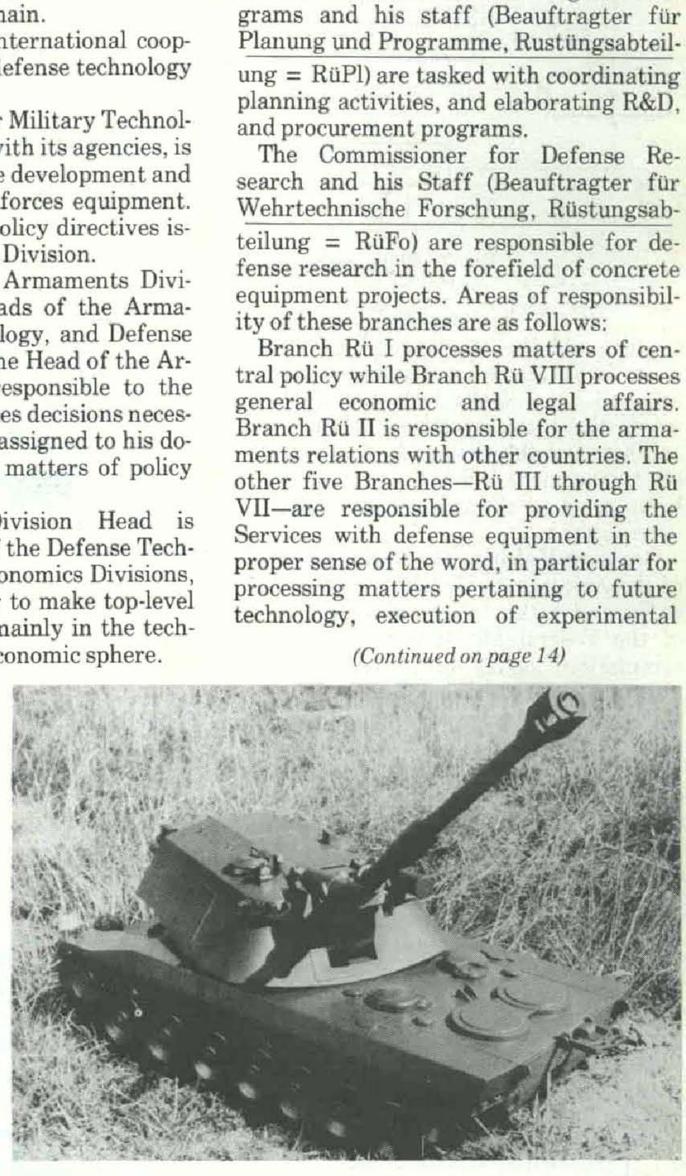


Fig. 1. Organization of Armaments Division



Self-propelled 155mm Howitzer M70. In early development by the FRG, UK, and Italy, this howitzer will use the same tube and components as the FH70.

FRG Defense Equipment R&D, Procurement

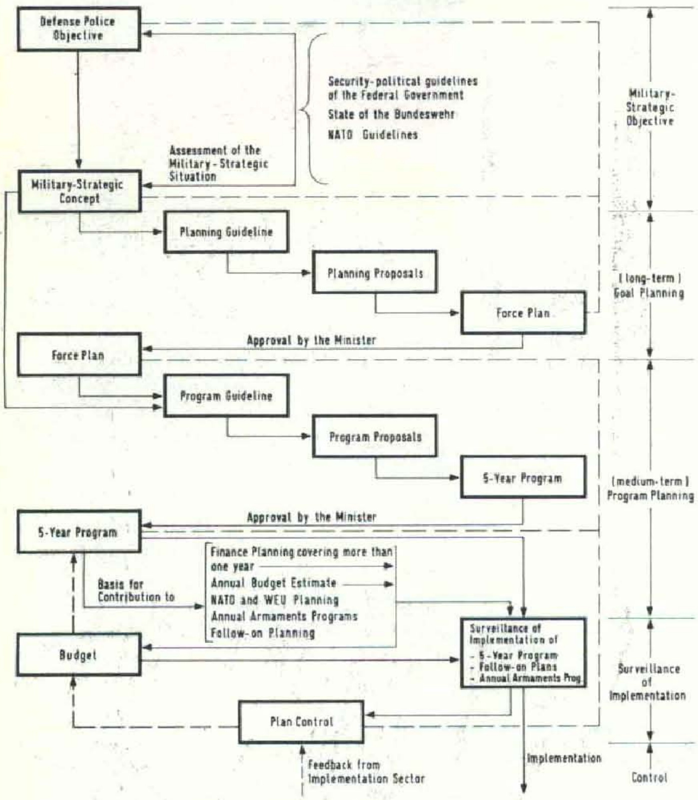


Fig. 2. Planning System Diagram

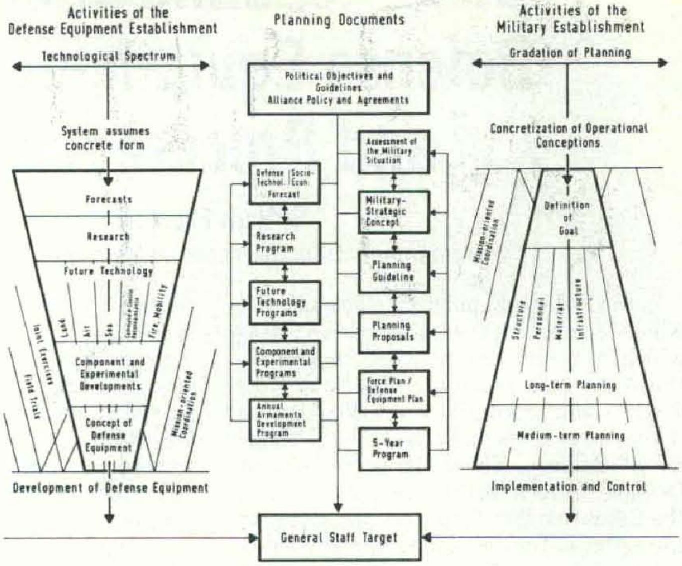


Fig. 3. Interaction of the Defense Equipment and Military Establishments' Activities in the Course of Decision-making.

(Continued from page 13)

studies, and the development of components for future weapon systems and projects—all these tasks being oriented towards the entire spectrum of land, air, and sea, technologies, and effective project management and control—these tasks being oriented towards concrete individual projects.

Decision-Making. The working process of the Armaments Division is, obviously, enfettered in the decision-making process of the Federal Ministry of Defense. A summarized survey of the Bundeswehr planning system is shown by Figure 2.

The central Bundeswehr planning document is the Military Strategic Concept which is derived from the Defense Policy Guidelines, on the basis of a Military-Strategic Assessment of the situation.

Since this concept formulates the overall mission of the Bundeswehr, it sets forth, first of all, operational principles. These principles cover tactical mission categories, e.g., command, control and communication, reconnaissance, target engagement, etc.

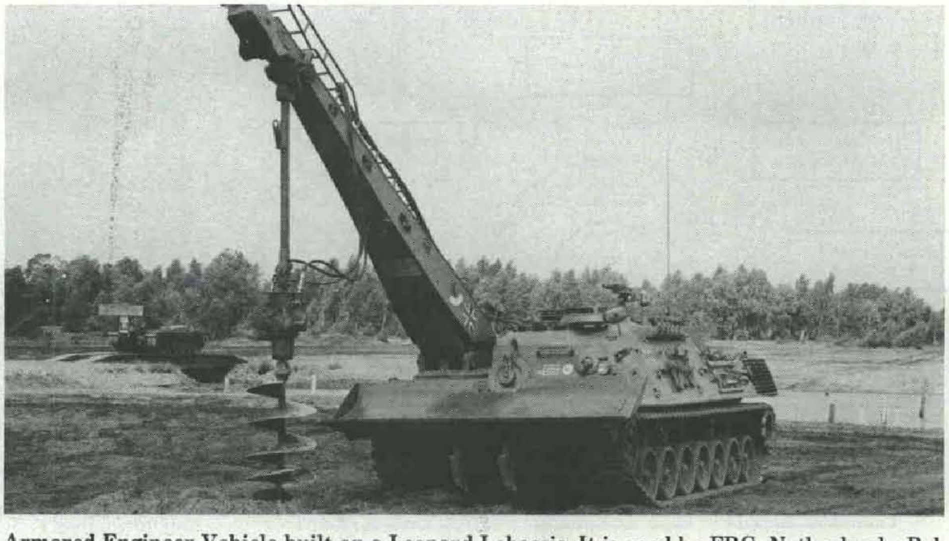
In order to obtain knowledge of the options possibly available in the future to meet requirements of such missions, mixed study groups composed of technical and tactical experts have been established.

These groups elaborate the technical and tactical standards of performance required to fulfill the various tactical missions, and outline, if possible, approaches to the problems involved. Results of these groups' activities eventually flow into the Force Plan as planning proposals.

The Force Plan integrates both the 10 to 15-year long-term Bundeswehr planning (goal planning), which is adjusted at about 2-year intervals, and medium-term programs as well as descriptions of medium-term planning goals (program planning).

Thus, the Force Plan stems from the analysis of the goals and planning concepts described in the Military Strategic Concept and other documents. The Plan also reflects the tactical/technological defense equipment conceptions as well as, for instance, long-term planning concerning the force structure, personnel, etc. Forces requirements are formulated to permit a general quantitative prognosis.

Armaments planning is reflected in the Force Plan as stage-by-stage defense equipment planning, namely: verbalized expected requirements; future equipment conceived in line with Staff Targets, that is equipment largely specified by tactical, technological, economic, and financial parameters; development-mature projects; and finally, already initiated projects in their various phases beginning with devel-



Armored Engineer Vehicle built on a Leopard I chassis. It is used by FRG, Netherlands, Belgium, Italy and Norway as a foxhole digger, bulldozer and grader.

opment and ending when procurement is discontinued.

The two last-mentioned categories constitute also the basis for the annually adjusted medium-term Five-Year Program which describes the manpower and financial requirements to be satisfied in order to enable the Bundeswehr to meet the day-to-day requirements of the forces, and implement medium-term planning under the Force Plan.

Results of all these planning activities flow into the Annual Armaments Programs, especially into the annual budget estimate.

Figure 3 is a very simplified survey of the pilot activities to be accomplished by both the user, i.e., the Service concerned and its agencies, and the agencies of the defense equipment establishment in order to arrive at the necessary decisions. Essential armaments planning documents and constituent elements are shown in the centre.

This dialogue, which is very intensively conducted by experts in the fields of military operations, defense technology, defense economics, and last, but not least, defense policy, eventually enable the aforementioned mixed study groups to identify mission-oriented requirements. It is these study groups that elaborate the General Staff Targets.

Defense Equipment Development and Procurement. Initiation and implementation of a new project must be ruled by procedures which are expected, amongst other things, to take into account the entire weapon system—not only the technical element but also the associated installations, services, personnel and training. Also, these procedures may help determine whether the requirement continues to exist in the light of political developments, and reduce risks inherent in the realization with respect of performance, time, and funds.

Figure 4 is a rough outline of the defense equipment development and procurement phases. The process is divided in phases such as prephase, concept phase, etc. Each phase leads towards a decision which is reflected in what is termed the phase document, e.g., General Staff Target, Military Technical Objectives, etc.

Prior to the first stage, the above-mentioned study groups consider the tactical mission categories or problems derived from the Military Strategic Concept. This is to identify gaps that remain to be closed (an activity which may lead to a General Staff Target). We might say a project originates in a mixed study group and a General Staff Target may be regarded as this project's "birth certificate."

The phase documents therefore are important under more than one aspect: They are testimony that the responsibility for a project is shared by the Chief of Staff of the Service concerned and the Head of the Armaments Division—every document carries the signature of either of them. Every phase document, except a General Staff Target and a Final Report, requires approval by the top management of the Federal Ministry of Defense.

In substance, each document is oriented towards two types of statement. At the beginning of a phase, goals are set forth which are determinators for the subsequent phases in which they are to be more and more refined.

At the conclusion of a phase, the determination is made as to whether the goals of the phase in question were achieved. A decision is made as to whether and how the project is to be continued. For instance, should a project continue with partially revised goals, should it be referred back to an earlier phase, or passed on to the next phase, or should the project be terminated?

Approval of phase documents releases the establishment of the respective management organization. Upon approval of a General Staff Target, and provided the ensuing conception is categorized as a weapon system or project, a system manager is appointed although, at that stage, merely the most significant technical and tactical properties have been established.

The system manager acts as the representative of the user and heads a working group established to his support, which comprises, for instance, an authorized representative of the Armaments Division (project manager) and a representative of the implementing agencies of the defense equipment establishment (project officer).

The system manager controls the combat system during all its development and procurement phases. This is to ensure that the final product will be an effective sys-

(Continued on page 18)

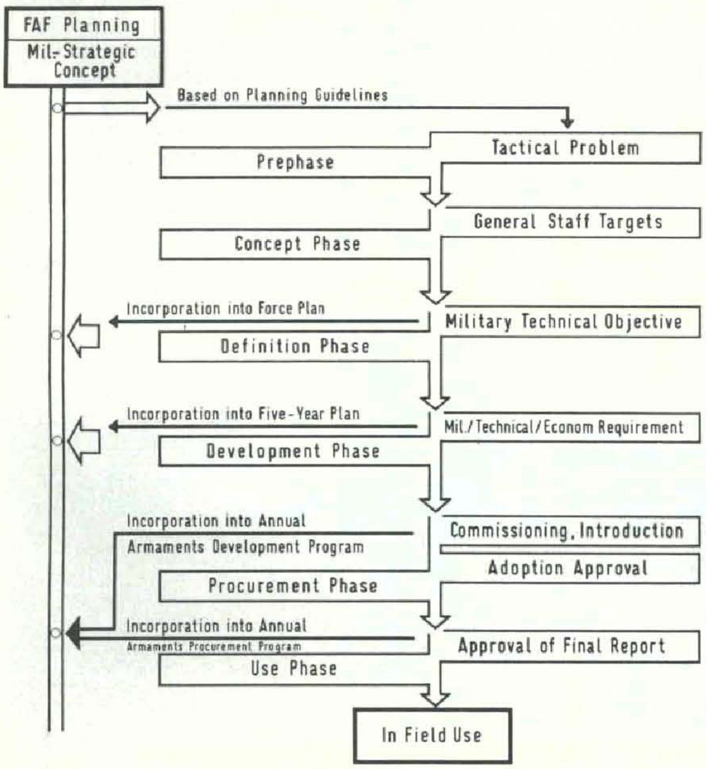


Fig. 4. Phases in Development and Procurement of Defense Equipment.

Armored Transport Vehicle deliveries are scheduled to start in 1979 to replace the MTW M113 and the MICV Hotchkiss.

Equipping the Army of Canada

by COL Robert Noce
Commander
U.S. Army Standardization Group
Canada

To understand materiel acquisition policies and practices to our north, one first must recognize that Canada's needs and situation are unique. One of our very closest and longest allies, Canada's military defence forces are given the mission of defending national sovereignty, being a partner in the defence of North America, participating in NATO and contributing to UN peacekeeping forces.

There are, of course, a familiar variety of add-ons—aid to civil authorities, disaster relief and some not familiar to the U.S., such as being the national force for search and rescue, and civic action in the northern and wilderness areas of their country.

With a population and GNP about one-tenth of the United States, a vast country, and the world's longest national coastline, they must, as a matter of course, field and support military forces at home as well at great distances abroad, and in environments ranging from the high arctic in the winter to the Middle East desert in the summer. Their materiel acquisition policies must fit military needs for both war and for peacekeeping operations, fit the nation's industrial capabilities and fit the government's budget. It is a most demanding requirement in view of Canada's unique situation and roles.

Establishing the need is the natural first step in a materiel acquisition process, or combat development system. The old Canadian Army had one. With total integration of the armed forces in the late sixties, it disappeared in the trauma of drastic organizational change. Now it has been reborn and operates well for the land element, the official term given their army.

Strategic objectives, NATO, the American-British-Canadian-Australian Standardization Program, and national concepts all influence planning guidance. This results in the Land Forces Combat Development Guide. This policy document in turn contains materiel objectives.

The objectives evolve by a deliberate process. The Land Forces Combat Development Committee, the senior leaders, produce guidance; study groups and working groups produce doctrine for their approval. All specific materiel requirement documents, programs and projects stem from the policy and guidance contained in the Guide.

Intertwined with the acquisition of materiel are the mission and operations of the integrated, tri-service defence research and development community. Every activity in the R&D program must be directly or potentially related to existing or possible operational capabilities of the Canadian Forces. Every R&D effort must be justified in terms of anticipated benefit or where requirements cannot be met from other sources.

In line with the government's Make or Buy policy, this means that as much as possible must be made in Canada if an industry capability exists. In-house R&D is aimed at maintaining a competent technology base, at making acquisition managers "smart buyers," at solving problems which industry cannot handle, and at conducting technical assessments and studies.

Canada cannot possibly conduct R&D in all areas. Hence, programs are selected carefully to complement those of her allies and to capitalize on Canadian industry capabilities. When appropriate, cooperative development programs are actively sought.

To accomplish this mission, the military R&D community consists of an experienced headquarters staff in Ottawa and six defence research establishments which are functionally oriented. One familiar to many U.S. Army developers is the Defence Research Establishment Valcartier near Quebec City, formerly called "CARDE" or Canadian Armament R&D Establishment. Complementing the high quality in-house capability is the capability found in Canadian industry and universities.

The process of program approval for a specific military item is outined in Figure 1. Though the chart is fairly well self explanatory, a few comments are in order. Once past the objectives/studies/capability stages, a Program Development Proposal is prepared, staffed and approved, all within the national headquarters. This implementing document provides guidance and funds to proceed into what roughly corresponds to the U.S. Army's advanced development phase.

However, this activity may well consist of sampling or studying prototype or production hardware available from other countries, as well as or instead of a development program as such. If the conclusion from this phase is to proceed, a Program Change Proposal is processed. This document may authorize extensive test and evaluation of prototypes acquired from other sources, if appropriate, and acquisition of a production run as well, together with ancillary equipment, spares, training and so on.

If a major full scale development is required, the PCP authorizes that alone, and a second one is subsequently required for production. When approved, these documents constitute departmental approval of the project. Final governmental approval of major projects rests outside the Department of National Defence, with the Treasury Board. That agency combines

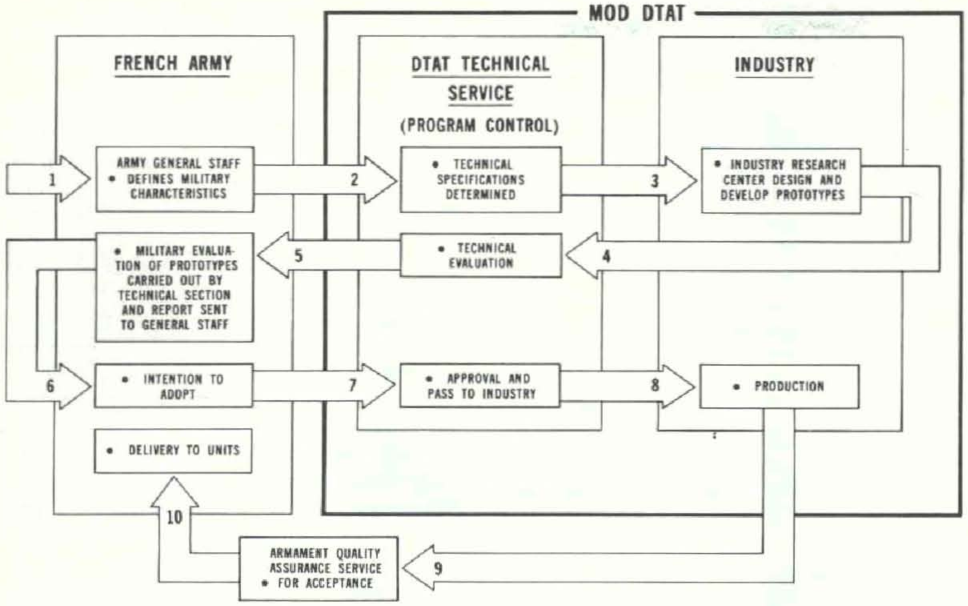
(Continued on page 24)

Armored Vehicle General Purpose Family. The Cougar (left) is a fire support vehicle mounting a modified UK Scorpion turret with a 75mm gun. The Grizzly is a recon/troop carrier, mounting .50 cal. and a 7.62mm machinegun.

Design and Development of a French Weapon System

(Continued from page 12)

FRENCH ARMY RDA



After evaluation of various competitive proposals, the final choice on technical proposals is usually based upon an in-depth analysis of projects showing technical characteristics, schedule and cost estimates. This step is followed by the development and manufacturing of one or several prototypes, i.e., true scale materiel, custom-built but with the same materiels to be used in the full line production.

During this phase, the dialogue is intensified between the responsible technical directorate of DGA and the Army Headquarters. To facilitate the dialogue, a Consultative Working Group is created and is comprised of officers and engineers involved in the program.

The first task of this group is to establish a document called "Fiche-Programme." This document is actually a genuine contract between DGA and the Army Headquarters, and as such, must meet the approval of both the Chief of Staff, French Army and the Délégué Général pour l'Armement.

During the research and development phase, the dialogue goes on the one hand, within the Consultative Working Group (CWG), and on the other hand between the Army Test Directorate (Section Technique de l'Armée de Terree—S.T.A.T.), DGA engineers and contractor.

The final or third phase—that of testing, is also under the joint responsibility of CEMAT and DGA. A system must undergo tests and experimentations made in collaboration with the contractor, DGA engineers and S.T.A.T. officers. The purpose of these tests and experimentations is:

• To ensure, at the contractor level ("manufacturer tests"), the technical development of the materiel.

• To check, at the S.T.A.T. and Army level, that the requirements specified in the contract of Fiche-Programme, are met. This test is known as the official evaluation test and is carried out jointly by S.T.A.T. and DGA.

This last phase leads to a value assessment of the equipment, often followed by modifications and reevaluation. Finally, this phase ends with the decision by the Chief of Staff to field, or not to field, the materiel. Concurrently, full scale engineering development may have been started in preparation for mass production under DGA sole responsibility.

Timeframe of the Process: Its Problems. From the time the tactical need has been stated to that required for the completion of the prototype manufacturing and test, five to six years have gone by and a delay of three to four years is to be expected before initial production items reach the field. The time span overall then, is eight to ten years.

Because of these delays, changes may occur in the course of the development program. These may be occasioned by changes to the military requirements because of tactical concept modifications or changes in forces structure. This can also be the case when a program initiated on a national basis is later pursued on an international cooperation basis involving military requirement adjustments.

There may be changes due to technical reasons. These may be either problems in coping with some of the military specifications or problems occuring while shifting from prototype production to assembly line production.

Or, changes may ensue as a result of costs. Cost increases may not be compatible with allocated funds, thus hindering steady development of long programs.

Only an uniterrupted dialogue between engineers and managing level can solve unforeseen problems on time and induce necessary decisions without delaying the fielding of equipment which is the DGA and Army common objective.

LTC ANDRÉ BASTIEN is assigned to the Bureau of Future Developments, Office, Chief of Staff, French Army. He has served formerly with several field artillery battalions and in the Programs and Industrial Affairs Office, Directorate of Armament. His academic credentials include a BS degree from St. Cyr.

AMX 10 RC. Amphibious armored reconnaissance vehicle scheduled to enter service late in 1979. Vehicle uses power train and other components of the AMX-10 P Infantry Fighting Vehicle. Unique characteristics include central tire inflation, hydrojets for water propulsion, and a 105mm gun with laser rangefinder and ballistic computer.

FRG Defense Equipment R&D, Procurement

(Continued from page 15)

tem integrating the necessary associated installations and facilities, supporting equipment, services and personnel, and thus will meet the expected standards of availability, performance and maintainability.

The project manager acts as coordinator at ministerial level in all matters falling within the ambits of the defense equipment establishment. He issues the necessary directives to the agencies of the implementing organization (the Federal Office for Military Technology and Procurement) and monitors their execution.

The project officer also acts as coordinator in the implementing organization. He is responsible for the technical-economic concretization of the project—a task incumbent upon the Federal Office for Military Technology and Procurement, and in this he is supported by a working group.

With the beginning of the concept phase, at the very latest during the beginning of the development phase, the technical-economic responsibility passes to the Federal Office for Military Technology and Procurement.

Thus, in the negotiations with the representatives of industry, the project officer acts as the responsible representative of the armaments establishment. Development and procurement contracts should always be governed by the prime-contractor principle.

The interaction of the development and procurement activities on the one hand, and Bundeswehr planning activities on the other are shown in Figure 4.

Once the Military Technical Objective has been laid down, the project is included in the Force Plan (long-term planning). After achieving development maturity, which is evidenced by the "Military/Technical/Economic Requirement," a project is incorporated into the Five-Year Program (medium-term planning).

Where procurement is to be expected shortly, the project will be incorporated into the next Annual Armaments Programs and thus into the budget estimate. The aim is to either begin procurement in the next following year or, should there be no need for urgent procurement, have the project at hand as an object of exchange for other projects which either do not progress as desired or not at all, so that procurement funds have to be re-allocated.

As regards the detail work to be accomplished during the course of each phase, it may suffice to point out that the individual phases are subdivided in what is termed phase stages, some of the most important being market surveys, elaboration of evaluation criteria, and preparation of a work/time/finance plan.

Whenever phase or stage decisions of relevance to foreign, defense, or economic policies are made, the respective committees of the German Bundestag require exact information. This is especially true in matters pertaining to the selection of prime-contractors and cooperation within the Alliance, or regular reports on very large projects.

Industry: A Partner. Every activity connected with the development and procurement of defense equipment requires industrial partnership. Its characteristic feature is the constant dialogue which begins even in the future technology working groups.

It is continued in the aforementioned system manager's and project officer's working groups. Thus, a General Staff Target is even elaborated in the light of information on the technical and economic capacities of the defense industries. The eventual transition to the development and procurement phases, hopefully, does not involve complex implications.

The industrial sector is prepared to assume its role as partner of the armaments establishment which functions as the customer awarding contracts on behalf of the government.

GEPARD self-propelled 35mm automatic cannon air defense system uses the Leopard I chassis. The Netherlands also uses a modified GEPARD.

Complex projects which are difficult to coordinate are handled by the defense equipment management, acting on behalf of the government, and a prime-contractor acting on behalf of the industries involved.

In other words, equipment development and production contracts are awarded, as a rule, on the basis of free competition to a prime-contractor who will bear the overall responsibility for the implementation of the project. It is he who awards the necessary subcontracts and coordinates the work of the subcontractors.

Conditions governing development and production are laid down in the contract negotiated between the defense equipment management and the prime-contractor. Defense equipment management, in coordination with the prime-contractor, provides for the step-by-step realization of the work, time, and funding control schedules established by the contracting authority.

Requirement-Oriented Procurement. Whether a new weapon system or a follow-on system is needed is a question answered solely by assessing the degree to which the available equipment meets the mission in question. It cannot be answered by mere follow-on-model thinking.

In the prephase activities, which are aimed at finding out whether or not modernization or replacement of defense equipment is necessary, it is of central importance to give heed to the rule that R&D and procurement must be oriented towards the defense mission of the Bundeswehr and the actual requirements of the forces.

In other words, the Armaments Division has to stick to the following rules: Procurement is to be confined to such defense equipment as needed to satisfy the actual requirements of the armed forces; Development is to be confined to what is considered suitable for procurement; and Research is to be confined to the specific fields of importance for the development and procurement of defense equipment.

Since the initial establishment of a requirement on the one hand and the commissioning of a new weapon system on the other are often separated by a space of time of five, ten and usually even more years, long-term planning and objectives are, no doubt, prerequisite to successful defense equipment development.

Long-Term Planning. Every analysis and prognosis effort must give heed to the lead time problem and at the same time be oriented towards the threat, or more correctly the environmental conditions to be expected at the envisaged time of service. The basis of such efforts rely on the defense equipment available at the time of their initiation.

The available weapon mix fully meets the requirement if its employment ensures a rate of attrition in enemy equipment which forces him to abort his attack at the Forward Edge of the battle area, if not before he reaches this critical line.

The aforementioned study groups then, have to assess the conditions that are apt to lower or increase the rate of attrition in enemy equipment. This calls for clarification of whether any weapon system, designed to meet the requirements of the mission, will have to be replaced by the next weapon generation or whether one or more novel systems may be required.

Should new intelligence give reason to expect a lowering of the enemy attrition rate, it becomes necessary to carry out thorough cost and effectiveness studies of new options. It is possible that at this stage even a Tactical Problem, and consequently a General Staff Target, may be formulated.

Examination and analysis efforts just described are connected directly to planning activities. They are, in fact, indispensable. The complexity of modern weapons systems and their development costs have reached a scale which is technically and financially acceptable only if both the necessity and scope of a development effort are clearly affirmed and delineated by extensive prior studies.

At this juncture, it becomes clear that any market-oriented control of defense equipment production or procurement, designed to meet the short-term demands of national economy, would not be compatible with long-term defense planning.

Moreover, selective control to utilize idle capacity of national industries may have precarious consequences if it involves an infringement of the principle of economy or interferes with international industrial relationship rooted in common planning and collaboration.

Enhanced Defense Equipment Collaboration. A stable international order guaranteeing the safety of the members to the Western Alliance must be based on the East/West balance of forces. Today, this balance is in jeopardy. The Soviet Union and the Warsaw Pact nations are enhancing their armaments efforts to an extent clearly exceeding their defense requirements. Their offensive potential is continuously increasing.

To ward off this threat, the West must arrive at a more economical exploitation of its resources. Differing defense equipment impedes both operational and logistic cooperation of the NATO forces.

Enhanced armaments collaboration promises enhanced effectiveness of the Alliance. If collaboration efforts nevertheless meet with great difficulties it must be made quite clear that hard and fast national interests may clash with the interests of the Alliance.

However, it should be pointed out that collaboration may mean an increase in technical know-how for trade and industry. It may also help overcome dependence on an industrially dominant partner, or may afford the chance of increasing the rate of export, or be conducive to alleviating the situation on the labor market—a grave concern shared by all the members to the Alliance.

If all these factors play a role in armaments collaboration, it cannot be confined to efforts in the technical sphere. It must be undergirded by resolved efforts in the political sphere.

Long-term planning, timely threat analyses and studies designed to fathom the technical possibilities are all clearly indicative that defense equipment development will be crowned with success only if the Alliance members commit themselves to coordinated military objectives. Cooperation on the basis of projects which have been or are being developed under differing aspects of philosophy and evaluation criteria is almost hopeless.

The Federal Republic of Germany is making many efforts at promoting allied collaboration in the fields of armaments development, production, procurement.

European Efforts. In recent years, the NATO members have become aware of this need for political backing and consequently new impulses have prompted a revival of the numerous armaments collaboration endeavors.

The National Armaments Directors who cooperate at the international level in the institution of the NATO Conference of National Armaments Directors, are making it their concern to enhance the interoperability of the weapons systems. However, many of these systems have been developed from duplicate efforts in order to ensure that the units and formations of the various nations can rely on effective logistic cross service.

Political discussions have revealed that industrial partnership with a powerful and completely self-reliant country, such as the United States, is and can only be maintained by a community of countries, which, on the basis of its joint capacities, will then be accepted as partner.

This being so, the European NATO members have begun to make use of two institutions. EUROGROUP coordinates their military concepts, and European Programme Groupe (EPG) harmonizes their defense equipment projects.

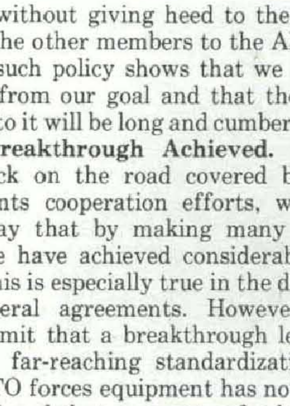
We have not gained enough experience to foresee whether these European efforts will, in fact, bring about balanced U.S./European armaments cooperation. The U.S. understands that such cooperation is necessary and has committed itself accordingly.

In political circles, the interest in such cooperation seems to increase. However, the vigor with which those circles that have been used to making armaments decisions without giving heed to the interests of the other members to the Alliance oppose such policy shows that we are as yet far from our goal and that the road leading to it will be long and cumbersome.

PAH-1 Antitank Helicopter is a BO105, armed with the German/French-developed 4000-meter HOT missile. A joint German/French follow-on PAH-2 is in the planning stage.

No Breakthrough Achieved. If we look back on the road covered by the armaments cooperation efforts, we can justly say that by making many small steps we have achieved considerable results. This is especially true in the domain of bilateral agreements. However, we must admit that a breakthrough leading towards far-reaching standardization of the NATO forces equipment has not been achieved and that prospects of achieving such a breakthrough in the foreseeable future are dim.

Therefore, the political leaders are called upon to enhance their efforts at reducing national interests in the interest of the Alliance in order to foster defense equipment cooperation which is badly needed to counter the growing threat.



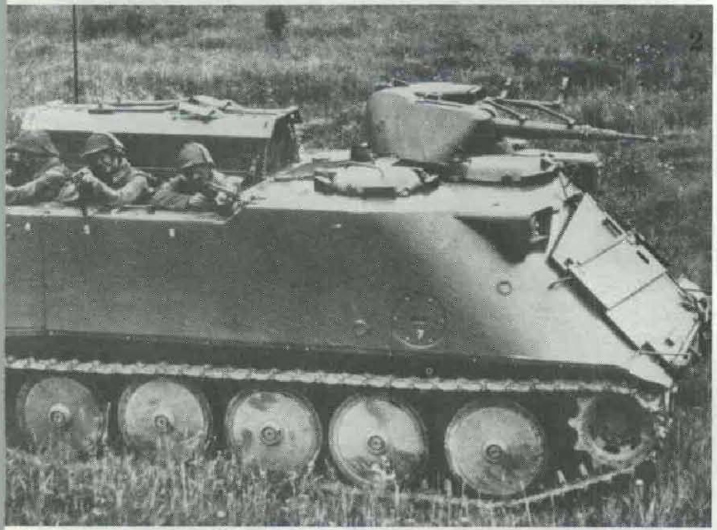
HANS EBERHARD is armaments director, Federal Ministry of Defense, Federal Republic of Germany. He previously served as deputy chief, Technology, in the Armament Department and was given the title of Ministerialdirektor. This followed a distinguished military career during which he achieved the rank of brigadier general. Additionally, he earned an MS degree in 1950 upon graduating from Darmstadt Institute of Technology.

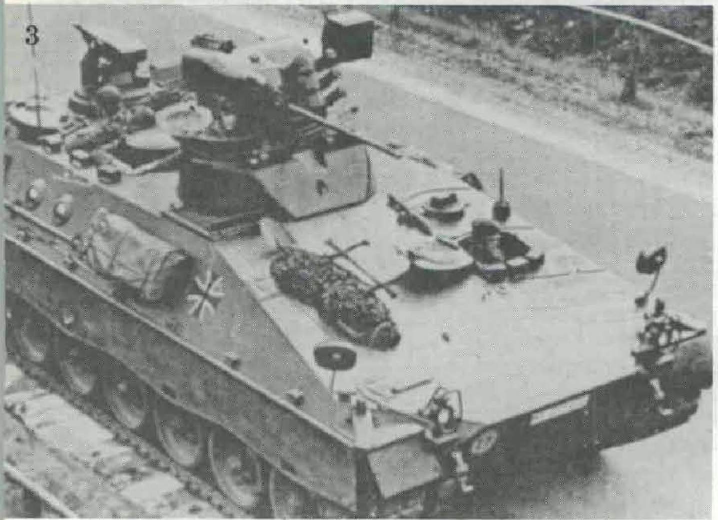
Foreign Infantry

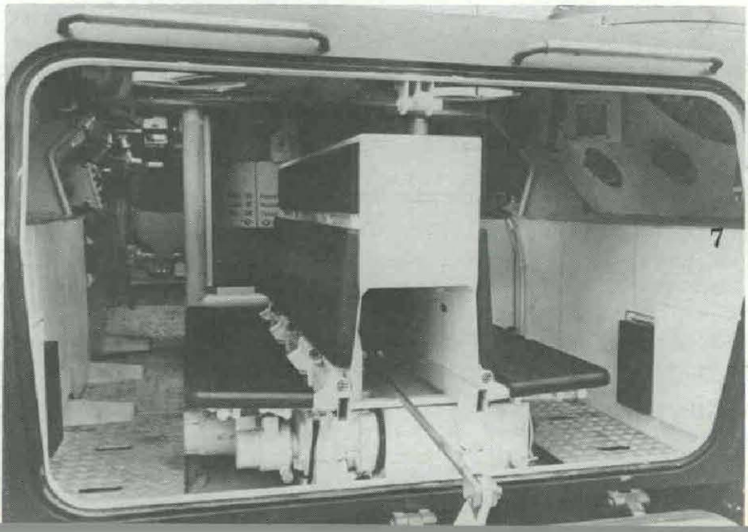
This is the third in a series of photospreads provided by the U. S. Army Foreign Science and Technology Center covering foreign weapons and equipment. The material shown here was the product of Messrs. Edwin W. Besch and Stephen P. Kirkup of that agency.

Approximately 40,000 infantry fighting vehicles (IFV) are now in service. The new concept of IFVs provides heavier firepower and protection and offers the infantry squad a mounted fighting capability, compared to earlier armored personnel carriers designed to merely transport infantry up to the battlefield. Shown below are 14 foreign IFVs. The year the vehicle entered service is shown in parentheses following the description.

Fig. 1—Soviet BMP amphibious Armored Infantry Combat Vehicle was the world's first advanced IFV and is the most numerous (1966). 2—Swedish PBV-302 is an example of a traditional design between the classic APC and IFVs (1965). 3—West German Marder IFV weighs 28.2



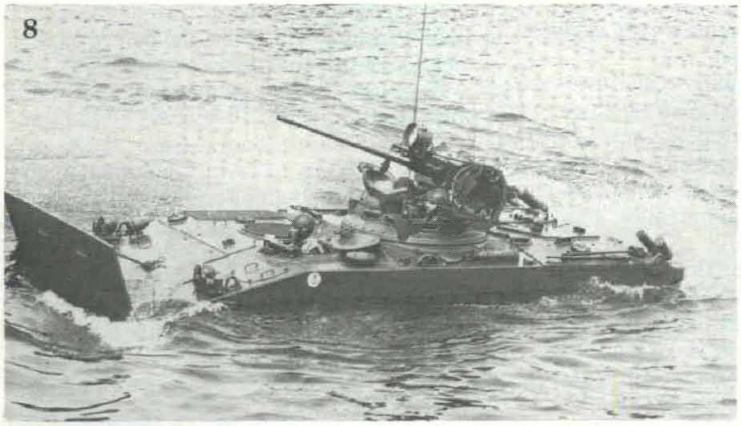




Fighting Vehicles

tons, is well-armed and well-protected (1971). 4—MILAN 2000p-meter antitank missile launcher retrofitted to Marder turret (1978). 5—VCTP IFV (shown) and TAM 105mm gun tank versions of Marder will be produced under license in Argentina (circa 1981). 6—Prototype Swiss MOWAG Tornado 2 IFV, swimming (1973). 9—Chassis of Netherland's VPR-765 Armored Infantry Fighting Vehicle is built by FMC in the United States (1977). 10—Yugoslav M-980 IFV resembles Soviet BMP, but uses French AMX-10P powertrain (1975). 11—Soviet BMD Amphibious Airborne Combat Vehicle (1970). 12— Italian M113A1 VCC-1 is based on Modified M113A1 APC chassis (1974). 13—Canadian Grizzly 10.5-ton Wheeled APC (licensed Swiss MOWAG Piranha) with 6 firing ports (2 each side and rear) is essentially a hybrid IEV-APC (1978). 14—Heavy 17-ton South African Ratel (Cape Badger) is world's first wheeled advanced IFV (1976).

8



9

10

1

12

13

14

Equipment Procurement in Britain

(Continued from page 11)

are in themselves not important enough to deny Acceptance. Approval, on the other hand, is normally given by the PE Director General responsible for development, when he is satisfied that the equipment is technically sound as a result, among other things, of technical trials.

Approval is given after Acceptance and indicates that the equipment is suitable for production and introduction into service. It is quite normal for certain limited Approvals to be given at an earlier stage to allow long lead items for production to be ordered so that there is minimum delay in starting production at the end of full development.

After Acceptance and Approval, and in very big projects after Ministerial consent, production is authorised and proceeds as fast as possible. For complex equipments most firms and Ordnance Factories produce pre-production equipment as a part of the production learning process and these equipments may well be used for the early stages of service training or for troop trials.

Troop trials are normally carried out by field units in different parts of the world under normal training or operational conditions after Acceptance. They are planned to test the way in which equipment matches tactics, organisations and logistics and vice versa, and also to prove the training methods used. If possible the equipments are the first off the production line and there should be a sufficient number of equipments to test them in realistic quantities.

Troop trials should ideally be complete before large scale production is begun but this is often impossible and defects found on troop trials usually have to be rectified by retrospective modification after the start of full production when some equipments are already in the hands of troops.

While pre-production and the first production batch is normally allocated to the developing firm where development has been done in industry, subsequent batches or the main production order will usually be put out to competitive tender.

Where R&D establishments have been the developing authority, production may be either in Ordnance Factories or in industry depending on whether the Ordnance Factories make that type of equipment or have the necessary capacity.

If production is in Ordnance Factories, it is normal for them to have been involved in the later stages of development. It is also usual for ROFs to incorporate many components and assemblies made in industry and the reverse is also true.

Defects will be reported from units in the field by means of a well-organised defect reporting system. When it is clear that a defect has been reported a significant number of times, the project manager responsible will make arrangements for the defect to be rectified by further design and development, carrying out trials to evaluate the rectification as needed.

Finance for this defect rectification programme is found from within allocations called Post Design Services (PDS) which are allocated on an estimated basis for each equipment in production. When the rectification has been accepted by the user, the project manager initiates production of modification kits, issues them to service and arranges for the remaining equipments in production to have the improvements incorporated.

Major product improvements are normally treated as new projects especially if they are mid-life improvements or particularly expensive. In these cases the normal approvals and procurement cycle requirements are invoked.

In very broad outline, estimates of expenditure in a financial year which begins on 1 April are prepared for approval by Parliament. Expenditure against those estimates is controlled by the Treasury and supervised by the Comptroller and Auditor General (C&AG).

During and after the financial year, Appropriation Accounts are prepared and subjected to three audits, initial audit by the payment agency, internal audit by the Staff of the Director General of Internal Audit (DGIA) and external audit by the Exchequer and Audit Department (E&AD) on behalf of the C&AG.

Finally, the E&AD pass the appropriation account with comments to the Public Accounts Committee, which is a parliamentary committee 15 strong, who make a report to Parliament on the efficiency with which government policy on expenditure has been carried out. In preparing this report the committee can and does question Accounting Officers about the transactions in their part of the account.

BRITISH 81mm lightweight mortar, weighing 35.44 kg (78 lb.), has a 15 rounds per minute rate of fire with standard UK ammunition to ranges up to 100 meters.

Compiling the Estimates is a year long process in which all those requiring to spend defence money in the next year put in their extimated requirements. These are consolidated under major headings of the Estimate which are known as Votes, because Parliament votes the money.

Each Vote has an Accounting Officer. The equipment votes are Votes 7-10 and the Accounting Officer is the Chief of Defence Procurement. Vote 7 is for PE Common Services (mainly Research, both intra and extra-mural, and intra-mural development) and Votes 8, 9 and 10 are Sea, Land and Air Systems respectively.

Thus MGO, although not formally the Accounting Officer, will control the preparation of Vote 9 Estimates and expenditure of allocated funds which cover land systems projects extra-mural development and equipment production expenditure including PDS for defect modification development and procurement.

Although Estimates are prepared and approved annually, financial planning is conducted on a longer term basis by means of the Long Term Equipment Plan (LTEP) and the Long Term Costing (LTC). The LTEP is a 10 year forecast of the quantitative requirements for equipment based on Unit Entitlements, Reserves and Repair Pools, as modified by MOD assumptions on changes in defence policy.

From the LTEP is derived the LTC which is rolling 10 year forecast of equipment expenditure including research, development and production. It is adjusted annually to take account of variations in future commitments, project cancellations, escalation of costs and delay and particular attention is paid to the first year of the LTC, which is next year's Estimate year.

It is practice to make considerable efforts also to refine the costing for the next two years as well, by eliminating such devices as wedges and block adjustments which are used in the later years to allow for uncertainty in compilation of costs.

The LTC includes planned projects which have not yet been approved, and an entry in the LTC is a necessary preliminary to obtaining endorsement of a project, as a means of showing that funding is available for it.

Estimates are for the actual expenditure (cash flow) expected in the particular year. Any money in the estimate not expended by the end of the year is lost and has to be reapproved in next year's Estimates.

Any over-expenditure in the Estimate year has to be covered by a Supplementary Estimate submitted to Parliament, and, needless to say, because an underestimate is considered to reflect on the Accounting Officers' efficiency, the Estimate is usually underspent and a significant proportion of the Defence Budget is lost each year.

A lack of flexibility in the rules for transferring money from one Vote to another, and within a Vote from one programme to another, and for bringing forward payment for work in progress means that, so far, all efforts to stop this leak of defence funding have been unsuccessful.

The LTC, each Vote and the Estimate as a whole are screened many times during their preparation to ensure that proper consideration is taken of priorities and finally discussions are held between the Service Departments, the Secretary of State, the Defence Council, the Treasury and the Cabinet before final publication of the Defence Estimates and presentation to Parliament in March.

Although CDP as the Accounting Office is ultimately responsible for the use of the funds that he controls the PE is organised in such a way that responsibility for the control of resources is focused at the Systems Controller level to who CDP delegates some of his financial responsibility.

Accountable management is maintained at lower levels by further financial delegation to Directors General, Project Directors and Project Managers (PM). Each of these is helped in his task by specialists in finance (Equipment Secretariat ES)), Contracts, Quality Assurance and so on.

Responsibility for day to day technical and financial management of development to approved plans and cost estimates rests largely with R&D Establishments, except where Prime Contractors are involved where responsibility rests with the Project Manager.

In the case of extra-mural development in aid of an intra-mural project, the establishment function is to monitor the work of contractors and ensure that progress is in accordance with agreed plans and approved cost estimates. Within establishments, project control is delegated to Development Project Officers (DPO) who will report failure to keep to time and cost to the PM.

It can be seen from the above that the Project Manager cannot reasonably be held fully accountable. This is because of the low limits to his delegated financial authority, because his freedom of action is, in practice, very circumscribed by his financial and contracts advisers who have other lines of responsibility and reporting in the event that the PM wishes to disregard their advice, and because the DPO is separated physically and hierarchically from the PM's staff.

Thus, the ability of a PM to manage his project in the way he wishes depends very largely on his own personality and his ability to "sell" his ideas to the "System."

Central Quality Assurance policy is determined by the Defence Quality Assurance Board (DQAB), chaired by DUS (Pol)PE and on which sit the PE Systems Controllers, the Director General of Quality Assurance (DGQA) and the Managing Director Royal Ordnance Factories (MDROFs). Responsibilities of the DQAB include:

Formulation of QA principles and procedures; Rationalisation of QA centres, laboratories, test houses and documentation; Specification of quality control requirements for major defense contractors; Maintenance of the Defence Contractors List; and Liaison with the British Standards Institution.

The engineering Quality Assurance Directorates are organised to cover the whole country on a regional basis under the supervision of Principal Quality Engineers (PQE) at Regional HQ and at the main Royal Ordnance Factories. Most QADs have service as well as civilians to ensure consideration of military aspects.

Expertise is fed into design teams at an early stage so that QA aspects can be catered for, and QADs also advise R&D Establishments on the production of satisfactory drawings, specifications and test schedules.

Recent QA policy has been to make defence contractors responsible for their own QA and this has led to a big reduction in government inspection.

As far as possible, defence contracts will only be let to firms which have passed certain assessments which are directly related to their NATO counterpart documents. The assessment of contractors is done by the Quality Assurance Directorates, and firms which pass assessment are entered on a List of Assessed Contractors (LAC), reviewed periodically.

Playing a major role in the scheme of things are the Royal Ordnance Factories (ROFs). These form a large manufacturing organisation with the main emphasis in the chemical and engineering fields, which will have an output in FY 1978-79 of approximately £370M($740M).

There are 11 ROFs under the control of a managing director (MD ROFs), who also controls the activities of two firms owned by the MOD but staffed and managed by industrial firms under an agreement.

The task of the ROF organisation is to manufacture munitions, stores and equipment for the British Armed Forces and, as authorised, for those of the Commonwealth and other friendly governments. Over part of their range of products the ROFs are the only UK source of supply and they also provide the main national reserve of capacity for a substantial range of munitions.

The ROFs are not solely manufacturing concerns, as design, development and experimental work is increasingly conducted with the R&D Establishments.

The ROFs operate under a trading fund and MDROFs are given the maximum possible discretion over the control of resources, including the investment of surplus funds, borrowing within prescribed limits, creation of reserves, discretion, in short, to manage the organisation to achieve the financial objectives even to the extent of taking on non-defence work to absorb temporary surplus capacity.

It has for a long time been government policy that the UK should wholeheartedly enter into international agreements and arrangements with a view to coordinated and cooperative equipment procurement. To that end the UK subscribes to the aims and methods of all the major international standardisation fora, and is committed to the principle of RSI. It is not necessary in this article to relate in detail how the aims of RSI are pursued, as much has already been written on the subject.

Much more could be written, indeed, about the British Procurement Organisation, covering such matters as contracts policy, production practice, control of research, defence sales, etc., but space does not permit.

It is important that the reader should be aware, however, that the United Kingdom still retains the ability to design, develop and manufacture the whole range of modern defence equipment, although for resource and standardisation reasons, some areas have in the past been and will in future be deliberately abandoned, at least for an equipment generation.

Pressure on the defence budget means that Britain has to be very selective in the areas of research which can be explored and will have to rely increasingly on coordinated and collaborative research within NATO to ensure that no promising areas are neglected.

Within these limitations the UK has a modern defence industry and government defence organisation, and well tried procedures for ensuring that only equipment which is acceptable to our forces and fits their needs reaches production.

BRIGADIER JONATHAN DENT, OBE, is Director of Munitions, Defence Equipment Staff, British Embassy. Commissioned into the Royal Armoured Corps in 1949, he has served with his regiment in Germany, Jordan, Libya, Borneo and Northern Ireland. He was also an instructor at the Royal Armoured Corps Centre at Bovington, Dorset. Additionally, he attended the Royal Military College of Science at Shrivenham in 1962-64, the Staff College Camberley in 1965 and the Royal College of Defence Studies in 1977.

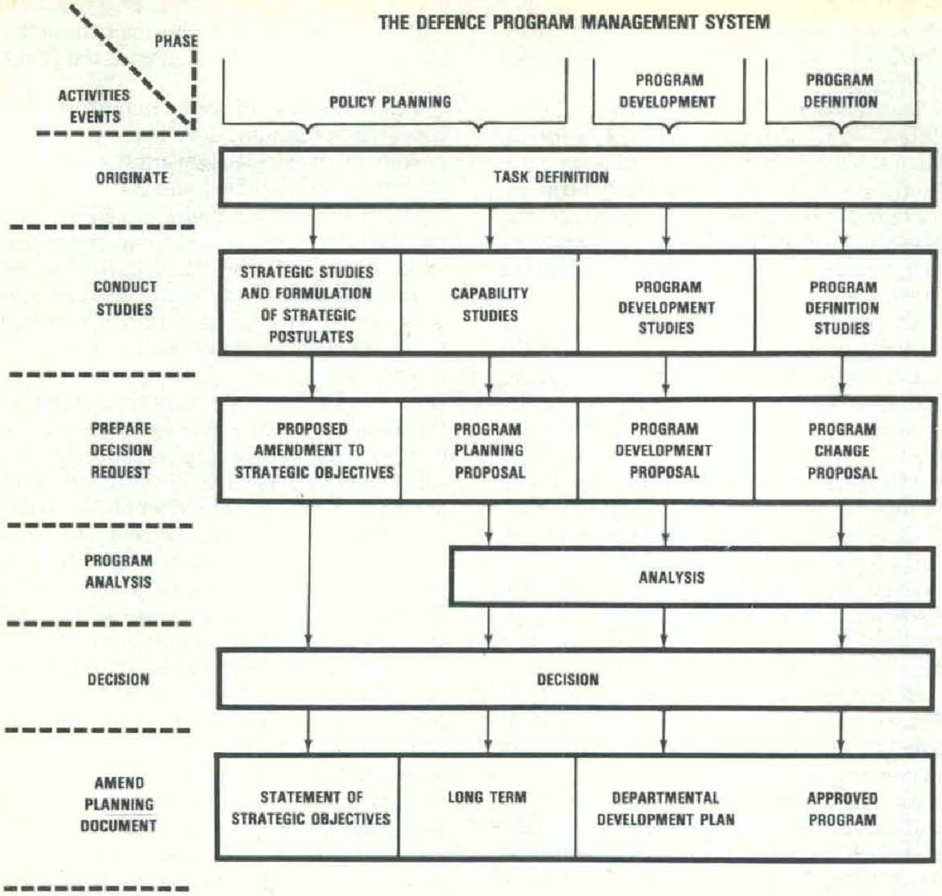


Fig. 1. The Defence Program Management System

Equipping the Army of Canada

(Continued from page 16)

some of the functions of the U.S. Office of the Secretary of Defense and Office of Management and Budget.

Funds are provided from the government's annual budget passed by Parliament and enacted into law. Canada's current and near future R&D and acquisition programs are diagrammed in Figure 2 in terms of dollars versus time. The one acronym therein, LRPA, stands for Long Range Patrol Aircraft. "Tank" represents the modified German Leopard 1 A3 or Canada C1 Leopard. The Armored Vehicle General Purpose ("Armored Vehicle") is made by General Motors of Canada based on a Swiss Mowag development (see Figure 3).

To further the technology and strength of Canadian industry, their Department of Industry, Trade and Commerce also participates in cooperative development programs for military equipment with U.S. armed services. Under this program, if the control for an agreed-on project goes to a Canadian contractor, the Canadian Government partially funds and manages the contract.

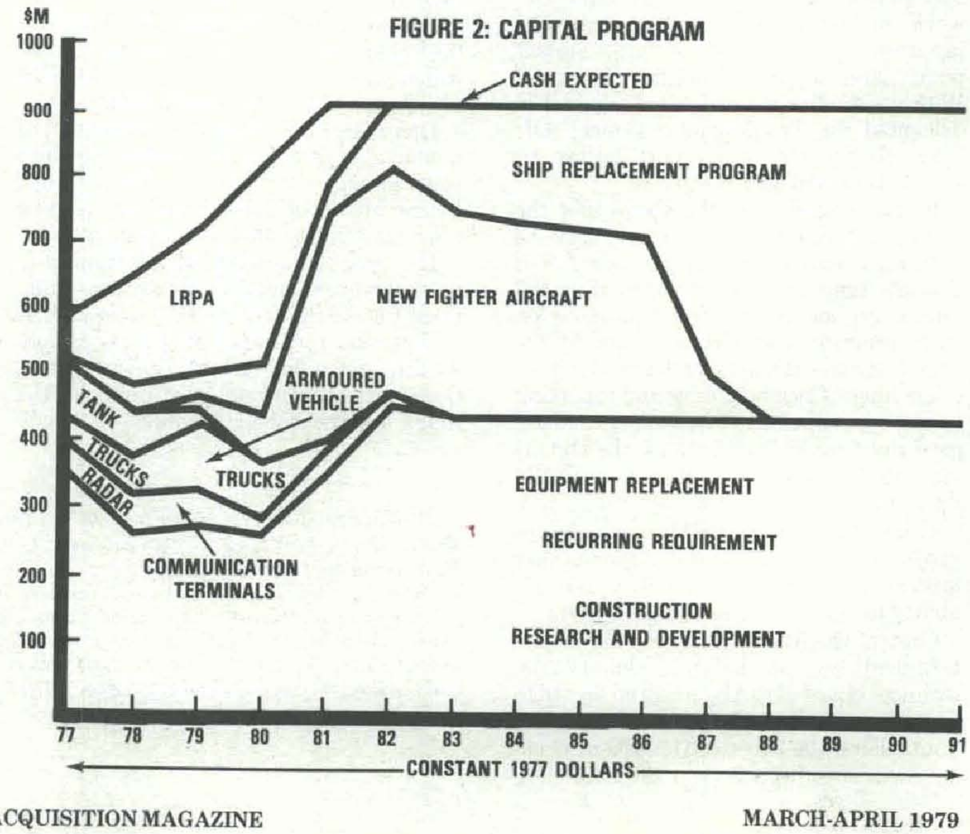
Based on a 1963 intergovernmental agreement, the overall U.S.-Canadian Defense Development Sharing Program's projects enhance the Canadian technology base and assist Canadian industry to prepare to compete on their own for following production contracts. The U.S. benefits through direct and lower development costs, sharpening of industry competition and broadening of the production base.

With some exceptions, Canada's industry cannot thrive on national work alone. It must compete for foreign markets. In the face of escalating costs and the ever increasing complexity of technology in the fifties and sixties, government policy has selectively supported promising industry capabilities, deemphasized others.

For example, Canada no longer attempts to develop and produce tactical fighter aircraft or tanks. However, they are excellent developers and producers of trucks, lightly armed vehicles, medium sized STOL transport aircraft, small gas turbine engines, advanced simulators, radios, individual equipment for the Arctic, oversnow vehicles and a host of other items.

Through this process of selectivity, Canada hopes to improve the balance between defence imports and Canadian-developed and produced defence exports. Some major offshore procurements, such as new aircraft, ships and armored vehicles, necessitate offset purchases by the selling country within Canada of non-defence items to prevent a major deficit in defence trade balance.

Recent government policy has multiplied national emphasis on enhancement of the technology base through irresistable tax incentives, stricter Canadian con-



tent and technology provisions for offshore procurements and direct funding. One manifestation of this heightened awareness and emphasis is the identification of centers of excellence for military R&D and production within Canadian industry.

These are companies which have exhibited strength, innovation and quality in functional research and engineering areas. Once so identified, government fund support is given in the form of both plant enhancement programs and specific development or procurement projects.

Finally, a word on RSI—Rationalization/Standardization/Interoperability. Adherence, support and pursual of these goals is clearly, definitely and officially stated policy, and the Canadian Forces pursue that policy very actively. They do so for the same reasons the U.S. does: threat, costs, and resource availability.

Priority is given to RSI considerations from the start. Efforts include information exchange, consideration of other countries' requirements, collaboration, cooperative development, emphasis on standardization and interoperability, cooperative production and cooperative logistic support.

The U.S. Army is represented in Canada for R&D and cooperative development by the U.S. Army Materiel Development and Readiness Command's U.S. Army Standardization Group-Canada located in the nation's capitol city, Ottawa, collocated with Canadian National Defence Headquarters.

COL ROBERT W. NOCE is commander of the U.S. Army Standardization Group, Canada, Ottawa, Ontario. A graduate of the U.S. Military Academy and an honor graduate of the Industrial College of the Armed Forces, he holds a master's degree in mechanical engineering from Georgia Institute of Technology. His past assignments have included project manager, Vehicle Rapid Fire Weapon Systems, and project manager, Sheridan.

Deputy Under Secretary of Defense (R&E) Discusses NATO Initiatives

Principal Deputy Under Secretary of Defense (Research and Engineering) Gerald P. Dinneen recently spoke on the "U.S. Department of Defense Research and Engineering Outlook and NATO Initiatives" at a meeting of the American Institute of Aeronautics Astronautics. A synopsis of his remarks follows:

The Deputy Under Secretary began his presentation by stating that Soviet military expenditures since 1970 have clearly exceeded U.S. expenditures. Today, he said, Soviet expenditures may exceed those of the U.S. by as much as 40 percent. This creates an observable disparity in our R&D efforts, in military equipment production rates, and in the quantity of military forces deployed, he noted.

In order to offset this imbalance in spending and to maintain a stable world balance of power, the U.S. must capitalize on three of its fundamental advantages. These, stated Dinneen, are its industrial base, its technology, and its allies.

A major emphasis with respect to the industrial base, he stressed, will be to increase the degree of competition over the next few years in order to reduce weapon costs and development time. Said Dinneen: "We are confident that industry can achieve significant cost and schedule savings when faced with competition."

He added that there has been a tendency in recent times toward less competition in defense acquisition. In order to provide more effective use of competition, several initiatives have been undertaken. These include greater use of competitively-derived design concepts at the front end, increased competition in procurement, and a 4-step source selection process.

Relative to the second fundamental advantage of the U.S.—that of technology—Dinneen noted that the U.S. will continue to emphasize high leverage technologies which promise "revolutionary" new weapons. High priority areas will include very high speed integrated circuits, advanced composite materials, and manufacturing technology.

The most significant promise for offsetting Soviet weapons production advantages is through NATO Alliance cooperation in weapons acquisition. He stated that the real challenge is to create an improved program of cooperation in development and procurement.

Dinneen cited five basic objectives regarding the NATO Alliance which he suggested should

Gerald P. Dinneen

be kept in mind. They are: to strengthen the military, political and economic cohesiveness of the Alliance; to develop Alliance forces capable of coalition defense; to rationalize development and procurement within the Alliance; and to capitalize on Western industrial technological strengths.

Three of the most prominent initiatives recently undertaken by the U.S. and its allies to enhance NATO are:

• **LTDP.** The first and most talked about initiative, according to Dinneen, is that of the Long Term Defense Plan. Adopted in May 1978, this is a broad action program which will extend over a number of years. All participants have committed themselves to a real 3 percent increase in defense expenditures.

Much of the LTDP is focused on upgrade of readiness, quicker reinforcement, and better logistics cooperation. However, one-third of the LTDP actions call for development and acquisition of new equipment.

• **USD (R&E) Approaches.** The second initiative, under the leadership of the Under Secretary of Defense for Research and Engineering, is three new approaches to improve cooperation. These approaches are a series of Memoranda of Understanding in arms development and procurements, dual production of existing systems on both sides of the Atlantic, and creation of a Family of Weapons concepts.

The purpose of the Memoranda is to open the defense market of each country to international competition and to facilitate industrial cooperation among the defense industries of the NATO countries. Thus far, MOUs have been negotiated with the U.K., Canada, Germany, Norway, the Netherlands and Italy.

Relative to dual production, Dinneen said that if one nation has developed a system which meets the needs of other nations of the Alliance, the developing nation could make its system available for production by other countries. Dual production, he stressed, is not necessarily the lowest cost production alternative. Rather, the savings are in nonduplicative R&D costs.

The Family of Weapons concept, explained Dinneen, is to examine mission areas to find operational requirements which can only be satisfied by more than one of a "Family of Weapons." When the needs of the U.S. and at least one European country coincide, the U.S. would develop one of the required weapons in the family while a European country or consortium would develop the complementary weapon system.

• **Armaments Planning.** The third initiative is the introduction of a process for planning and programing important NATO research, development, and procurement actions. Such a process, stated the Deputy Under Secretary, will be tried this year within NATO.

Dinneen concluded his presentation with a brief discussion of some of the major concerns regarding U.S. cooperative programs with NATO. Some people, he said, have expressed concern that cooperative programs mean loss of U.S. business and jobs. We believe this will not happen, he said.

He added that the danger to U.S. business and jobs is more real if we do not improve cooperation, because Europe has both the technological capability and political need to build a large portion of the equipment their nations need.

A second concern—that of technology transfer—must also be addressed, stated Dinneen. "We must be prudent in the transfer of technology. We must consider technology transfer not only in terms of the risk of compromise and threat to our competitive position, but also in terms of the risk to NATO effectiveness if our policies are too restrictive."

In closing, the Deputy Under Secretary reminded his audience that the 1976 Culver-Nunn legislation established new U.S. policy. That policy, he said, is that equipment procured for use by U.S. troops in Europe should be standardized or at least interoperable with equipment of other NATO nations.

TECOM's Quest for RSI in Testing

TECOM representatives listen to briefings through a translator during a recent visit to Germany's Bundesamt für Wehrtechnik und Beschaffung (BWB) in Koblenz. Seated from second left, background, are Robert Cook, chief, International Materiel Evaluation Division; MG Patrick Powers; Benjamin Goodwin, chief engineer; and Keith Dixon, engineer.

By MG Patrick W. Powers
(USA, Ret.)

In the clear blue sky over New Mexico, a nimble Roland missile streaked after a drone target. In Utah, a cluster of smoke grenades popped into a dense white curtain, enshrouding a group of sensing towers. On a test course near the Chesapeake Bay, an 8-wheel-drive supply truck lugged a 20,000-pound payload through deep mud.

These activities would be business as usual for the U.S. Army Test and Evaluation Command (TECOM), which conducts thousands of military hardware tests each year, except that Roland, the smoke grenades and the truck are not American products—they are developments from U.S. Allies.

These tests represent a new facet of the TECOM mission which yields, in addition to highly sought research data, still another opportunity for the Army to demonstrate its commmitment to NATO Rationalization, Standardization, and Interoperability (RSI).

The International Materiel Evaluation (IME) Program, an effort to expand RSI possibilities, came under TECOM management in early 1977 so that foreign items could be tested and evaulated under a comprehensive and unified program. To maximize the potential of this program, TECOM knew that it should seek a solid orientation to U.S. Allies' weapons development and testing.

To this end, and to further cooperation among allies in the materiel development and acquisition process, a TECOM team visited Germany, the United Kingdom, and France—three of the European nations that produce equipment for NATO.

Taking advantage of technology and equipment from across the Atlantic has occurred in the past. The Continental Army, for instance, depended heavily on France for Charleville muskets, field artillery, and much of the ammunition that kept it in action.

In World War I, Army aviators Eddie Rickenbacker and Frank Luke made history in French aircraft, while in the trenches below, many American infantrymen carried British Enfield rifles, and field artillarymen fired French 75 and 155mm cannon. World War II saw the British hound enemy submarines in American-built destroyers and Americans track enemy aircraft with British-developed radar.

Since NATO was established in 1949, Standardization Agreements (STANAGs) have led to the sharing of both operations and equipment on a more formal basis. The more than 500 agreements ratified by this country so far, have made possible some joint development of equipment and interoperability of munitions. The Mutual Weapons Development Data Exchange Agreement (MWDDEA) augments the STANAGs by making possible exchanges of test information.

The International Materiel Evaluation program follows quite naturally this progression of individual agreements. Under its authority, TECOM formally began testing and evaluating foreign items.

By April 1977 the British 81mm mortar completed its initial tests and evaluation, to become the first in a continuing series of foreign equipment evaluations. Among others, TECOM engineers have lately been examining two models of Sweden's Small Unit Support Vehicle for cold regions operations.

As TECOM sought an understanding of the foreign test philosophies that produced some of this materiel, the TECOM team approached them from the perspective of its own test philosophy. For U.S. Army developments, TECOM is an independent tester and evaluator; it does not develop materiel.

TECOM's sister commands, under the U.S. Army Materiel Development and Readiness Command (DARCOM), conduct the research and development of projects and then send them to TECOM.

TECOM then carries out tests to see if an item meets its specifications, U.S. Army requirements, and that the engineering design and development process is complete.

To reduce time and costs, TECOM has adopted the Single Integrated Development Test Cycle (SIDTC) concept. This system identifies problems early in development by integrating the civilian contractor, the military tester, and the soldier-user in simultaneous testing where possible.

A Test Integrated Working Group (TIWG), chaired by the developer, generates key documents for test planning and coordinates the interests of the testers, the developers, the contractors, and the commodity command with DARCOM.

TECOM also conducts an evaluation of

SWEDISH Small Unit Support Vehicles (SUSVs), the BV206 (left) and the BV202, at the Cold Regions Test Center, Ft. Greely, AK, during tests conducted by TECOM, under the International Materiel Evaluation Program (IMEP).

GERMAN M. A. N. truck rolls up mileage during TECOM tests at Aberdeen Proving Ground, MD. The 8-wheel drive, 10-ton truck is being tested under the IMEP.

the test results for all but major or specially designated projects (about ten percent), which are evaluated by the Army Materiel Systems Analysis Activity. Findings, are forwarded to the appropriate decision-making body, such as the Army Systems Acquisition Review Council (ASARC), or the Defense Systems Acquisition Review Council (DSARC).

TECOM carries out its mission at nine installations and activities that are equipped with sensitive instrumentation and feature all types of terrain and climates for testing.

Two of several computerized information management systems, the Test Facilities Register (TESTFACS) and the Test Resource Management System (TRMS), keep the development community informed on tests and facilities.

Against this work pattern as a measure, the TECOM team made its first stop in Germany. Ingenuity and expertise have characterized German military equipment for hundreds of years, and today's developments uphold this tradition.

The German Ministry of Defense (MOD) assigns the military materiel management function to the Bundesamt für Wehrtechnik und Beschaffung (BWB). A civilian organization, BWB is headquartered at the juncture of the Rhine and Mosel Rivers in Koblenz.

With the exception of some nuclear-biological-chemical research and development conducted by BWB, all R & D and production of materiel for the MOD is performed by industry. BWB uses a management-by-team concept to monitor development programs for all services.

Six commodity-oriented technical divisions carry out the project management and each operates a proving ground, "Erprobungstelle," devoted to its particular commodity. A BWB Quality Assurance Directorate generates quality assurance specifications that it requires industry to follow.

A typical German materiel life cycle begins with a definition of a tactical requirement by the Army staff or Materiel Office of the Army. BWB then defines specifications for the industrial contractor, who produces and tests a first experimental prototype.

Results of these contractor trials are considered during construction of the next prototype. This improved item undergoes the BWB-conducted Technical Trails, which measure it against specifications, at one of the proving grounds. If successful, these tests result in a declaration of acceptance and start of service trials, which are roughly equivalent to U.S. Army Operational Tests, testing with soldiers in field conditions.

Technical trials include measurement of static and dynamic performance and climatic tests in extreme temperatures. In support of the measuring requirements inherent in the testing business, BWB has recently developed a comprehensive instrumentation calibration program to set all instruments to primary standards.

Determined by the Armed Forces Calibration Committee, these standards will go a long way toward making Germany's test results more useful to its allies as well as between its own agencies.

German test facilities, the TECOM team noted, have developed several innovative instruments and facilities tailored to the needs of test programs. At Proving Ground 51, on the Mosel River, engineer, amphibious, and logistics equipment run the test gauntlet. Engineers have developed a special ramp that simulates a variety of streambanks. By adjusting this roadway to different inclinations, testers can measure the angles at which vehicles can enter and exit the water.

Many programs and facilities, however, bear close resemblance to those in TECOM. Proving Ground 41, near Trier and the Luxembourg border, carries out testing not appreciably different from U.S. testing. The team saw trucks and armored personnel carriers working out on a modern, well developed proving ground similar to the Munson Test Area at Aberdeen Proving Ground, MD.

An automotive laboratory supplements the test facilities at Trier by providing additional resources to examine vehicle drive trains and engine components. To help collect and reduce test data, Trier will soon bring an automatic data processing (ADP) system into full operation, and eventually it will link Trier with BWB.

Recognizing similarity between the Trier ADP system and our own TRMS, the TECOM team suggested cooperation through an exchange of information on ADP systems for test data handling. The team also noted significant potential for standardization of instrumentation calibration and automotive testing.

The Germans have already expressed their willingness to standardize by adopting some U.S. military standards (U.S. MILSTD 810C) and the Western European Union standard for wheeled vehicles.

The TECOM team next visited the United Kingdom. This NATO ally has enjoyed a reputation for its well trained and well equipped military force since the middle ages.

The organization responsible for providing that equipment is the Procurement Executive for the Army Materiel under the Secretary of State for Defence in the Ministry of Defence.

The Procurement Executive has three commodity-oriented controllers responsible for procurement in their respective areas. They are: Controller of the Navy, Controller of Aircraft, and Master General of Ordnance (MGO). A fourth, the Controller of Research and Developments Establishments and Resources (CER), conducts the research through testing phase of materiel and controls the government-owned-and-operated Royal Ordnance Factories.

Operating under a project management program similar to ours, the U.K. Army manages its major projects at the Ministry of Defence level. Subordinate panels, under a project steering committee, perform various functions along the acquisition process.

One of these panels, the Trials Panel, like our TIWG, draws up the trial specifications, designs and oversees the conduct of trials, and evaluates the results.

When testing begins, it falls into two categories: Research Trials, roughly equivalent to U.S. testing in early phases, include establishment trials and some field testing. Development Trials consist of technical evaluation trails, and troop trials.

For weapons and ammunition, Ordnance Board Trials, a special type of development trials are also conducted. At various points, committees similar to our ASARCs and DSARCs review testing.

The Director for Material Quality Assurance (DMQA) monitors production and occasionally conducts quality assurance own testing. Test Facilities also come under DMQA scrutiny for calibration and general operation.

Though they principally conduct proof testing of production weapons and ammunition, the Proof and Experimental Establishments (P & EEs) lend their ranges and facilities to research and development establishments and other customers for testing of weapons, munitions and equipment.

The TECOM team visited Shoeburyness, one of five P & EEs, where the U.K. proofs artillery and tank weapons—some of the first tanks designed were tested here in World War I. Among the remarkable facilities were a "soft recover" artillery range, consisting of tidal sand.

At high tide, projectiles can be fired into the water. At low tide, when the water recedes, the projectiles can be recovered. One of the Shoeburyness tenants, the Environmental Centre, conducts a wide range of physical and climatic trials (storage and drop tests, for instance) to measure materiel against standards similar to U.S. standards.

A slightly different kind of establishment headquartered at Chertsey, the Military Vehicles and Engineering Establishment (MVEE), takes charge of R & D of all armed services vehicles. Like the German facilities at Trier, many MVEE facilities duplicate those at APG, particularly in the test course area.

One of the instruments that caught the visiting team's attention, measures the dust environment by analyzing particle

(Continued on page 28)

TECOM's Quest for RSI in Testing

(Continued from page 27)

size and density for display on a cathode ray tube. This fine example of U.K. test technology is one reason TECOM is anxious to follow with a comprehensive program for test information exchanges.

Generally speaking, the U.K. proving ground equipment and techniques, in combination with the stringent quality controls monitored by the DMQA, indicate a refined testing program with philosophies and facilities fundamentally compatible with our own.

Having gained a deep appreciation for both Germany's and the U.K.'s military materiel development processes, the TECOM team went on for the final leg of their mission to France, our oldest ally. The nation that produced our own Statue of Liberty also produces excellent military materiel through an interlocking relationship between the military and industry.

The Direction Technique des Armements Terrestres (DTAT), the technical directorate located in the Paris suburb of St. Cloud, administers all Army materiel development and production. The DTAT interfaces with industry through the Groupement Industrial des Armements Terrestres (GIAT), an association of ten industrial concerns combined under central control.

Each of the ten specializes in a different discipline relating to armament or its equipment, providing DTAT with a wide range of capabilities for materiel development and production. Industrial assets operated by GIAT belong partly to the government and partly to private concerns.

DTAT carries out the French Army's test and evaluation mission at one of four subordinate technical test centers, which are organized to accommodate telecommunications equipment, vehicles and related components, aircraft, and weapons. At these centers, project managers and technical experts, both civilian and military, hold career positions in the materiel development and testing field. In contrast, TECOM's military members rotate regularly to and from field billets.

The Etablissement Technique de Bourges (ETBS), about 200 kilometers south of Paris in the center of France, gave the TECOM team an example of how the French system works at technical test center level.

When Army headquarters has a weapons requirement, the weapons-related GIAT element, also at Bourges, is tasked with conducting the weapons system design studies and the development program, including building the prototypes.

The Centre Technique Arms and Munitions (CETAM), at ETBS, concurrently details the specifications and develops the testing and evaluation plan, coordinating to some extent with the user. ETBS performs the actual testing, and results go to CETAM for evaluation.

The Army staff then conducts its own evaluation, sometimes requiring additional testing with troops at ETBS, before Army headquarters makes the final decision whether to adopt the system.

A wide range of testing and laboratory facilities, augmented by fine instrumentation, gives ETBS an excellent capability to perform a variety of weapons testing. The center has developed a good instrumentation calibration program, and backs it up with an ADP system for maintaining calibration status.

One of the admirable ETBS-designed instruments incorporates laser technology to support small missile testing. Its laser-reflection system records the pitch and yaw of missiles in flight at ranges up to 100 meters.

Like their allies, the French keep a watchful eye on testing and production for quality assurance. An organization separate from the producers and the testers, the Service de Surveillance Industrielle de L'Armement (SIAR), monitors production, executes the quality assurance function with GIAT and controls the issuance of production items to the field.

Quality controls, excellent test facilities, and innovative instrumentation available in France contribute to a progressive and responsive materiel development and testing system. As French-German joint developments such as the Roland air defense system and the Argus radar system demonstrate, the French organization works well with other counties as well as independently to develop quality materiel.

Recognizing their lack of range space and facilities for testing in the natural environment, French engineers expressed their interest in taking advantage of TECOM's expansive facilities at White Sands Missile Range and Yuma Proving Ground. TECOM, it turn, expressed interest in performing some U.S. testing for IME programs at French centers and encouraged further discussions that would lead to an exchange.

The TECOM team visit then, generally confirmed the expectation that the principles behind NATO standardization may be advantageously applied in materiel testing. Despite some differences in test criteria, procedures, and calibration, many of the programs and equipment facilities are similar to our own.

This similarity makes it practical and desirable, when time or cost factors indicate, to use foreign proving grounds to conduct, or have conducted, tests of materiel that we procure from our allies. Basic informational exchanges, such as the MWDDEA, will be augmented, and TECOM has provided copies of our Test Operations Procedures and our recently completed Project Engineers Handbook to our Allies.

DARCOM currently accepts technical experts from Germany, but so far this personnel "exchange" has been one-sided. By sending our scientists and engineers abroad to selected facilities, we could complete this informational cross-pollination and bring home some valuable test technology as well as sharing our own.

Long-range benefits of joining forces for materiel testing include potential maximization of scientific, industrial, and economic resources. The reduction in cost accruing from reduction in redundancies will lead to an invaluable increase in NATO's overall effectiveness.

Of course, combining our efforts for more efficient materiel testing will not be without problems. We must contend with differing languages, legalities, and logistical systems. Even national geographies, tactical concepts, and diplomatic policies will bear on plans for cooperation.

TECOM's trans-Atlantic tour through foreign test facilities took but a single step toward overcoming these obstacles, but it took a step in the right direction. If we are to be ready to stand shoulder-to-shoulder with our Allies on some future battlefield and expect victory, we must stand shoulder-to-shoulder with them today on the test ranges and in the labs.

(EDITOR's NOTE: Early in its new International Materiel Evaluation mission, the U. S. Army Test and Evaluation Command (TECOM) visited the Federal Republic of Germany, the United Kingdom, and France. The team, headed by MG Powers, consisted of Benjamin S. Goodwin, chief engineer; Robert C. Cook, chief of the International Materiel Evaluation Division; and Keith T. Dixon, an engineer.)

MG PATRICK W. POWERS, until his retirement from the U.S. Army in November 1978, had served since September 1975 as commander of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD. Graduated from the U.S. Military Academy in 1945, he has authored numerous articles on guided missiles and other military subjects, including A Guide to National Defense, a book used by the National War College.

An Analysis of:

The Importance of RSI

(Continued from page 3)

lugs, nor the same firing voltages for our munitions. If we in the advanced development business were thoroughly committed to RSI, these things would happen automatically.

Although RSI is now thoroughly and thoughtfully implanted in our Army program offices, it is a learning process just barely started with our technologists. It is not made easier by being separated from our allies by distance, culture, and bureaucracy, and by lack of easy contact, sameness of language or travel funds.

If RSI is to happen early in design, it will take an active effort on the part of each technologist of the R&D community. It is that extra special effort that I hope to encourage.

This imputed lack of interest in RSI does not exist in the project offices of DARCOM and TRADOC. Presumably, this is because they are one step closer to the troops in the field who clearly know the reality of interdependence on their NATO allies.

An absolutely fabulous job is being done by most, if not all, of the program managers to ensure that our European allies are offered the technical and economic opportunity to use our developments. XMI, IFV, Roland, Stinger, GSRS, AAH, all are great examples of the RSI problem being effectively worked.

However, these programs themselves suffer because the interest of our allies was not dominant in the early stages of these developments.

In the presumption that many readers are or will be interested, let me take a moment to describe the principal mechanisms through which RSI opportunities in advanced technology can be developed.

The organization for armaments cooperation within the NATO alliance is substantial in size and breadth of scope. To describe in detail the totality of the NATO cooperative armaments structure would require more space than afforded by this article, and its reading more patience than expected of any reader. However, here are the main elements.

The *Conference of National Armaments Directors (CNAD)* is the senior civil body under the North Atlantic Council concerned with making best use of Alliance resources in development of defense equipment.

The CNAD has three single Service oriented groups under it. These are the NATO Naval Armaments Group, the NATO Army Armaments Group, and the NATO Air Force Armaments Group. There are also three multi-service groups—the Defense Research Group, and the Tri-Service Groups on Air Defense and Communications and Electronic Equipment.

These groups have in turn panels beneath them. They exist in such numbers that almost every conceivable area in which an Army technologist might work has an international Alliance forum.

These panels publish their findings, and these publications are easily available. The panels also support symposia and other forms of informative exchange. So there is an opportunity to interchange ideas with our allies if we try.

In addition to the foregoing main governmental groups, the *NATO Industrial Advisory Group (NIAG)* has been constituted under CNAD from representative industrial leaders of the Alliance both on business topics within the field of armaments cooperation.

The concept of CNAD is strongly backed by the U.S. and our allies. Meetings by the CNAD main groups and subsidiary bodies represent approximately 8,000 total man-days per year.

Because of the great dimensions of this interchange, it is primarily through these CNAD bodies that U.S. and Canadian information becomes available to a wide range of European countries. Knowledge of the military technology of our allies also becomes available to us.

However, there is another body within NATO, this time on the military side. It also facilitates technical information interchange among alliance nations. It is the *Advisory Group for Aerospace Research and Development (AGARD)*. Its principal mission is to provide scientific and technical advice to the Military Committee. It also promotes interchange of information in science and technology relating to military aerospace.

AGARD provides, through its panels, a means of integrating the aerospace technology of member nations for common utilization. It is a forum of uncommon competence representing the foremost experts of each member nation.

AGARD's proceedings are internationally accepted as state-of-the-art documents of high merit. These volumes are easily available to the Army technologist, our preliminary designer. Their reading cannot only be professionally enhancing, but can also acquaint one with the Allied technical peers who can join with their American counterparts to make a sensible application of RSI.

Under the aegis of the Military Committee is the *Military Agency for Standardization (MAS)*. There is yet one more body which for years has worked for common use of alliance technical response. MAS has promulgated Standardization Agreements (STANAGs) on procedures, doctrine, and equipment characteristics aimed at providing various levels of standardization, interoperability, or compatibility.

Most of the STANAGs are established through MAS bodies, but some of the work on equipment STANAGs is undertaken by bodies under the CNAD. These STANAGs can, in many cases, provide a point of departure for the development of future armaments to be produced by European nations.

Although they apply only to developed items, STANAGs and STANAG procedures must be understood by the technologist who has as his objective the putting of hardware into the field.

These preceding paragraphs have been a short introduction to the technologist of the mechanics of NATO RSI. There is much, much more to learn if one chooses to do so. This article cannot, nor can DARCOM or the DA Staff, make the technologist and preliminary designer think and act seriously with respect to RSI.

The desire to design for cooperative warfare, or what we today call by the "buzzword" RSI, can only come if there is a belief in its importance. This can come only if you have an ingrained interest in understanding whether you are working the "right" problem or not.

So what I ask by this article is for you to consider how you can best help the Army fulfill its difficult commitments to participation in the NATO Alliance. Given this consideration, I am confident that the proper balance can be worked out. Such a proper balance in RSI has already been successfully worked out in the program offices so there is no reason that it cannot be done for early technical work.

To conclude, my challenge to you is to think seriously about the RSI issue. If you think that

$$\dot{A}_{RSI}(t,l) = \frac{d}{dt} A_{RSI}(t,l) = \frac{k_s 10^{-N_{DSARC}}}{S_R/S_C} i_{RSI} \int_0^{+} \frac{e^{K_\tau \vec{p}(t)}}{V_{ai}} dt$$

when $l \neq l_{HASC}$, and

$$\dot{A}_{RSI} = A_{RSI} = 0$$

When $l = l_{HASC}$

is nonsense, find in your mind a more responsible position on RSI, and then go do something about it.

DR. WALTER B. LABERGE has served as Under Secretary of the Army since July 1977, following a prior assignment as Assistant Secretary General for Defense Support at NATO. He has also been a member of the U.S. Air Force Scientific Advisory Board, and the Chief of Naval Operations Industry Advisory Committee. His academic credentials include a BS degree in naval science and BS and PhD degrees in physics, all from the University of Notre Dame.

DARCOM & RSI

(Continued from page 4)

RSI PROBLEM AREAS

Policy Guidance re:

- **Differences in U.S./Allies Procurement Policies & Objectives**
- **Agreement on Required Capabilities of New Items**
- **Implementation of Balance of Procurements**

European nations, however, favor the "chosen instrument" approach in which source selection is not necessarily made on a competitive basis. Some nations have statutory or contractual practices which favor the development contractor in the early production stage, thus hindering competition, while the U.S. practice is to carry competition as far down the acquisition process as is possible without prejudice for or against anyone.

Compounding the problem of the "chosen instrument" approach is the existence in most European nations of legislation which severely discourages rapid expansion or contraction of a contractor's labor force. Thus steady employment, rather than optimum procurement rates, is the dominant consideration in acquisition awards and scheduling.

A second problem, perhaps more easliy solved than the first, is attaining agreement on the required capabilities of the equipment to be purchased or improved. In part, the difficulties are due to a differing assessment of the threat and the use of varying doctrines and tactics which are based on national military experience and judgment. While such differences by no means preclude multinational cooperation in procurement, they do result in reduced participation in collaborative projects. Since each nation is rightly concerned about the lives of its men and women who might have to use the systems developed, each seeks to avoid temporizing capabilities which are felt necessary to protect its citizens. In short, even with the best of efforts, standardization and even interoperability must be victims of perceived required operatonal capabilities.

Of course, some definite progress has been made in solving these problems through direct talks between military staffs. In progress at this time are the German-U.S. Bilateral Staff Talks which are attempting to harmonize tactical concepts, develop materiel requirements and, fulfill these requirements through some form of collaborative effort. These talks are now concentrating on materiel cooperation. In addition, talks with the United Kingdon are underway, and we are investigating areas of common concern which might result in similar discussions with the French.

Still another unresolved issue is the implementation of the "balance of procurements" or the "two-way street." In many ways, this concern involves the broadest spectrum of issues, including one already mentioned—trading military capabilities to promote RSI. I doubt that endeavoring to balance procurements on each side of the Atlantic just to achieve a balance will provide the best equipment at reasonable cost. Ideally, the criteria which ought to be employed for selection of firms during a competitive bidding process should not only address cost and promised performance but also who has the leading technology and who has the most efficient machinery and production techniques. But we must recognize that this is not an ideal world and that our European allies will continue to insist on their right to participate.

In any event, we should encourage free competition in Europe and in America as agreed in the general Memoranda of Understanding already signed. Solicitation for bids should be widely advertised, perhaps in some type of international "Commerce Daily" so that any interested business would be able to find such proposals easily.

Further, the "two-way street" must really be that. And it cannot be simply viewed in terms of materiel flowing from Europe to the U.S. and vice-versa. The protection of the technology base, or adequate compensation for its dissemination, no matter to whom it belongs, is a paramount question for the respective industries who are expected to incorporate their knowledge and techniques in executing these contracts.

My point in citing these problems (which definitely are not the only ones in attempting to implement RSI) is not to discourage consideration of RSI in our procurements but to emphasize that real difficulties exist. We *must* consider RSI for all acquisitions, but on the other hand we must not feel obligated to use it simply because it is there. Common sense must prevail; the military and economic benefits must be weighed against such liabilities as program stretch out (and therefore probable increased costs) and the effect on our adversaries. It is much more costly for them, as an example, to contend with numerous detection radars than with simply one model.

Although there are obviously no easy solutions, the hurdles are not impossible to overcome. But a major and concerted effort is required by all levels within the Defense Department in conjunction with the Congress, business, and labor organizations.

First, the various services must know the contents of government-to-government memorandums of understanding which apply to acquisition policy and procedures. In fact, the services should be a party to such discussions or at the very least should be kept abreast of the progress and topics being considered.

Specific guidance must be provided the operators on the mechanism for implementing and controlling the advancement of projects which include RSI. This does not mean becoming involved in the daily workings of these projects, but the provision of an overall program mechanism which the operator can follow and still adjust to the peculiarities of individual projects.

More information, earlier in the cycle, must be provided to business and labor by the Defense Department. They need to know, they have a right to know, and DOD should actively solicit their considered responses to RSI initiatives. A possible way to accomplish this objective is to hold various symposia for large and small businesses, meetings which include representatives from the various services and their acquisition activities. Business and labor ultimately pay the bills and do the work. They are most directly affected by the economics of employment and the technological risks of RSI. Not to include them as fully as possible can only result in the uncritical abrogation of all RSI endeavors, even those which hold the greatest military and economic benefits for ourselves and our allies.

If thoughtfully employed, RSI can succeed. But it requires full commitment to insure its implementation in a manner which, while increasing the military and industrial preparedness of the free world, does not penalize any nation for its technological prowess or compromise its economic health. Success involves political will and economic cooperation with NATO's military strength as the focal point. But information and education—a two-way street on how to implement RSI—is needed right now within the American political, economic, and military spheres. This is our immediate challenge; only when we have our own procedures rationalized can we confidently approach our NATO partners and solicit an equally confident and well considered response.

RDA in the Smaller NATO Nations

By LTC J. F. Corby

The RDA processes of NATO's major powers are covered by individual articles. However, NATO is a 15-nation organization, and the armed forces of the smaller nations play an integral and vital role in NATO's operations. To that end then, this article summarizes the limited RDA activities of these smaller NATO powers.

RDA within all the NATO armies is accomplished through means and processes which are similar, for the most part, in logic, pattern and execution. RDA generally begins with a conceptual need for an equipment. A feasibility study will usually follow, and may lead to a validated statement of a requirement.

Hardware development, if appropriate, is then undertaken with milestone events and decision points marked at critical junctures throughout the development process, finally leading to production, procurement, and deployment. This is a logical, well-established order, and is the pattern for RDA by all armies. The exception is Iceland, which does not field an Army, and thus has no Army RDA activity.

Dissimilarities in RDA between nations lie not in the order of events, but in the magnitude and scope of activity. These latter are driven by national policies and priorities, economics, industrial capabilities, the technology base, and the forces of international competition for domestic and foreign markets. It is the difference in scope and in magnitude of RDA activity which divide, in an RDA sense, the major producing nations from the smaller nations and which further subdivide the smaller nations.

The level of research performed by the smaller nations varies considerably. The bulk of the research conducted by this group is done by industry. Most nations also sponsor some modest level of research within the academic scientific community. Government (in-house) defense research facilities in many of the countries, notably Belgium, Greece, Luxembourg, Portugal, and Turkey, are minimal.

Denmark and Norway have very good government research programs; these are mainly devoted to operational research/systems analysis studies to identify or validate threats and requirements. In both Italy and the Netherlands, government research is more extensive and comprehensive than the others, yet relatively small in comparison to that of the major nations.

In all these countries the research effort is rather selective and principally directed toward support of existing development capabilities, that is, project oriented rather than theoretical research.

The defense industrial base of each of these countries is, of course, diverse, but there is a preponderance of capability in certain areas. These include light armaments, vehicles and electronics. The examples to follow are by no means a complete or all-inclusive listing.

Belgium is a major arms producer of small arms, machineguns, mortars and artillery. Denmark has a highly developed electronics industry, including avionics. The Netherlands is strong in production of heavy wheeled vehicles and communications equipment. Italy's defense industry, centered around communications-electronics with a heavy emphasis on radar and lasers, has an excellent helicopter production capacity.

Portugal has real potential for expansion of its existing good base for manufacture of light armaments, as well as ammunition for small arms, mortars and artillery, and has a large capacity for assembly of electronic equipment. Greece and Turkey have considerable facility for manufacture of light armaments and ammunition and have a good capability for rebuild/retrofit of tanks and other fighting vehicles. Norway has a well-developed electronics industry, particularly in radar and fire control technology.

All these nations possess almost unlimited potential for subcontract work involving assemblies, components, spare parts manufacture, and repair/overhaul of most type equipments.

Traditionally, the main producing nations, particularly the United States, have had the lead in developing most new technology. This is still true and will continue for the foreseeable future. However, the technology base of the smaller nations is expanding in most areas.

Much of this expansion can be attributed to technology transfer from the major nations. But there is a long way to go. Technology transfer is a sensitive issue and an extremely complex and difficult undertaking. Successful transfer is dependent not only on the willingness of the transferring nation to release the technology, but also, perhaps more importantly, on the ability of the recipient to receive it and apply it. The high technology required for modern sophisticated equipment systems makes the problems of transfer ever more difficult.

Over the past thirty years, the smaller nations have been accustomed to equipping their forces with military hardware acquired from the larger nations. Just after WW II and into the 1950s, this acquisition was in the form of military grant aid from the United States.

As economic recovery from WW II progressed, there was a transition from grant aid to foreign military sales or direct purchase from the producing nations. Today, direct purchase acquisition is the norm for most smaller nations.

The bulk of their defense equipment procurement is from foreign sources. This ranges as high as ninety-seven percent for one nation; sixty to seventy percent is the norm. These nations find such expenditures a painful drain on their national budget, yet more cost-effective than attempting to fully equip themselves from within. They lack the raw materials, the technology and the market to be competitive internationally for major systems.

Seeking a compromise, they have adopted a course whereby they continue to purchase from the big producers, but are bargaining for an equitable share of the total production to bolster their own economies. They are also negotiating equivalent return in the form of offset agreements and other compensation arrangements. This trend toward greater participation in defense markets has begun to accelerate in recent years, and has been given renewed emphasis by the current renaissance of alliance standardization and interoperability objectives. Even the lesser industrialized, southern flank economies, are beginning to turn their attention more and more toward military-industrial development; further, recent political events in the southern flank nations have promoted an enhanced determination for self-sufficiency in arms provision.

The current and increasing emphasis within the NATO on rationalization, standardization, and interoperability (RSI) suggests a need for fuller industrial participation of the smaller nations in alliance defense preparedness. In the present climate of shrinking defense budgets and inflating costs to meet a growing threat, more effective use might be made of all NATO resources.

Through data exchange, effective coordination of research programs, cooperative development programs, coproduction and licensing arrangements, the vast, largely dormant, RDA potential of the smaller nations can be brought to fuller realization, thereby greatly enhancing NATO's ability to deter aggression.

LTC JOHN F. CORBY, U.S. Army Corps of Engineers, has served as a standardization representative in the U.S. Army Research and Standardization Group, London, since May 1974.

A 1959 graduate of the U.S. Military Academy, LTC Corby holds a master of science degree in civil engineering from the University of Illinois, has completed the non-resident course of the Command and General Staff College and is chairman of the Combat Engineer and Materials Handling NATO military standardization working parties.

New Smoke System May Improve Tank Survival Rate

Data gathered in the 1973 Middle East War indicated that a significant number of armored vehicles fell victim to antitank guns and missiles. What's more, the data revealed that many of the losses could have been prevented if the vehicles had been provided with some means of obscuration from a foe's observation.

Armed with this battlefield information, the Army initiated a research and development program to provide a means of preventing or delaying detection of U.S. Armored vehicles in combat actions.

From this specific R&D program the Army recently announced the development of a Vehicle Engine Exhaust Smoke System (VEESS), a development that, according to reports, greatly increases the ability of the Army's M60 series main battle tanks to survive in battle.

The development program, under the direction of the U.S. Army Materiel Development and Readiness Command (DARCOM) Project Manager for Smoke/Obscurants, was conducted by researchers in the Munitions Division of the Chemical Systems Laboratory (CSL), Aberdeen Proving Ground (APG), MD.

Located in the Edgewood Area of APG, CSL is a major research activity of the U.S. Army Armament Research and Development Command.

The VEESS is a relatively low cost design since it utilizes the vehicle's engine and fuel pump to inject onboard diesel fuel into the engine's exhaust system where it is vaporized and expelled.

When the diesel vapor comes in contact with surrounding air, it cools and condenses to form a dense white smoke cloud that complements the rapid smoke produced by the Army's standard M239 smoke grenade launcher. Vehicle tests conducted at APG by the Army Test and Evaluation Command and at Fort Knox, by the Army Armor and Engineer Board, have demonstrated that the reinforced smoke screen is effective in obscuring vehicles from visual observation as well as image intensifying near infrared devices.

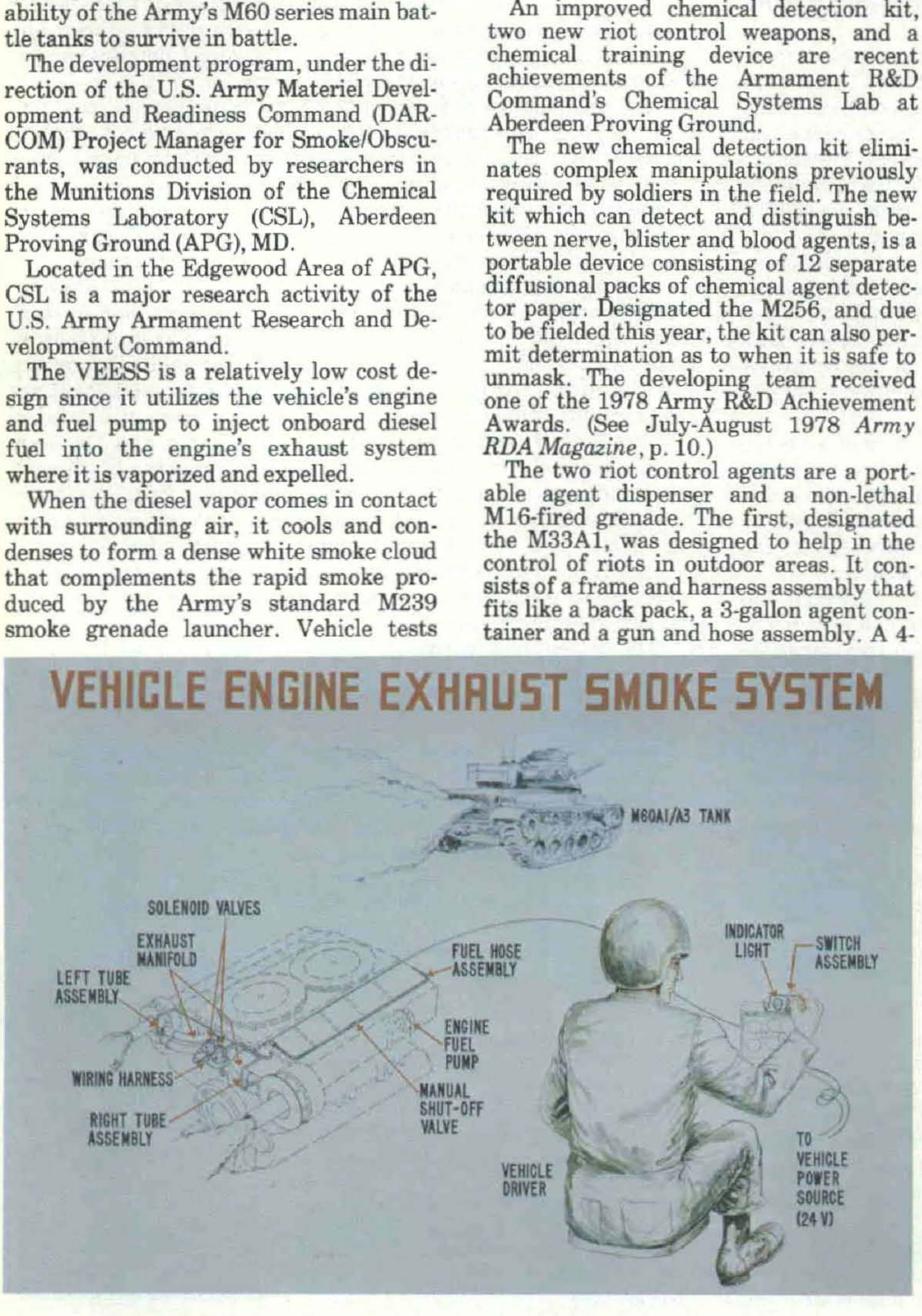
When activated by the vehicle driver from his normal driving compartment, the system can be operated intermittently, or, for sustained periods and generate smoke as long as diesel fuel is available.

Simplicity and use of standard parts are just two of the design features of VEESS that result in an economical smoke system that increases the life of the vehicle as well as the survivability of crew members.

CSL engineers and technicians, working in conjunction with engineering personnel of the Teledyne Continental Motors, MI, developed and evaluated the VEESS in less than a year.

Currently, 1,000 VEESS modification kits are in production for installation on M60A1 tanks in Europe. This is to be followed by application to all M60A1 and A3 tanks currently in production.

Efforts are underway to provide kits for the M60, M60A2, amd M48A5 tanks as well as the M88A1 Medium Recovery Vehicle, the M728 Combat Engineer Vehicle and the Army Armored Vehicle Launch Bridge. Also underway are studies to apply the system to other combat vehicles.



Chemical Systems Lab Fields 4 Items

An improved chemical detection kit, two new riot control weapons, and a chemical training device are recent achievements of the Armament R&D Command's Chemical Systems Lab at Aberdeen Proving Ground.

The new chemical detection kit eliminates complex manipulations previously required by soldiers in the field. The new kit which can detect and distinguish between nerve, blister and blood agents, is a portable device consisting of 12 separate diffusional packs of chemical agent detector paper. Designated the M256, and due to be fielded this year, the kit can also permit determination as to when it is safe to unmask. The developing team received one of the 1978 Army R&D Achievement Awards. (See July-August 1978 *Army RDA Magazine*, p. 10.)

The two riot control agents are a portable agent dispenser and a non-lethal M16-fired grenade. The first, designated the M33A1, was designed to help in the control of riots in outdoor areas. It consists of a frame and harness assembly that fits like a back pack, a 3-gallon agent container and a gun and hose assembly. A 4-port rotating nozzle on the end of the dispersing gun can spray a stream or bursts of irritant solution up to 70 feet.

The M33A1 can be converted to fire a dry powder riot control agent by substituting a single port for the 4-port nozzle and replacing the agent container valve with an agitator type assembly.

The multipurpose disperser was originally developed by Fred Alter, now retired, who received a U.S. patent for it. Larry Shaft, now the development engineer, feels the M33A1 has applications as a fire-fighting apparatus, as a portable flame thrower, and for crop dusting.

The M33A1 is scheduled for delivery next October under a production contract let by the Army.

The Sting Ring Airfoil Grenade (Sting RAG), a totally new concept in civil disturbance control, has been type-classified as an official Army weapon. Part of a low-hazard projectile system that has been under development since 1972, it consists of the M234 launcher and the M743 riot control projectile. The launcher is attached to the Army's standard M16A1 rifle.

When the Sting RAG is fired, a cartridge supplies propellant gases to the launcher, propelling the projectile at a velocity of 60 meters per second and a spin rate of 5,000 revolutions per minute.

Civilian law enforcement agencies are interested in the system, which is expected to be highly effective in helping to handle disturbances without inflicting permanent injuries.

The lab has also successfully modified for American troop use, a chemical defense training device developed in the United Kingdom. The device, known as SPAL (Simulator, Projectile, Airburst, Liquid), can provide each soldier in a combat unit with a realistic but safe chemical defense training system.

SPAL fills an interim need. A joint working group for chemical defense training, representing both the Army Training and Doctrine Command (TRADOC) and Army Materiel Development and Readiness Command (DARCOM), has directed the Chemical Systems Laboratory to develop a total chemical training defense system by 1983. In the meantime, SPAL has demonstrated in operational feasibility tests that it fills the current need.

MERADCOM Reports on Military Lubricants Use in Commercial Equipment

Basic methods within the Army for procurement of construction equipment in the past were either to develop its own or to modify commercially available items. The former method required the full RDTE acquisition cycle to produce a finished item. This often resulted in the belated consideration of timely developments occurring in new technologies.

The second method avoided some of the R&D costs. However, this approach required considerable investment in order to develop military modifications followed by the need to conduct extensive formal Army testing.

In many aspects, the Army's military construction mission resembles the tasks of civilian construction enterprises. The latter ones practice continuous competition through improvements and modernization of equipment through R&D.

Recognizing the same need for modernization and being simultaneously confronted with decreasing R&D budgets, the Army adopted a policy of procuring commercial construction-type equipment (CCE). In other words, the Army went commercial for "off-the-shelf" equipment to accomplish its construction tasks.

Although there are obvious advantages for this policy, there are certain problems that require resolution. As a case in point, construction equipment is normally purchased under a CCE specification that requires use of military lubricants. However, many equipment items have supplier-imposed lubrication requirements.

Supplier-imposed requirements can only be satisfied by using the manufacturer's proprietary fluids. This would obviously lead to a proliferation of proprietary hydraulic fluid specifications. It also creates a logistic burden to the supply system. The unwillingness of equipment builders to allow use of other fluids would eventually lead to the loss of equipment warranty claims.

For military equipment without wet brake systems, automotive engine oils meeting MIL-L-2104C (Lubricating Oil, Internal Combustion Engine, Tactical Service), have been and are currently being used for practically all Army hydraulic and power transmission applications.

With the introduction of the CCE Programs, John Deere and Co. was awarded a contract to furnish a CCE item which introduced the first wet-brake equipped commercial vehicle into the Army.

Since subsequent contract procurements could conceivably be awarded to other companies, there was great concern within the Army as to potential supply problems. This was because each of these companies required their proprietary hydraulic fluid be used.

Moreover, each company felt that MIL-L-2104C automotive engine oils would not perform satisfactorily in their respective equipment systems. When queried as to available data to substantiate these claims, no information was provided.

This concern within the Army had already been brought to the attention of ASTM and SAE in 1974 with a request to consider development of a multipurpose hydraulic fluid. However, no agreement was obtained because the various equipment builders preferred their proprietary fluids.

Since industry was unable to provide assistance at this time, MERADCOM elected to consider development of an universal hydraulic fluid for construction equipment which would reduce the multiple fluid requirements.

For this purpose, a test program was initiated in 1975 to establish performance levels for a number of existing military specification lubricants and several commercial and government stocked hydraulic and power transmission fluids against the John Deere JDM-J20A factory and service fill specification.

All fluids were subjected to extensive laboratory bench and wet-brake tests. Since frictional and gear wear requirements were considered to be most important, selected lubricants considered to have the best potential as universal fluids were also evaluated in the John Deere wet-brake capacity/chatter test, full-scale transmission/final drive wear test, and the power take-off clutch stall breakaway test.

In these full scale tests some of the military specification automotive engine lubricants, namely MIL-L-2104C, OE/HDO-10, MIL-L-46167 (Lubricating Oil, Internal Combustion Engine, Arctic), and MIL-L-46152 grade 10W-30 (Lubricating Oil, Internal Combustion Engine, Administrative Service), proved to be equal or better in regards to gear wear than the John Deere proprietary fluid.

Although some of the military specification fluids produced more chatter than the John Deere Factory fill/service fluid, one MIL-L-2104C OE/HDO-10 product had equal or superior brake chatter performance.

Two of the lubricants, namely MIL-L-2104C OE/HDO-10 and MIL-L-46167 OEA, were also evaluated in the Caterpillar TO-2 and Allison C-3 transmission systems for frictional performance. Both exceeded the John Deere specification and manufacturer's requirements.

One of the MIL-L-2104C OE/HDO-10 engine oils has been proved to be equal or better than the John Deere proprietary fluid in all performance areas and a few of the other military specifications of OE/HDO-10 grade oils possess generally acceptable characteristics in the most critical performance areas.

On the basis of these results, John Deere agreed to waive their warranty requirement that John Deere proprietary oil be used in its equipment. Thus, a major logistic burden has been eliminated and considerable cost savings realized. Proprietary fluids generally are not only more expensive but also impose higher logistic and storage costs.

Future plans in the Commercial Construction Equipment Program involve long term durability tests and efforts to develop universal performance test procedures for multipurpose engine/hydraulic and power transmission lubricants and to possibly include these in a military specification.

MERADCOM Gets Charter for Photovoltaic Systems R&D

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, has received a charter from the Department of Defense giving the Command responsibility for the development of photovoltaic systems for this country's Armed Services.

This charter, which was signed by MERADCOM Commander COL Bernard C. Hughes recently, is part of a government-wide program which places increasing effort on the development of new and improved ways to use solar energy.

The Defense Photovoltaic Program Office is being established at MERADCOM to act as a central point of contact between DOD and the Department of Energy. The office will establish and administer interagency agreements on DOD's portion of this energy initiative.

It will also review and coordinate the photovoltaic programs of the military departments, manage the funds provided to these departments for photovoltaic applications, compile reports and plans for transmittal to DOD, maintain current information on the status of these projects and handle other related matters.

The new office will be set up within the Energy Systems Project Office, headed by Donald D. Faehn, in MERADCOM's Electrical Power Laboratory. The Electrical Power Laboratory is one of eight MERADCOM labs conducting R&D on barrier and counterbarrier systems, countersurveillance systems, energy and environmental systems and supply distribution and construction equipment.

International Cooperation in Firing Tables

The Firing Tables Branch at the U.S. Army Armament Research and Development Command's Ballistic Research Laboratory (BRL) has recently enjoyed the services of German mathematician Mr. Herbert Hackl and British investigator Mr. Paul Fitch. Both have been involved in integrating different techniques and solving the problems of the interoperability of weapons and ammunition among NATO countries.

Mr. Charles Lebegern, a mathematician and chief of the lab's Firing Tables Branch, says production so aiming data has become a matter of international concern. Since World War I, BRl has prepared and published firing tables for all Army surface-fired projectiles and missiles. Since U.S. weapons and ammunition now are being used by other NATO nations, BRL is responsible for developing firing tables that are internationally known and widely used.

Since its founding in 1917, BRL has increased the reliability of firing tables by optimizing the range firing experiments from which firing tables are derived and by developing better mathematical models for processing firing data and computing the values contained in the tables.

Hackl, whose assignment to BRL came through the International Professional (scientific and engineers) Exchange program, arrived here last October from Koblenz, Germany, and just returned to that country.

Fitch, who arrived shortly before Hackl left, reviewed the German firing table techniques. He will continue to study the U.S. methodology for the remainder of his one-year stay.

Fitch's assignment came about when Lebegern, who chairs a NATO Artillery Weapons Group, learned of a new technique being investigated in the United Kingdom for processing data obtained for firing tables. Fitch was the principal investigator for the new methodology, and Lebegern, while visiting the U.K., proposed an exchange of personnel between the two nations.

Mr. Joseph Wall, a mathematician in BRL's Firing Tables Branch, is currently working within the Royal Armament Research and Development Establishment in Sevenoaks, U.K., where Fitch is normally assigned.

"Besides gaining a greater familiarity with their techniques, we learn each other's technological idiosyncracies," Lebegern said.

"In fact, Fitch has devised a technology to reduce the number of rounds necessary to fire to produce the firing tables data. A breakthrough like this is significant because of the expense of firing missiles and projectiles to develop this information, a common economic consideration shared by all the NATO nations."

Natick Gets Canadian Polar Bear Fur for Research

The American, British, Canadian and Australian (ABCA) Armies' Standardization Agreement of 1964 was recently exercised in an unusual way. The spirit of cooperation between the United States and Canada is reflected in this unique story.

The ABCA Standardization Agreement makes provisions for loans of materiel between the participating Armies when such loans are in the interest of standardization. It was through this mechanism that the U.S. Army Natick (MA) Research and Development Command (NARADCOM) requested the loan of a small quantity of polar bear fur for research related to possible applicable to cold weather clothing technology.

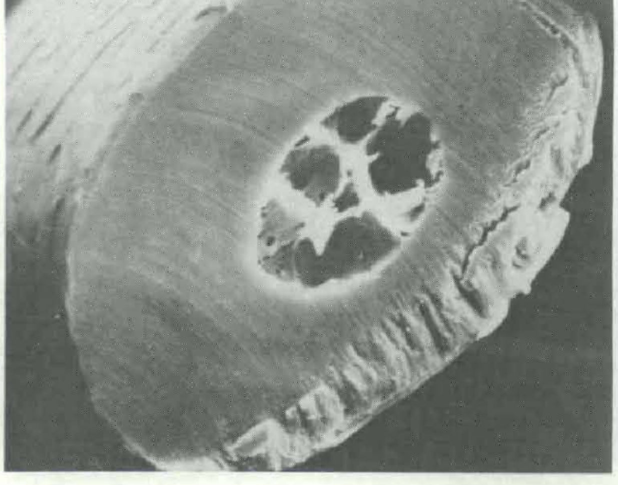
The loan was processed through the Canadian National Defence Headquarters in Ottawa, Ontario, by the U.S. Army Standardization Group-Canada. The director of Clothing, General Engineering and Maintenance, located at Canadian Forces Headquarters, was quick to respond and within a week, a piece of skin had been located and forwarded to NARADCOM.

NARADCOM's Dr. Malcom Henry, after reading about the work of the University of Oslo's Nils Oritsland, learned that aerial thermal infrared photography was useless when counting baby harp seals or polar bears. Apparently neither animal showed up on the film because their surface temperatures were nearly the same as the ice and snow around them.

Furthermore, both animals showed up as black objects silhouetted against background ice and snow using ultraviolet photography. This signifies that although the fur is white and should be an excellent light reflector, the animals' bodies are absorbing most of the solar ultraviolat rays that strike them. Dr. Henry's task was to determine how the bear accomplishes this.

The hairs were examined with an electron microscope. Results revealed that the polar bear hairs are hollow and contain no pigmet. The inner surfaces are rough, causing visible light to reflect. This gives the hairs the appearance of being white when in fact they are transparent.

Henry concluded that the hairs actually funnel ulraviolet light through the core and focus it on the bear's skin. If this is in fact how the polar bear absorbs ultraviolet rays, perhaps the mechanism can be applied to cold weather clothing design. This interesting experiment began by the application of a provision of the ABCA Agreement and the helpful assistance of the Canadian Forces.



ELECTRON MICROSCOPE photo reveals hollow, tubular construction of polar bear hair. Actually transparent, the hairs appear white because the rough inner surface causes light to reflect. From their research, NARADCOM coworkers Dr. Malcolm Henry and Dr. John Sousa and Northeastern University Prof. Richard Grojean have concluded that the hollow hair funnels sunlight to the skin, making it a living, breathing solar collector.

From Flintlock to Bofors. . .

The U.S. Army and Foreign Technology, 1776-1945

Americans have always liked to think of themselves as inventors, as entrepreneurs, as a breed of men who, if they did not invent something, took the design and perfected it. But in the review of the two centuries of our Army, it was not until WWII that U.S. technology dominated our weapons inventory.

When one thinks of the Revolutionary War, the usual weapon that springs to mind is the long rifle—though its role in that war is monstrously overplayed. Too many think of the long rifle as an American weapon, but it really wasn't; it was a refinement of a system brought to the New World in the mid-1700s by German and Swiss gunsmiths and refined in the frontier settlements of Pennsylvania.

But realizing that the bayoneted musket was really the dominant weapon on the battlefield, the rebelling colonies first tried to equip their forces with captured British Brown Bess flintlock muskets, while simultaneously authorizing embryonic manufacturing plants to make carbon copies of the Bess.

The sympathy of France subsequently brought supplies of the lighter, stronger Charleville musket into the hands of the Continental Line, along with the Charleville pistol. This French Charleville musket design that used metal barrel bands to secure the barrel to the stock rather than pins through the stock, would remain a part of U.S. military weapon design until the advent of the M16.

Because of the lack of good foundries able to work bronze—the principal cannon metal of armies in those days, the Americans with their abundance of local iron mines, did cast some iron cannon of their own design. However, much of the cannon used by the Continentals was either captured British or copied from their design, or supplied by the French.

Edged weapons were virtually exclusively copies of British designs initially.

The War of 1812 saw the U.S. land forces equipped with muskets that were refinements of the Charleville, and its cannon largely hand-me-downs from the Revolution.

By the time of the Mexican War in 1848, the new U.S. musket was still a refinement of the Charleville. Only the Colt pistol, then just coming into popularity, and a handful of Hall breechloading rifles and carbines could be said to be purely American technology. The edged weapons in the hands of dragoons and foot troops were copies of French or British design.

The American Civil War saw the country change from a basically agricultural nation to a manufacturing one. But even so, the Northern and Southern Armies both relied heavily on European technology. It was the first time American infantry would be equipped with rifled weapons as standard items, but the Minié system of the expanding bullet that made them work, was the result of European experiments, to which French Captain Minié is given the most credit. (The rifled musket is credited with inflicting over 90 percent of Civil War battle casualties versus 10-15 percent of WWII casualties by small arms.) And even the banding system of the rifled musket retained the technique of the earlier Charleville.

The principal and preferred cannon of both armies was the 1857 model 12-pounder bronze smoothbore Napoleon, so-called because it was copied from the cannon designed for Napoleon III of France.

While rifled cannon were first entering the inventory, and most designs were of American origin, the favorite round for such guns was that of the foreign Hotchkiss. The first breechloading field cannon, of which a few were used by the Federals on the Pennisula in 1862, and by the Confederates at Gettysburg, were of British design and origin. The Blakely cannon with its studded projectile, used so effectively by Confederate Artilleryman John Pelham, was of British origin. The standard cannon Borman fuze was likewise an imported design.

Then, to fill out the lack of native manufacturing capabilities, all manner and shapes of foreign infantry and cavalry weapons were purchased by both sides, in great quantities. Many a Union or Confederate unit would have been weaponless at some point in the war had it not been for foreign imports.

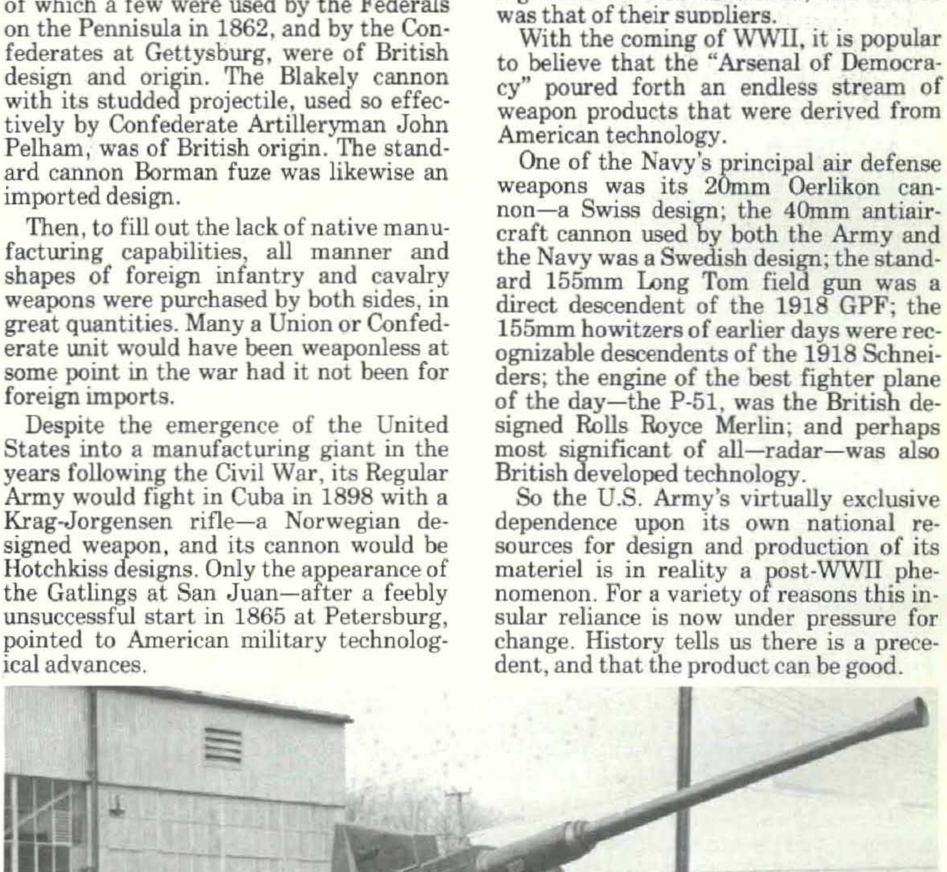
Despite the emergence of the United States into a manufacturing giant in the years following the Civil War, its Regular Army would fight in Cuba in 1898 with a Krag-Jorgensen rifle—a Norwegian designed weapon, and its cannon would be Hotchkiss designs. Only the appearance of the Gatlings at San Juan—after a feebly unsuccessful start in 1865 at Petersburg, pointed to American military technological advances.

Two decades later the American Army that fought in France had virtually no American designed nor produced weaponry. Even the beautiful M1903 Springfield rifle used Mauser technology purchased from the Germans. Its machineguns were largely French Chau-chats and Hotchkiss, its mortars British Stokes, its grenades British Mills, its tanks French Renaults or British Mark Vs, and its cannon French 75s, 155mm Schneider howitzers and 155mm GPFs guns. Its aircraft were French and British, with the exception of a handful of U.S. built but British designed DH4s that saw action in the closing days of the war. Even the helmet was of British design, and for those units serving under French command, the helmet was that of their suppliers.

With the coming of WWII, it is popular to believe that the "Arsenal of Democracy" poured forth an endless stream of weapon products that were derived from American technology.

One of the Navy's principal air defense weapons was its 20mm Oerlikon cannon—a Swiss design; the 40mm antiaircraft cannon used by both the Army and the Navy was a Swedish design; the standard 155mm Long Tom field gun was a direct descendent of the 1918 GPF; the 155mm howitzers of earlier days were recognizable descendents of the 1918 Schneiders; the engine of the best fighter plane of the day—the P-51, was the British designed Rolls Royce Merlin; and perhaps most significant of all—radar—was also British developed technology.

So the U.S. Army's virtually exclusive dependence upon its own national resources for design and production of its materiel is in reality a post-WWII phenomenon. For a variety of reasons this insular reliance is now under pressure for change. History tells us there is a precedent, and that the product can be good.



BOFORS 40mm Antiaircraft Gun (1943)

Capsules...

$3.34 Million Contract Orders FIDS Development

The U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, has signed a $3.34 million contract with GTE Sylvania for development, fabrication and testing of the Facility Intrusion Detection System (FIDS).

FIDS is a Joint Service program for development of an interior intrusion detection system. FIDS will provide the Armed Services with a system that can be used to protect nuclear and chemical weapons and other sensitive items against a variety of threats in many different environments.

The system consists of a communication, control and display system, a variety of sensors and sensor test simulation devices. Depending on the situation, FIDS can use infrared or ultrasonic motion sensors, ultrasonic, vibration or switch type structure penetration sensors and point sensors that detect intruder proximity to or of protected objects.

Under the provisions of the contract, GTE Sylvania will design, build and test three FIDS systems including technical improvements, prepare training manuals and write the technical data package and ILS documentation for the system. Delivery of the three systems is expected in the summer of 1980. They will then undergo government testing at MERADCOM, Fort Huachuca, AZ, and Fort Bragg, NC.

Black Hawk Achieves Record Setting Flight

A Black Hawk aircraft recently recorded the longest flight by an Army helicopter, when it was flown a total of 880 miles, nonstop without the benefit of refueling.

The record setting flight was conducted over the east coast states of Connecticut, New York, Rhode Island and Massachusetts. This 6.9 hour endurance flight reportedly proved that the Army's newest utility helicopter has the capability to be self-deployed to Europe.

MAJ Rick Walker, Army test pilot, flew the aircraft, which was equipped with a crashworthy extended range kit, designed and constructed by the Sikorsky Corp. This kit permits the aircraft's fuel capacity to be increased from 2,400 to 7,700 pounds.

Following the record setting flight, the extended range kit was removed and the aircraft was transported to Fort Eustis, VA, where it will be used as part of the Army's training program for Black Hawk maintenance personnel.

Three production Black Hawk helicopters have been delivered to the U.S. Army, with 50 more aircraft scheduled to be turned over to the Army by the end of this year. One of the aircraft is being prepared for icing tests, the second is undergoing electrical and electromagnetic compatibility evaluation and the third is being assessed for performance qualities.

Firm to Receive $105 Million for Improved Hawk

A contract valued at approximately $105 million has been awarded to Raytheon Co. to produce the Improved Hawk air defense system for the government of Belgium, which has joined the Improved Hawk program of the North Atlantic Treaty Organization (NATO).

About half of the work on the 3-year program will be done by Raytheon and the other half by European firms, with overall program management provided by Raytheon.

NATO nations already participating in the program, which began in 1974, are Denmark, the Federal Republic of Germany, France, Greece, Italy, and the Netherlands. Raytheon's manufacturing effort on this program will be performed principally at its facility in Andover, MA.

Army Plans Procurement of Air Cushion Vehicles

Decision makers have agreed that the U.S. Army Mobility Equipment Research and Development Command's (MERADCOM's) Lighter Air Cushion Vehicle 30-ton capacity (LACV-30) should be introduced into the Army inventory. On 15 Jan. 1979, a General Officer's In Process Review was held at the Pentagon to determine if the 30-ton air cushion vehicle should be standardized for Army use.

After being briefed on the productivity, operational effectiveness and performance during DT/OT-II testing, Army officials agreed the craft should be produced to support the logistical mission of ship-to-shore resupply. According to Project Engineer John Sargent, current plans are to procure sufficient craft over a 5-year period to form a company (12 craft). MERADCOM expects to award a contract in August 1979 for four craft with an option to procure an additional eight, four in FY80 and four in FY81.

The air cushion concept is a major deviation from prior wheeled amphibian concepts which originated with the WWII DUKW. The LACV-30 will replace the LARC V and the LARC XV. Although designed primarily for the ship-to-shore logistical mission, the LACV-30 could support secondary missions of coastal, harbor, and inland waterway roles; and as search, rescue, and medical evacuation.

Success of a sustained amphibian operation is critically dependent on logistical resupply. With the LACV-30, containerized cargo loads up to 25 tons can be carried ashore and transported inland avoiding beach congestion and the possibility of enemy attack which could destroy more vulnerable landing craft and barges.

In March 1975 a contract was awarded to Bell Aerospace Textron for construction of two militarized Voyageurs (LACV-30s) complete with software, spare parts, ground support equipment and training. The two craft were procured for Operational (OT-II) and Development Test (DT-II).

The craft were delivered to the government in March and May of 1976. OT-II was a mission oriented type test conducted at Fort Story, VA, the home of U.S. Army Amphibian Training and Testing. DT-II involved engineering type tests conducted at: Aberdeen Proving Ground, MD, for initial orientation, human engineering and limited water tests; the U.S. Naval Coastal Systems Laboratory, Panama City, FL, for water performance on the U.S. Navy instrumented sea range; Eglin Air Force Base, FL, for cold chamber testing down to $-40°$ F; and Camp Pendleton, CA, for surf tests.

DT-II started in October 1976 and OT-II in January 1977. OT-II was completed in October 1977 and DT-II was completed in February 1978. In addition to the DT/OT-II, craft No. 1 performed an ice breaking and flood control mission on the Illinois River last winter. Two 15-man military teams were trained to operate and maintain the two craft.

Initial Operating Capability is scheduled for 4QFY81 with a platoon of these craft involved in a Follow-on-Evaluation operating as an organization. The addition of these 12 craft to the Army fleet will provide a logistical resupply rate up to 7,000 tons per day.

NY Bank Calls for Bulletproof Vest Public Support

Bulletproof vests developed by the U.S. Army Natick (MA) Research and Development Command have reportedly proven so effective that they are the subject of a community relations drive being conducted by a New York City bank.

An advertisement which ran in the 2 Feb. *New York Times* as a full-page spread is a story in itself. It reads as follows: "The lightweight bulletproof vest can save lives—the lives New York City's police officers put at risk. That has been proved, recently and dramatically, by two New York police officers shot in separate incidents at point-blank range, who were wearing bulletproof vests and who are alive because of that protection.

"Unfortunately, the New York City policeman who wants such a vest—as an overwhelming majority have indicated they do—must today, in most cases, buy it himself. At a cost of about $100. That's why Citibank has contributed $100,000 to buy bulletproof vests for New York City policemen. That $100,000 adds up to about 1,000 vests—not enough, in itself, to cover the need. But we hope it will stimulate other concerned citizens, both corporate and individual, to join Citibank in taking tangible action to protect those who protect all of us."

CSL Developing Remote Sensing Agent Alarm

A remote sensing unit that provides an early warning of an approaching chemical agent cloud is being developed at the U.S. Armament R&D Command's Chemical Systems Laboratory (CSL), Edgewood, MD.

Officially designated XM21 Remote Sensing Chemical Agent Alarm, the detector resembles a simple television camera. It is designed to operate automatically. When it is set up in the field, it scans an upwind path by monitoring the infrared spectral characteristics of the atmosphere.

The presence of a nerve agent cloud is detected by any specific change in the normal atmospheric infrared spectrum. This change triggers the alarm and provides field troops with sufficient time to take protective measures.

According to Mr. Dennis Flanigan, XM21 project engineer, the unit is designed to operate unattended for a 12-hour period. It is expected to be ready for production and use in the field in the 1980s.

Optical Tracker Program Gathers Data on ICBMs

The U.S. Army's Ballistic Missile Defense Advanced Technology Center, Huntsville, AL, has announced successful completion of the first of several planned flight experiments to obtain infrared measurements of an incoming ICBM target complex.

Objectives of the Designating Optical Tracker (DOT) Program are to obtain data demonstrating the feasibility of detecting and tracking ICBM warheads by means of infrared telescopes carried above the sensible atmosphere.

A recent experiment began with the launch by the Air Force of a Minuteman III ICBM from Vandenberg Air Force Base to Kwajalein Atoll. Subsequently, an infrared telescope was carried aboard a rocket launched from the atoll, pointed towards the incoming target complex, and commanded into a viewing sequency for about five minutes.

After successfully gathering data, the vehicle carrying the telescope was prepared for reentry and a parachute descent into the ocean where it was recovered by U.S. Navy forces. Boeing Aerospace Co. is prime contractor for the DOT program, and Hughes Aircraft Co. built the infrared telescope.

CERL to Study Alternate Nonfossil Fuel Source

Experiments supported by the U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL, may help reduce future Army fuel oil and gas bills.

Fifty tons of pelleted wood waste will be fired as a supplementary central boiler plant fuel at Fort McCoy, WI, and Fort Benjamin Harrison, IN, as part of CERL's research program to evaluate alternate heating and power plant fuels for the Army. Assessments will be made on the fuel's handling, boiler performance and air pollutant emissions.

The waste wood fuel is formed by forcing a mixture of sawdust, hog wood and other nonmerchantable wood materials through a compacting die. The result is pellets, one inch long and one-fourth inch in diameter. They contain almost no sulphur and provide about two-thirds as much fuel value as an equivalent amount of coal.

Conferences & Symposia . . .

Speakers Stress Technology Transfer . . .

DOD, LASL Sponsor Meet on NBC Technology

The U.S. Department of Defense and the Los Alamos Scientific Laboratory (LASL) held a joint conference on nuclear, biological, and chemical defense technology in Los Alamos, NM, 16-18 Jan. The purpose was to stimulate a cross-fertilization of ideas and a transfer of technology between DOD and LASL.

Opening remarks for DOD were presented by BG Vincent E. Falter, director, Nuclear-Chemical Directorate, Office of the Deputy Chief of Staff for Operations and Plans, HQ, Department of the Army. Dr. Harry C. Hoyt, LASL's assistant director for Weapon Planning and Coordination, described LASL capabilities and research activities. Both speakers emphasized the need for a vigorous research and technology base directed toward improved NBC defense capabilities.

Other speakers included: COL John A. Mojecki, director, C/B Systems Directorate, HQ, TRADOC; COL Walton A. Philips, chief, Physical Protection Division, U.S. Army Chemical Systems Laboratory; Cdr Wayne T. Hildebrand, HQ, Naval Material Command; and MAJ Billy C. Henry, HQ, U.S. Marine Corps. An Air Force presentation by COL John J. McCambridge, director, Life Support Systems Program Office, Wright-Patterson AFB, was cancelled because of bad weather.

The importance of military needs in the NBC defense area was discussed in a presentation entitled "The Chemical/Biological Threat," by CPT Leonard A. Izzo of the U.S. Army Foreign Science and Technology Center.

A series of LASL speakers discussed how their facilities and research capabilities, developed to support nuclear-weapon and energy research, could also be used to investigate problems associated with NBC defense. Presentations were followed by a tour of LASL's modern, unique facilities and equipment displays in LASL's National Security and Resources Study Center.

Dr. Paul Robinson, leader of LASL's Applied Photochemistry Division, discussed how lasers with specific wavelengths have potential applications for use in chemical-biological agent detection-identification and decontamination-demilitarization systems.

Dr. Edward Dowdy of LASL's Nuclear Safeguards Division discussed the latest in radiological monitoring devices. His presentation was highlighted by a display of LASL-developed radiac equipment.

Dr. Donald Petersen, alternate leader of LASL's Health Research Division, discussed radiological health hazards associated with plutonium. He also described dosimetry instrumentation, research on protective masks and clothing, particulate filtration media, and biological detection and identification techniques and equipment.

An interesting sidelight involved discussion of an electronic identification device developed by LASL for use in livestock management programs. These small electronic devices may be used to identify friendly personnel on the battlefield.

Dr. Richard Baker, leader of LASL's Chemistry and Metallurgy Division, gave an overview and tour of his division's laboratories involved in new-materials-development technology. Special interest was displayed in carbon-cloth fibers and bulletproof materials.

Dr. Robert Jeffries, Nuclear Field Test Division, gave the final LASL presentation. His topic was atmospheric science, with emphasis on cloud-aerosol transport models and laser air-pollutant monitoring devices.

Technology transfer from government laboratories such as LASL to the DOD reportedly can contribute to: reduced R&D costs, less duplication of effort, and a stronger DOD research and technology base for future material developments.

TSARCOM Will Host Aviation Logistics Conference

The U.S. Army Troop Support and Aviation Materiel Readiness Command (TSARCOM), St. Louis, MO, will host the 1979 Worldwide Aviation Logistics Conference (WALC), 14-18 May, according to MG Richard H. Thompson, TSARCOM commander.

Representatives from the Department of the Army and some 30 installations throughout the continental United States as well as Germany, Japan, Iran, Turkey, Korea and Italy will be in attendance.

Purpose of the WALC is to review and/or establish depot maintenance programs and distribution schedules for aircraft, avionics, armament subsystems, ground support equipment and aircraft survivability systems through Fiscal Year 1980; and to discuss aviation logistics problems.

Awards . . .

Former ASAP Members Honor Dr. K. C. Emerson

In a ceremony at the Pentagon on 7 February 1979, Dr. K. C. Emerson, retired former Deputy Assistant Secretary of the Army for Research, was awarded a handsomely engraved silver tray. The tray was presented by former members of the Army Scientific Advisory Panel and others who worked closely with Dr. Emerson during his years of service. Making the award on behalf of the group was Dr. Bruce Reese, head of the Aeronautic and Aerospace Department, Purdue University, IL.

The tray carries Dr. Emerson's initials on the face, and the reverse carries the inscription: "The Army Scientific Advisory Panel's most heartfelt thanks and appreciation for a career of leadership, devotion and dedication to the country and to this

(Continued on page 38)

(Continued from page 37)

panel." The names of those who contributed are engraved below the inscription.

Among those present were former Chief of Research and Development LTG A. W. Betts, USA-Ret., MG Stewart C. Meyer, Ballistic Missile Defense Program Manager; MG Robert J. Lunn, Assistant Deputy Chief of Staff, RDA; former Assistant Secretary of the Army (R&D) Dr. Russell D. O'Neal; Deputy Assistant Secretary of the Army (R&D) Dr. Joseph H. Yang; Deputy for Science and Technology Dr. E. E. Yore; Mr. Charles Poor; and many other distinguished guests.

Dr. Haley Receives Meritorious Service Award

Dr. Richard L. Haley, deputy director for Development and Engineering, HQ DARCOM, received the Meritorious Civilian Service Award—the Army's second highest for civilian employes—in a ceremony 23 Feb. 1979 at HQ DARCOM. GEN John R. Guthrie, DARCOM commander, made the presentation.

The citation reads, in part: "For demonstrated proficiency and excellence of service while serving as Deputy Director for Development and Engineering. Dr. Haley's devoted service has been characterized by his dedication, loyalty, high degree of technical competence and professional integrity. Through the consistent application of superlative ingenuity and sound judgment, Dr. Haley has made numerous fiscal and technical contributions vital to the success of the Army."

Present at the well-attended ceremony were Dr. Haley's wife, Margaret, and nine of their eleven children.

A graduate of the U.S. Military Academy, and a former officer in the U.S. Army and U.S. Air Force, Dr. Haley has held high positions with NASA, and with the former Office Chief of Research and Development, Department of the Army.

He holds MS and PhD degrees from the University of Pennsylvania, and is a member of the American Institute of Aeronautics and Astronautics, Association of the U.S. Army, Association of the U.S. Air Force, and the American Management Association.

CERL Technical Director Gets Commander's Award

Dr. Louis R. Shaffer, technical director of the U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL, is the first CERL employe to receive the U.S. Army Commander's Award for Civilian Service.

Established in August 1978, the award is a Department of the Army honorary distinction to recognize civilian employes who have made significant contributions to an Army activity.

Chief of Engineers LTG J. W. Morris cited Dr. Shaffer for providing "outstanding technical leadership and managerial expertise in the programing and execution of CERL's military research and development activities," and for his work in instituting the organization's program manager concept to increase efficiency.

Shaffer, who received his doctorate in construction engineering from the University of Illinois (UI), has served as CERL's technical director since the Corps of Engineers' laboratory opened in 1969. He also is a professor of civil engineering at the UI.

Additionally, he is a member of the American Society of Civil Engineers, the American Institute of Constructors, American Association of Cost Engineers, Society of American Military Engineers, and serves as chairperson of the U.S. National Committee of the International Council for Building Research Studies and Documentation.

Meszaros Receives BRL's 1978 Zornig Award

Mr. Julius J. Meszaros, a nuclear expert who gained international recognition during a 31-year career, has been named the 1978 winner of the U.S. Army Armament R&D Command Ballistics Research Laboratory's presitious Zornig Award.

The annual award honors the person whose work in support of BRL's research and development mission is deemed most worthy of special recognition. It was established in 1959 in honor of COL H. H. Zornig, who was in charge of ballistic research at Aberdeen Proving Ground from 1935 to 1941.

Meszaros was a branch chief in BRL for many years before he was appointed assistant to the director in 1973. He retired last September after serving for more than a year as nuclear program coordinator.

Meszaros, who holds a degree in mechanical engineering from Akron University, first came to Aberdeen in 1943 as an enlisted man. He attended Ordnance Officers Candidate School and received his commission, then was assigned to APG with the Army's development and proof testing organizations.

He advanced to the rank of major and served until 1946, when he resigned his commission in order to accept a civilian appointment as an ordnance engineer. One year later he transferred to BRL as a mathematician.

Meszaros was chief of a BRL Explosives Kinetics Branch from 1956 to 1973. He first gained international recognition in 1960 when he directed a U.S.-Canadian cooperative program in nuclear blast simulation. Earlier he had been involved in all of the U.S. nuclear test programs conducted in the Pacific and in Nevada.

He was chairman of an Army nuclear weapons committee from 1961 to 1972 and chairman of the antiballistic missile vulnerability working group from 1965 to 1974. For 10 years he was the Army representative on a nuclear technical cooperation program panel.

Before he retired, Meszaros coordinated BRL's nuclear weapon effects programs with the Harry Diamond Laboratory and other Army commands and with the Defense Nuclear Agency. He is now a consultant on nuclear blast and thermal effects matters for Harry Diamond Laboratory, Adelphi, MD.

Julius J. Meszaros

Monmouth Employes Patent Laser Training System

Three Fort Monmouth inventors have been granted a United States patent on a laser beam weapon training system using a motion picture target screen.

Electronics engineers Herman I. Pardes and Joseph R. Schwartz and physicist Frederick B. Sherburne, all employes of the U.S. Army Electronics Research and Development Command's Night Vision and Electro-Optical Laboratory are the recipients of the patent.

Their apparatus permits realistic indoor target training by using weapons having laser attachments that can be aimed and fired at a simulated target scene displayed on a curved panoramic screen by a motion picture projector.

A laser beam detector positioned adjacent to the projector includes a second film used as a mask to receive laser beam reflections from selected target areas on the screen. A pulse generator provides frame synchronization between the two films. A light-emitting diode on the weapon, activated by signals from the detector, indicates to the firer when a hit has been scored.

Joseph Schwartz holds part of laser weapon training system invented with Herman Pardes (center) and Frederick Sherburne.

3 Natick Personnel Get Achievement Citations

Food technologists Mr. John L. Secrist, Mr. Robert L. Scott, and Mr. Walter J. Fitzmaurice, Food Engineering Laboratory, U.S. Army Natick (MA) Research and Development Command (NARADCOM), recently received Certificates of Achievement for two adopted suggestions which resulted in first-year government savings of $3,148,175.

The certificates were the third time in 1978 the trio had been honored for their development of a restructured meat process adopted by the government which also offers 40-50 percent savings to the American meat consumer in purchasing meat.

Their flake-cutting technique, transforming less costly and less tender cuts of beef, veal, pork and lamb into tender and highly acceptable steaks and chops has gained attention, as a means of off-setting a predicted rise in hamburger, steaks and roasts.

The trio had previously earned the Natick Scientific Director's Gold Pin for Engineering and the Rohland A. Isker Award from the R&D Associates for Military Food and Packaging Systems. The Isker Award citation hailed the flake steaks and chops as an "outstanding contribution to national preparedness in the area of applied food research."

Troop acceptance of restructured veal cutlets, now being purchased, was so enthusiastic the Army had no hesitancy in accepting the trio's suggestion to procure frozen restructured lamb cutlets rather than frozen lamb chops. With an annual procurement of 88,000 pounds of lamb, at a savings of $1.03 a pound, first-year savings to the government amounted to $90,640.

A second adopted suggestion that pre-cooked frozen roast beef replacing boneless frozen oven roast beef resulted in the first year savings of $3,057,535 in the procurement of 8,992,750 pounds of beef.

Engineer Improves Antenna Alignment Method

Mr. Peter E. Cunningham, an electronics engineer at the U.S. Army Communications and Electronics Materiel Readiness Command, Fort Monmouth, NJ, has been granted a U.S. patent for an improved method of adjusting and aligning a whip antenna matching base unit during production.

By use of the method, one can reportedly be assured at the time of production that the antenna will have proper radiation characteristics when the antenna is mounted in a vehicle for actual battlefield operation.

Cunningham notes that the invention permits direct parameter measurement, rather than indirect measurement, and produces more accurate and consistent matching units. These matching units are used in vehicular antennas for ground tactical, very high frequency FM radio sets.

Cunningham, who has been engaged 10 years in the field of vehicular whip antennas, holds a bachelor's degree in mechanical engineering from General Motors Institute, Flint, MI. He received an MS in electrical engineering from the University of Michigan, and is working on his doctoral thesis at the New Jersey Institute of Technology.

Career Programs...

ALMC Offers Army Contracting Officers' Course

The U.S. Army Logistics Management Center (ALMC), Fort Lee, VA, offered its first class of the Army Contracting Officers' Representatives Course in March. The new 2-week course is slated to be given six times this fiscal year. The proposed schedule at ALMC is: 12 Mar., 9 Apr., 6 Aug., and 10 Sept. It will also be offered at Fort Gordon, GA, 30 Apr. and 11 June.

The course will provide training to those in the Army, who are, or will be, functioning as contracting officers' representatives for contracting related to technical and support services.

It is designed to improve job performance of personnel outside the contracting career field who will be involved with contracts at installation or field organizational level, and will be performing such contract functions as: writing statements of work; doing contract surveillance; contract quality assurance; and, providing overall monitorship of contractual requirements.

Course nominees must be a contracting officers' representative or anticipate immediate appointment as a contracting officers' representative for one or more service contracts. This is the only course of this type offered to Army military and civilian personnel. It will be given by personnel of the School of Acquisition Management at ALMC.

Army Completes Schools Consolidation Study

The Department of the Army has announced that the study concerning consolidation of the U.S. Army Ordnance and Chemical Center and School at Aberdeen Proving Ground, MD, and the U.S. Army Missile and Munitions Center and School at Redstone, AL, has been completed.

Although the study indicated that consolidation would achieve annual savings, these would not be as large as originally estimated because of intervening management actions. This reduced the desirability of implementing the consolidation. Loss of the schools' effectiveness during such a consolidation was also a consideration.

These factors, combined with the fact that it is considered advisable at this time to retain the current orientation of the two activities without diminution, resulted in the conclusion that the consolidation should not be accomplished.

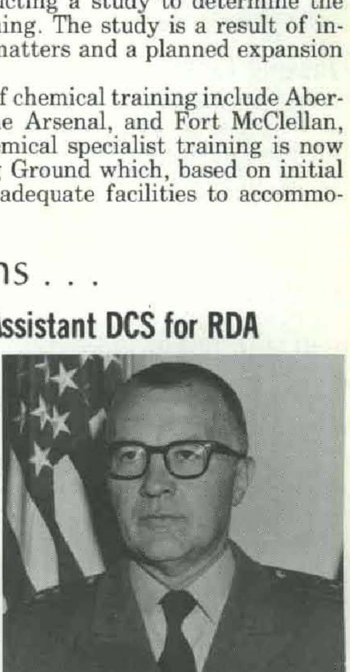
The Army is presently conducting a study to determine the best location for chemical training. The study is a result of increased emphasis on chemical matters and a planned expansion of defensive chemical training.

Alternatives for the location of chemical training include Aberdeen Proving Ground, Redstone Arsenal, and Fort McClellan, AL. The majority of Army chemical specialist training is now conducted at Aberdeen Proving Ground which, based on initial examination, may not contain adequate facilities to accommodate the expanded training.

Personnel Actions . . .

Lunn Succeeds Vinson as Assistant DCS for RDA

The Department of the Army has announced the reassignment of MG Robert J. Lunn from Director for Development and Engineering, HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA, to be Assistant Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army. The new assignment for General Lunn became effective on 22 Jan. 1979. He replaced MG Wilbur H. Vinson Jr.



MG Robert J. Lunn

General Lunn graduated from West Point in 1950, and was commissioned in the artillery. He subsequently attained a master's degree in aerospace engineering in 1961, from the University of Arizona. His military schooling includes the U.S. Army Command and General Staff College, the Armed Forces Staff College, and the U.S. Army War College.

General Lunn entered the materiel acquisition field in 1961 when he joined the U.S. Army Artillery Board at Fort Sill as chief of the Air Defense and Missile Division, Office of the Chief of Research and Development, Department of the Army. This was followed by an assignment as Assistant to the Secretary of the Army for Anti-Ballistic Missiles. Prior to his assignment to HQ, DARCOM, General Lunn was the commander of the U.S. Army Air Defense Center and Fort Bliss.

General Lunn had been in his position at DARCOM since September 1977. No replacement has been announced as of press time.

Griffin Heads Manufacturing Technology Office

Mr. Darold L. Griffin, deputy project manager for Munitions Production Base Modernization and Expansion (MPBME), is the new civilian chief of the Office of Manufacturing Technology (MT) at HQ U.S. Army Materiel Development and Readiness Command (DARCOM), Alexandria, VA.

Selected on the basis of his demonstrated technical and professional knowledge and managerial ability, he will guide and control the technical aspects of the total DARCOM MT effort, including the programs at subordinate commands and activities.

Griffin entered federal service in 1957 at Picatinny Arsenal. Since that time he has held a number of increasingly responsible positions culminating with his designation as deputy project manager for MPBME in 1973. In this capacity, he played a vital role in the formulation and operation of the Project Manager's Office.

(Continued on page 40)

(Continued from page 39)

He reportedly provided notable leadership and mobilized the MT program as the primary vehicle to develop processes and improve productivity of plants being modernized or expanded.

His academic credentials include a degree in metallurgical engineering from the University of Cincinnati and additional graduate level work in various civilian and government sponsored training programs. He is a member of Alpha Chi Sigma, the honorary society for chemical engineers. His accomplishments have earned him two Meritorious Civilian Service Awards and numerous other honors and commendations.

Juvenal Takes Over as TECOM Deputy Commander

COL Michael P. Juvenal, a 26-year Army veteran and chief of staff of the U.S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD, since 1976, has succeeded BG Philip L. Bolte as TECOM deputy commander.

A 1952 graduate of the U.S. Military Academy, COL Juvenal holds a master's degree in electrical engineering from Georgia Institute of Technology. He has also completed requirements of the Army Command and General Staff College and the Army War College.

In 1973, COL Juvenal was appointed secretary of the general staff, HQ, Allied Forces in South Europe, Naples. This assignment followed a 2-year tour at West Point as executive officer for the 1st Regiment of the U.S. Corps of Cadets, Department of Tactics.

Listed among his earlier assignments are battalion commander, 4th Infantry Division, Vietnam; administrative systems officer, Office of the Assistant Vice Chief of Staff, Pentagon; and regimental senior adviser for the 5th Vietnamese Division.

COL Juvenal is a recipient of the Silver Star, Legion of Merit with Oak Leaf Cluster (OLC), Distinguished Flying Cross, Bronze Star Medal with "V" device and four OLC, Meritorious Service Medal, Army Commendation Medal with OLC, and the Purple Heart.


COL Michael P. Juvenal

Binney Assumes Duties as APG MT Director

COL Charles W. Binney, former chief of the Combat Systems Materiel Test Directorate, U.S. Army Test and Evaluation Command, Aberdeen (MD) Proving Ground, has succeeded COL Edward P. Davis as director of APG's Materiel Testing Directorate.

Prior to his arrival at APG in July 1978, COL Binney has served in Nurnberg, Germany as executive officer of the Military Community. Other key assignments have included commander, 2d Battalion, 59th Air Defense Artillery Groups, 1st Armored Division, Schwabach, Germany; and chief, Plans and Programs Division, Directorate of Training Development, U.S. Army Air Defense School. He also served earlier with the International Division, Office, Chief of R&D, Department of the Army.

Graduated with a bachelor's degree in psychology from Washington University, he holds a master's in public administration from Shippensburg State College, and he has completed requirements for the U.S. Army Command and General Staff College and the Army War College.


COL Charles W. Binney

COL Binney is a recipient of the Bronze Star Medal, two Meritorious Service Medals, the Air Medal, two Army Commendation Medals, a Meritorious Unit Commendation, and the Republic of Vietnam Cross of Gallantry with Palm device.

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on . . .

SATCOM Demonstrates New Satellite Communications

The U.S. Army Satellite Communications (SATCOM) Agency unveiled its newest piece of equipment - a terminal known as the Mark IV (X) Highly Transportable Communications Satellite Link Terminal - that could reach 22,300 miles into space and back.

The terminal was designed to communicate with the National Aeronautics and Space Administration's SYNCOM II synchronous orbit communications satellite, launched 26 July 1963, to orbit 22,300 miles over the Atlantic Ocean near Brazil.

The system included a 15-foot, air-inflated antenna that could be collapsed for movement, a control and equipment shelter and a trailer-mounted 15 kw generator. Because the complete terminal system, along with its operating crew, could be loaded aboard a C–130 aircraft, the Mark IV (X) was of particular interest to STRIKE Command, which must stand ready to move combat-ready task forces to trouble spots anywhere in the world.

The terminal was built by Hughes Aircraft Co., which also developed and built the SYNCOM satellite. A militarized version of such a terminal could accompany a task force into an area where no communications complex exists, and within three hours after touchdown, could provide the task force commander with voice and teletype circuits via satellite back to STRIKE headquarters or to any point in CONUS, it was reported.

R&D Chief Tells AUSA Unit of New Materiel

Speaking to the Worchester (MA) Chapter of the Association of the U.S. Army about the latest in Army R&D, Chief of R&D LTG William W. Dick discussed protective clothing and footwear for the soldier, greatly improved rations, and advanced weapon systems in development and production.

Among firepower improvements he discussed were the M-14 rifle, the Special Purpose Individual Weapon, the Redeye shoulder-fired air defense weapon, the TOW system for destroying tanks and other targets with pinpoint accuracy, and the new family of self-propelled howitzers.

GEN Dick also talked about the Pershing missile system as a replacement for Redstone; Sergeant as the replacement for the first-generation Corporal; and Lance, the developmental division support weapon intended to replace the Honest John and, possibly, the Little John systems.

Other materiel items he discussed included the Nike X as the second-generation of the Nike Zeus program; the Gama Goat; the General Sheridan armored reconnaissance airborne assault vehicle; the projected Main Battle Tank being developed under agreement with West Germany; the Chinook transport helicopter, along with the Canadian-developed fixed-wing STOL Caribou; three new helicopters being developed jointly with the Air Force and the Navy; and the Hummingbird surveillance aircraft, which made its first transition flights in November 1963.

The Chief of R&D also outlined the program called the Command Control Information System; the use of mobile computers such as MOBIDIC, the Random Access Discrete Address communications system; and the terrain analysis program at the U.S. Waterways Experiment Station, Vicksburg, MS.

*U.S. GOVERNMENT PRINTING OFFICE: 280-982:2

NATO's 30th Anniversary

On 4 April 1979 the North Atlantic Treaty Organization will celebrate its 30th anniversary. At the time of its creation the memory of the most terrible war civilization has ever known was still vivid in the minds of most peoples of the world. Their fervent wish was to be able to look to the future with reasonable certainty that the terrors of war would never again ravage their lands, their lives, and those of their children and children's children. The United Nations Charter, drawn up in 1945, became the initial vehicle for the implementation of that hope.

But Western Europe and its friends were soon to learn that the words peace, freedom, individual liberty, and democracy had totally different meaning to the world of communism. The Free World of Western Europe stood shakily on a precipice in 1949. To an exhausted Europe, struggling to rebuild, the solution to slipping into the dark abyss of communistic domination lay in stronger mutual cooperation.

That strengthening move came to reality with the creation of NATO. It was truly a momentous event in the history of mankind, in that it committed, in time of peace as well as war, the free powers of Western Europe to mutual military, economic, and political cooperation.

Equally momentous was the commitment of the United States, as a fully involved partner, in the continued existence of a free Europe through its memberships in NATO.

That Western Europe has survived the threat, to prosper and strengthen, is due in no small way to the shield of NATO.

Today that shield continues to stand, erect and powerful. But where possible pits and blemishes have become evident, there is a newly recognized need to polish, refurbish, and rehone NATO's shield. Even greater cooperation among NATO nations is indeed the theme of 1979.

President Carter has reaffirmed United States determination to work in closer cooperation in furtherance of strengthening our common defense capability. It is truly significant and important that greater emphasis than at any time in United States history is being given to obtaining enhanced military harmony of its forces with those of other NATO members.

Full participation by the United States in this renewed enhancement of NATO's military defense is truly critical to its success and the continued existence of a Free World.

This issue of the *Army RDA Magazine* then, commemorates the 30th anniversary of NATO by featuring articles intended to foster the spirit and understanding of NATO cooperation. We have endeavored to incorporate articles intended to tell the U.S. reader audience how our NATO partners undertake their materiel acquisition. To that end the magazine owes a great measure of gratitude to the Ministries of Defense of the NATO powers, and to the Hon. John Walsh of NATO Headquarters, for the splendid cooperation extended to the magazine.

The Editors

★ ★ ★

JOHN B. WALSH who generously and appropriately provided this issue with the Foreword, has served as Assistant Secretary General for Defence Support, NATO, since 1977. He is responsible for effective application of resources related to armaments, research and development, production procurement and support, and for the NATO Infrastructure Programme. Prior to his present assignment, he was Deputy Director (Strategic and Space Systems), Office of Defense Research and Engineering, U.S. Department of Defense.

A native of New York City, he graduated (Summa Cum Laude) with a bachelor's degree in electrical engineering from Manhattan College in 1948, and he received an MS degree from Columbia University in 1950. He is a professional engineer in New York and New Jersey, and has authored three text books and numerous scientific and technical articles.

Additionally, he is a Fellow of the Institute of Electrical and Electronics Engineers, a member of the American Institute of Aeronautics and Astronautics and the New York Academy of Sciences, and he is listed in *American Men of Science, Who's Who in the South and South West,* and *Who's Who in Government*. He received the Department of Defense Meritorious Civilian Service Award in 1971 and the Department of Defense Distinguished Civilian Service Award in 1977.

DEPARTMENT OF THE ARMY

Headquarters
U.S. Army Materiel Development & Readiness Command
5001 Eisenhower Avenue
Alexandria, VA 22333

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DoD-314

CONTROLLED CIRCULATION RATE

SCULPTURED representation of the North Star, NATO's symbol as it stands in front of NATO Headquarters, Brussels, Belgium