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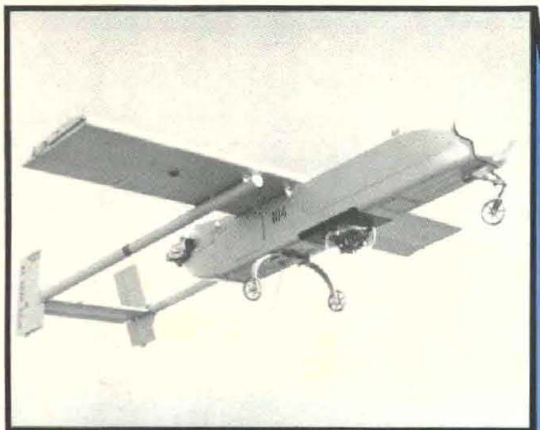
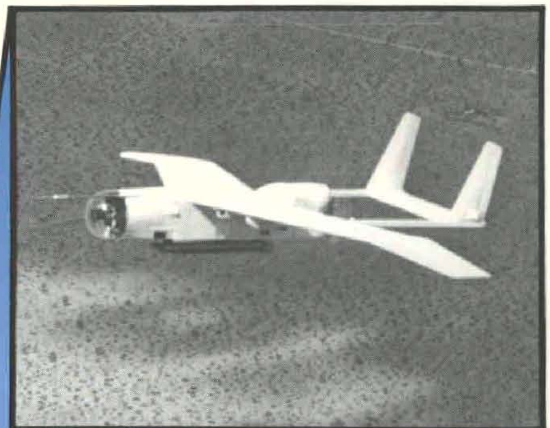
JULY - AUGUST 1984





REMOTELY PILOTED VEHICLES

ARMY R,D&A

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ABOUT THE COVER:

This issue of *Army RD&A Magazine* features a front cover story on Remotely Piloted Vehicles and their support equipment. Shown clockwise from the upper left are the Israeli Scout, Lear-Siegler's Skyeye, Lockheed's Aquila (currently undergoing full-scale engineering development for the U.S. Army), and the Canadian Canadair CL-227. A remote-controlled mine-clearing vehicle, under development by the U.S. Army Tank-Automotive Command, is displayed on the back cover. Cover designed by Carolyn J. Zakaski, HQ DARCOM Graphics Branch.

FEATURES

DEPARTMENTS

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Interview With GEN William R. Richardson

Commanding General, U. S. Army Training and Doctrine Command

Q. One of the primary functions of the TRADOC Systems Manager is to insure that the user is represented during development and fielding of a weapon system. How effective is he in performing this function?

A. I think the TRADOC Systems Manager (TSM) is performing his job a lot better now than he was in the past. We all once had a tendency to spend too much time tracking the weapons system itself—not giving much attention to the Integrated System Support which includes the training support package, the logistic support package, and the personnel support package. We have turned that around now.

The TSMs are committed to insuring that non-weapons actions are accomplished systematically so we end up fielding the total system. At various benchmarks it is his responsibility to notify TRADOC HQ on the status of the Integrated System Support. (We then notify HQDA and the rest of the field).

Specifically, we require the TRADOC Systems Manager to blow the whistle on the system—and that may mean on TRADOC—when something is not ready for fielding. So, we think we are organized better than ever for total system fielding and that we're doing a better job, thanks, in large measure, to the aggressive action by TSMs who are working the whole schoolhouse in logistics, personnel, and training matters. The user certainly wants the complete package. We think TRADOC Systems Managers are doing a pretty good job of representing the user.

Q. **Success and survival on the battlefield relate directly to the quality of training a soldier receives. How would you assess the quality of training received by the U. S. soldier and how does this training compare with that of the Soviet soldier?**

A. The quality of training received by the U. S. soldier today exceeds anything that I have ever seen in my career. Our Basic Training right on through Advanced Individual Training in the training centers and our training programs in the various branch schools are superb. They are tough, demanding training programs and they meet the needs of the soldiers' MOS requirements.

We have strengthened Basic Training over the last two years to include soldierization and we have carried that soldierization process on into Advanced Individual Training—thus reinforcing the important common skills all soldiers must have to be complete performers.

Our task is to provide units with soldiers that can go to war the day after they arrive. This is a tall order, but we are closer to meeting that goal than we have ever been. I would make another point: the training we provide is realistic. It is hands on and it is field oriented. We have stripped out those peripheral subjects which are desirable but not essential, and thus training is tough and demanding and the soldiers we have today respond to it in a magnificent way.

With regard to Soviet training, we know far more about the types of training than we do about the quality. But, I am convinced that our soldiers go through a more rigorous, comprehensive training program.

"The quality of training received by the U.S. soldier today exceeds anything that I have ever seen in my career. . . . Our task is to provide units with soldiers that can go to war the day after they arrive."

Q. **There has been some recent emphasis by TRADOC and DARCOM to intensify efforts to compress the materiel development cycle and to project requirements further into the future. Can you cite some specific examples?**

A. We in TRADOC are trying to do everything we can to compress the materiel development cycle. We've got the Army Science Board studying this very matter—trying to find out where it is that we in TRADOC and elsewhere in the Army can make substantial adjustments in order to reduce that development cycle, which is far too long. In many instances, by the time we are ready to begin engineering development for delivery to the field, the system is outdated and the technology has passed us by.

One thing we are doing is trying to go with more non-developmental items of equipment. That way, we can take something that has been tested and proven and go ahead and put it out in the field.

We also have probably been testing entirely too much and too long. We are taking a look at that and will see what we can do to cut down on testing where possible. We are going to a more generic requirements document and we think that will give us more flexibility in the provision of a technical solution to materiel needs.

As for projecting the requirements well into the future, we have a good assessment of that through our Mission Area Analysis. This provides us with the deficiencies that each commandant has in his functional area of responsibility. Then we provide those to the laboratories and insist that they work on those deficiencies in the tech base. As for specific areas, we are taking the whole chemical program and finding both administrative and procedural areas in which we can make some impact on the length of the cycle.

Q. **One of the stated objectives of the Mission Area Analysis process is to project potential battlefield deficiencies. How would you rate the success of this particular objective thus far?**

A. I would say "adequate." We have done extremely well in identifying deficiencies—bringing them to the surface and providing them for our own inspection. However, until the commandant in each of the schools takes those deficiencies and cranks them through a very thorough process in his mission area development plan, we will not be making substantive progress in correcting those deficiencies. That is the next step. From that we determine the true priorities that we will push for in the long-range RDA plan. In short, we have made a lot of headway the last few years, but we still have a long way to go.

Q. **Many people believe that the systems manager and the project manager must work closely in fighting unnecessary changes in weapon system requirements. What specifically has TRADOC done in this area?**

A. I completely agree that the TRADOC Systems Manager and the PM must work very closely on this. The TSM is a key player there . . . in fact, the school commandant is the other key player. The commandant, supported by the TSM, must discipline the system and must insure that the original requirement is maintained unless there is good reason to make a change in order to expedite the materiel development process.

Quite frequently we establish a requirement that is too tough to meet. You can see that this ends up causing changes and we're trying to quit doing that.

Our emphasis is to insure discipline throughout the system by proper controls, by proper visibility at TRADOC HQ and at the integrating centers, and by making sure necessary changes to requirements come through to DA only after a rigorous review by the Combined Arms Center and my headquarters.

Q. **What is the Army 21 Concept and what are its implications for TRADOC?**

A. The Army 21 Concept is a follow-on from AirLand Battle 2000 and is an important and far-reaching attempt to look into the future. We want to determine: what technology can provide us to meet the threat; how, in light of changing operational and organizational requirements, we can take the forseeable weapons and equipment systems and make them perform much more effectively than the comparable organizations and weapons of today are performing; and how to incorporate new thinking and new tactical doctrine to complement technological opportunities. Because TRADOC is in the long-range combat and doctrine development business—and for that matter training—Army 21 has implications for everything we do.

Q. **The delay of user testing until late in the acquisition process is often blamed for system inadequacies. What is your response to this criticism?**

A. I agree that user testing is often too late. We are in the process of correcting that and want to start some sort of an OT I early on. We must get the user involved right away so that we can look at the item from a user standpoint—look at its fightability and get some of those changes made that in the past have occurred far too late in the cycle.

We would prefer not to have to go to an OT III but instead make necessary changes or accommodations with OT I and then make final fixes with OT II. We can then continue to field items and use a final check with the first items in the field to make any added changes. The whole idea is to reduce the amount of testing and do the most important testing early.

Q. **A senior Department of the Army official recently stated that there is too often an unrealistic assumption that all equipment must work under all conditions and in all environments. What is your opinion?**

A. I agree with that official. I think, for instance, we often go too high and too low on the temperature scales in order to insure that an item of equipment will work almost anywhere in the world. We've got to take a more realistic approach and look at those environments where 90 percent or maybe even 85 percent of the time the materiel will be operative. We can save ourselves a lot of time and probably a substantial amount of money if we get smarter about how we state our requirements.

Q. **What advice or guidance might you offer to a TRADOC System Manager if he is to be successful?**

A. For a TRADOC Systems Manager to be successful, he must first truly understand the organizational and operational concept for the weapons system for which he is responsible—he must understand how it is to perform on the battlefield. Next, he must insure that the entire schoolhouse supports him in that endeavor.

The TRADOC Systems Manager has to work each element of training, logistics, personnel, and manpower into the total support effort for the weapons system. He must insure that all players are supporting him at all times in this endeavor and, if not, seek the support of the Director of Combat Developments or the Assistant Commandant. Next, he must appear to the world as an equal to the DARCOM PM in the whole life cycle process. The DARCOM PM has the money and manages production, but it is the TRADOC Systems Manager who has the final say as to whether the total system is ready for fielding.

Remotely Piloted Vehicles

By Paul G. Fahlstrom

On the modern battlefield, U.S. military forces will place increasing reliance on bold tactics and high technology to offset the numerical advantage of its opponents. Economy of force and the ability to see deep and strike deep are two significant elements in the tactical equation.

The remotely piloted vehicle (RPV) is a technological innovation which promises to be a key factor in allowing the battlefield commander to detect and strike the enemy deep in his territory with minimal expenditure of his forces.

What is an RPV?

There are three kinds of aircraft, excluding missiles, that fly without pilots. They are unmanned aerial vehicles (UAV), remotely piloted vehicles (RPV), and drones. All, of course, are unmanned so the name UAV can be thought of as the generic one.

Some people, including the author, use the terms RPV and UAV interchangeably. To the purist, the remotely piloted vehicle can be piloted or steered (controlled) from a remotely located position. The RPV is always a UAV but a UAV is not always an RPV.

In the past, these aircraft were all called drones, i.e., a "pilotless airplane controlled by radio signals," according to Webster's dictionary. However, today the term drone connotes a vehicle that has limited flexibility for accomplishing sophisticated missions and flys in a persistently dull, monotonous and indifferent manner, such as a target drone.

Whether the RPV is controlled manually or via a preprogrammed navigation system, it should not be thought of as having to be "flown," that is, controlled by someone that has piloting skills. RPVs used by the military usually have autopilots and navigation systems that maintain attitude, altitude and ground track.

Manual control refers to controlling the position of the RPV by manually adjusting the heading, altitude, speed, etc., through switches or a joy-stick in the ground control station, but allowing the autopilot to stabilize the vehicle and take over when the desired course is reached. Navigation systems of various types (radio, inertial) allow for preprogrammed missions which may or may not be over-ridden manually.

As a minimum, a typical RPV system is composed of air vehicles, ground control station, payload, and a communications or data link. In addition, many systems include launch and recovery subsystems, air vehicle carriers and other ground equipment.

The world's most sophisticated RPV system is probably the U.S. Army's Aquila. This system will be described in some detail because it contains almost all of the subsystems one would find in any RPV system and it provides a good standard upon which to compare other systems.

Aquila

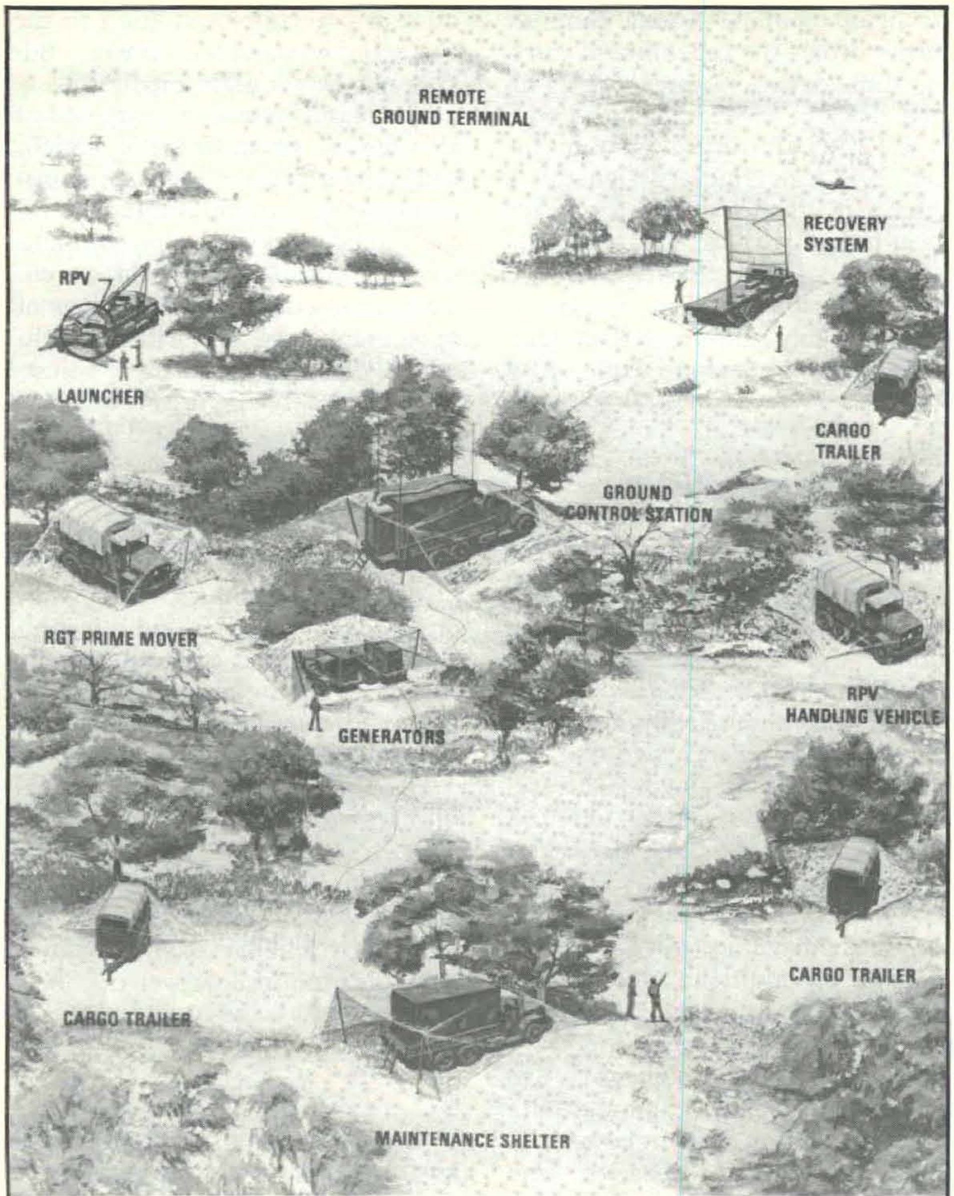
The Aquila's first priority mission is target acquisition, designation and reconnaissance, both day and night. It has the potential for many other missions such as communications relay, electronic warfare, mine detection, electronic intelligence, meteorological measurements, and psychological operations, just to mention a few.

A second priority mission is radio relay. Development of a VHF radio relay platform is now in the works. The Aquila battery will be located in armored, infantry and mechanized divisions. The system is composed of air vehicles, ground control station, remote ground terminal, a launch system, recovery system, maintenance shelter, air vehicle handler, supporting equipment and mission payload(s).

The deployed system is based on a centralized control concept utilizing two centralized launch and recovery systems and three forward control systems per division. The launch, recovery, maintenance, and other functions are conducted in the centralized launch and recovery system and the air vehicle is flown to the forward control system where it is handed-off (picked-up) for tactical missions near or behind the enemy lines.

Air Vehicle

The air vehicle is the airborne part of the system which includes the airframe, propulsion unit, flight controls, electric systems, and airborne data terminal. The airborne data terminal is also, of course, the airborne portion of the data link.



Aquila RPV System deployed in a combat scenario.

The airframe is approximately 6½ feet long, has a wing span of about 13 feet, and weighs about 250 pounds in the "all-up" mission configuration. The airframe is fabricated from preimpregnated kevlar-epoxy resulting in a very small radar cross section.

The propulsion unit is a two cylinder, two stroke, 26 horsepower air cooled engine driving a two bladed pusher propeller protected by a ring shroud. The airborne data terminal receives command signals (up link) and returns video signals (down link) to the ground control station via the remote ground terminal.

The air vehicle can fly at speeds of 50 to 100 knots and altitudes up to 12,000 feet. The flying wing configuration is highly suitable for net recovery.

Ground Control Station

The ground control station is the operational control center of the RPV system where telemetry and video data from the aircraft are processed and displayed. Command data are generated and relayed through the remote ground terminal. The environmentally controlled shelter contains a mission planning facility, three control/display consoles, video/telemetry instrumentation, a computer and signal processing group, internal and external communications, ground data terminal control equipment, environmental control, and survivability protection equipment.

The ground control station serves as a command post for the mission commander who performs mission planning, receives mission assignments from supported headquarters, and reports acquired data and target information to weapon fire direction systems. The station also has positions for the air vehicle and mission payload operators to perform monitoring and mission execution functions. Nuclear, chemical hardening and ballistic vulnerability protection techniques have been applied to the shelter design.

Remote Ground Terminal

The remote ground terminal is a trailer mounted microwave antenna that provides line-of-sight communications between the ground control station and the RPV. It is connected to the control station via two fiber optic cables (one redundant) laid directly on the ground.

The remote ground terminal transmits guidance and payload activation commands and receives flight status information (altitude, speed, direction, etc.) and mission payload sensor data (video, target range, etc.).

Launch System

The launch system is a mobile, foldable, hydraulic catapult. It consists of a structural base, catapult, engine starter, control console, communications equipment, and adaptor equipment mounted on a 5-ton truck. It is designed to accommodate an RPV weighing up to 264 pounds.

Overall length of the launch system when deployed is approximately 39 feet. The system may be operated from an unimproved site, on or off roads, under all required environmental conditions and can be ready for launch or reoriented for changing winds within five minutes.

Recovery System

The recovery system uses a vertical net and, like the launcher, is mounted on a 5-ton truck. The system is a vertical ribbon barrier made of nylon webbing that is suspended between two arms of an extended crane-like structure. The supporting structure is hydraulically deployed and can be rotated 360 degrees, to accommodate changing winds.

The barrier is approximately 14 feet high and 23 feet wide. The top is approximately 36 feet above the ground when deployed. When the RPV enters the net it extends lines attached to deceleration devices which absorb its kinetic energy and leaves it suspended in the net one meter above the ground in a nose down attitude. The RPV is then removed from the net and lowered onto a handling vehicle by a mechanical handling device.

Hydraulic power is provided from the truck power takeoff. The recovery system set up process takes less than five minutes and the automatic approach guidance units use an infrared quadrant mounted on the barrier structure to track the air vehicle. Approach path deviations are transmitted to the vehicle and corrections are made to assure safe capture.

Supporting Equipment

Ground support equipment essential to the RPV function includes a truck- mounted air vehicle maintenance shelter; an air vehicle handler and transporter (RPVs), and an air vehicle cargo vehicle (with three RPVs); and two trailer-mounted diesel powered generators.

Mission Payloads

Mission payloads are, perhaps, the most important part of the RPV system. The Aquila is flexible enough to accommodate many different kinds of payloads and has a payload capacity of 60 pounds. Aquila currently carries or has the capability of carrying three devices: a three-axis stabilized daylight television camera with type 4 YAG (Yttrium aluminum garnet) laser rangefinder/designator; a three-axis stabilized night package including a laser designator; and a VHF-FM radio relay system.

The payloads, when integrated with a highly jam-proof data link, make Aquila a formidable RPV system.

Other RPVs

The Israelis have two operational RPVs, the Scout and the Mastiff. Both are operational and have been used in combat. They have, however, limited payload capability (at this time) compared to Aquila.

Scout missions are real time reconnaissance, surveillance and artillery targeting and adjustment. The system contains air vehicles, ground control station, mobile launcher, recovery net, and payload(s). Although the Scout system is said to consist of three units (trucks), there is probably an additional truck or two included to carry air vehicles and ground maintenance equipment.

Scout is deployed somewhat like Aquila except that the ground data terminal antenna is mounted directly to the ground control station. The system is highly mobile and carried on standard Israeli Army trucks. When a section reaches the deployment site, each crew sets up its unit. Estimated set-up time is less than 60 minutes. Each section is manned by 12 Israeli Air Force troops.

Primary payloads for Scout are a daylight video and a camera system. The daylight video is a stabilized line-of-sight TV camera mounted on a two-gimbal stabilized platform. The TV camera video is down-linked to the control station video monitor. The picture is also recorded for later evaluation.

A photographic camera is carried with the stabilized line of sight TV camera. It can scan 60 degrees to each side of the nadir and provides high resolution panoramic photographic pictures. Scout can also carry other mission payloads in addition to the TV and photographic cameras, but does not have a night capability.

The Mastiff system is composed of air vehicles, ground control station, launch and retrieve systems, transportation and communication vehicles and payloads. Its missions include real-time battlefield surveillance using a daylight video system or photographic system with a high-speed developing facility, adjustment of artillery fire, use of electronic countermeasures, and the delivery of small explosives and chaff.

Mastiff carries a number of payloads, such as TV cameras mounted on either unstabilized or stabilized platforms, panoramic and motor-driven 35mm cameras and a combination of TV and still camera (the ground system can include photographic reproduction facilities if desired).

Like the Scout, however, the Mastiff does not yet have night and laser designator capability. The Israelis are reportedly developing a night capability. Laser designation in combination with the night capability is much more difficult if low weights, necessary for RPVs, are to be realized.

Skyeye

One might wonder if the U.S. has anything that is currently operational and comparable to the Israeli systems. After all, from what we know of the Scout and Mastiff, even if they don't meet the rigid Aquila specifications they are well within the state-of-the-art of RPV technology known to exist in this country, so someone here must have built something like them. The answer is yes. A small California company, Developmental Sciences, Inc., of City of Industries, has developed a family of Skyeye R4E air vehicles, many of which are in operation today. Developmental Sciences has recently been purchased by Lear-Siegler Astronics Division and is now backed by a substantial corporate capability. The system is currently in operation with an Army in the Far East.

A typical Skyeye section or platoon consists of three ground vehicles.

These are a ground control station, a launcher, and an equipment transport truck. A fourth vehicle, film processing unit, is optional. Air vehicles and payloads complete the full section.

The R4E series of air vehicles are twin boom pusher propelled aircraft powered by air-cooled engines with varying power from 8 to 40 horsepower. The R-4E-40, for example, weighs 280 pounds empty and has a 150-pound mission payload. It has a maximum altitude of approximately 20,000 feet and maximum air speed of about 135 knots.

The Skyeye 40 incorporates a three-axis position and rate autopilot and can be operated manually or preprogrammed. The wing span and length are 210 inches and 166 inches respectively. All Skyeye R4E RPVs use a skid landing system for recovery, however, a parachute landing is also available.

The Skyeye payload is enormous compared to other RPVs and can carry any of the current payloads, including Aquila payloads with the proper integration.

Canadair CL-227

The above are examples of currently available fixed wing, recoverable RPV systems that are useful for military missions. There are many other systems available or in development in the U.S. and consist of various shapes and sizes. The systems discussed so far typify the kind of capability that is necessary in an RPV if sophisticated military missions are to be accomplished. You will note that all of these systems require a catapult and net, flat surface or parachute for launch and recovery. To eliminate these subsystems, one can utilize a rotary wing concept.

The Canadian Government has made the decision to enter full scale development of a coaxial rotor RPV for their Army. Known as the Canadair CL-227, the system, because of its battlefield mobility and transportability, has application to U.S. Army light divisions and the U.S. Marine Corps.

The Canadair CL-227 is a real time surveillance and target acquisition system based on a rotary wing concept. The system is comprised of air vehicles, ground control station, a mobile takeoff and landing station, ground support equipment and payloads. The ground equipment and six air vehicles are carried on three 2½-ton trucks pulling one trailer. The system requires a minimum crew of six.

The air vehicle is rotary wing, and modular in design. The three modules are the power module, propeller/avionics module and payload module. Within each category, the modules are interchangeable so that an air vehicle can be assembled from a random selection of appropriate modules. The power module contains a Williams gas turbine engine, gearbox, fuel and all necessary engine accessories.

Canadair's engine uses standard military diesel fuel and is rated 42 horsepower (soon to be upgraded to 50 horsepower). The propeller/avionics module is comprised of the rotor blades and attendant parts such as hub, swashplate, linkages and actuators. The rotor system is a three bladed counter rotating coaxial arrangement where the tilt angle of the swashplate in pitch and roll translates into vehicle tilt and resolves the rotor thrust into vertical and horizontal components.

Yaw motion is obtained by differential braking of the upper and lower rotors. The avionics part of this module houses the autopilot, power supply, tether reel and lower brake assembly. The payload module contains space for a number of different kinds of fixed or gimbaled payloads.

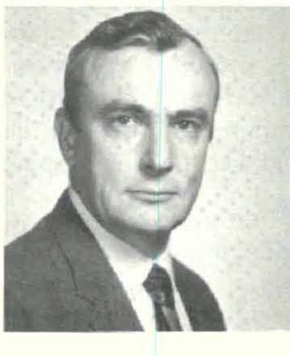
Canadair's mission payload capacity is over 45 pounds and the full scale engineering development version will up this to at least 60 pounds. The body of the vehicle is radar absorbitive material and the rotor blades are of non-metallic material resulting in a small radar cross-section. This, along with its rounded shape and vertical engine exhaust, make it very survivable.

Electronics necessary for air vehicle control, communications and image interpretation are contained in a shelter mounted on a 2½-ton truck. Data and command link electronics and associate antennas are mounted on a ¾-ton trailer that is remotely located approximately 50 meters from the ground control station. The RPV can be controlled manually or by preplanned programs.

The payload is a two degree of freedom TV camera. FLIR and electronic warfare systems similar to those previously discussed can be adapted to CL-227 but it currently contains only the daylight TV on a pitch and roll stabilized gimbal.

Summary

The Aquila was conceived almost 10 years ago for the Target Acquisition Designation and Reconnaissance System mission. Since then, a myriad of new missions and requirements have evolved, some of which must be accomplished by RPVs having characteristics different than Aquila. The Army is atuned to this changing situation and is prepared to acquire the kinds of systems, described herein, that best meet its needs.



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Improving The DOD Spare Parts Acquisition Process

By Carl Brotman

This article addresses the background and major actions taken recently within DOD regarding spare parts procurement. The term spare parts, when referred to in this discussion, includes spare and repair parts and, in many cases, support equipment.

Background

The DOD spare parts budget for FY1984 is about $20 billion and, as in most years, represents approximately 10–12 percent of the total DOD purchases. Nevertheless, spare parts acquisition involves the bulk of personnel employed in requirements, acquisition and supply functions because of the size of the inventory (about 4 million individual parts) and the large number of annual individual purchases.

The procedures involved in acquiring and managing spare parts are heavily labor oriented, even though the majority of parts and the majority of purchases have a low dollar value.

For all of these reasons, and more, spare parts have traditionally tended to escape the attention of top level managment although problems were periodically perceived by the public and the Congress during the past 20 years.

Elements of the current Office of the Secretary of Defense (OSD) began to consider methods for improved management of spare parts in 1981, particularly in the area of organization and mission responsibility. This effort has matured to the point where concrete management proposals have been developed and implemented.

Reports from DOD internal and contract audit activities began to cite problems with the pricing of spare parts in 1982 and early 1983. These reports were given wide publicity by the press and the media, and have been the subject of numerous Congressional hearings. It was clear that the problems were of long standing and systemic. They required top level attention and a strong commitment to change.

OSD Actions

Recognizing the need for top-level attention, the Secretary of Defense issued memoranda in July and August 1983 establishing 35 actions to be taken by the military departments and DOD agencies. The Secretary requested the Deputy Secretary of Defense, as Chairman of the Defense Council on Integrity and Management Improvement, to take the lead in providing overall guidance and coordinating the efforts of the DOD components to reform the management and acquisition of spare parts.

In support of this management oversight, the Principal Deputy Under Secretary of Defense for Research and Engineering has been holding bimonthly sessions with the DOD Services to track their progress and to provide a forum to interchange reform techniques and approaches.

The Deputy Secretary of Defense and top officials from the Services met and corresponded with representatives of industry associations and corporate chief executive officers to obtain mutual commitment to resolving the problems. The Inspector General was tasked to continue extensive review of spare parts, with periodic reports. The most extensive effort resulted in a report issued in May 1984.

In February 1984, OSD issued memoranda requiring the Services to identify the sources of production of spare parts during the provisioning process. The Services were also required to provide rules for allocation of costs so that unit prices are reflective of the value of the part, and to include a "most favored customer assurance" clause in all negotiated contracts for commercial end items or components.

During the course of briefings by the Services and the Defense Logistics Agency (which began in January 1984) to the Principal Deputy Under Secretary of Defense for Research and Engineering, the OSD staff led a task group in development of a model concept to provide incentives for contractors to focus attention on competitive procurement of spare parts early in the acquisition process. In

May 1984, the Services were asked to begin using the concept.

DOD reported to Congress on spare parts procurement in December 1983 as required by the Defense Authorization Act. A final report to Congress was made in June 1984. This report provides an overview of the initiatives and actions being taken by DOD to improve the management and acquisition of spare parts.

Actions by the Components

Each DOD component has formulated and is giving high level management attention to a written spare parts initiatives program. These initiatives address the functional areas of requirements, finance and budgeting, system development and acquisition decisions on spare parts, contracting, pricing, support, resources, and equipment.

Special task teams have also been established to review reprocurement data packages for currency, accuracy, and completeness. Data rights for competitive reprocurement are being evaluated and DOD has initiated an in-depth study for acquiring reprocurement data and data rights.

Additional resources have been assigned exclusively to value engineering tasks. The dollar threshold for spare parts contracts to contain a value engineering incentive clause has been reduced from $100,000 to $25,000.

Procedures have been established to identify and resolve pricing anomalies and to evaluate price increases over 25 percent. Additional purchasing personnel have been assigned to analyze significant price increases, negotiate reasonable prices, and accurately justify and document the price increases.

The purchase of spare parts, when the price has increased by more than 25 percent within the most recent 12 month period, has been prohibited unless the contracting officer certifies in writing to the head of the contracting activity that the price is reasonable or that national security interests require the parts to be purchased.

The DOD Parts Control Program is mandatory for all new systems in order to enhance the use of commercial or common parts, or parts already in the inventory.

The Services have been directed to change contractor overhead cost allocation practices which result in either distorted or unreasonable prices for spare parts. Equal allocation of overhead costs among all items in a contract has been barred because this accounting practice results in distorted unit prices.

Voluntary refunds have been secured, as well as suspension and debarment of offending contractors in appropriate instances. Most cases of overpricing involve accepted accounting practices for cost allocation, but result in skewed unit prices for low dollar parts.

Use of redeterminable ordering agreements has been eliminated in most instances and significantly curtailed even when dictated by readiness and support considerations. Preferred and traditional methods of contracting are being utilized, and every effort is being made to definitize the price in a timely manner.

The breakout program has also been strengthened by new procedures. A revised regulation with stricter procedures was issued in July 1983. A related initiative is the designation of breakout managers at all procuring activities.

Pricing "hot lines," which have been in existence for several years, are also receiving increased emphasis. Reports of suspected overpricing receive prompt and thorough review by inventory managers in order to correct erroneous prices and to resolve instances of overpricing by contractors.

In the training area, curricula have been expanded to include both entry level training and refresher retraining for journeyman.

Another improvement initiative is personnel evaluation factors. These are being revised to consider the achievement of economical procurement. Greater emphasis is placed on performance in keeping down costs and prices rather than achieving quantity production and speed.

Improvements in modernized automated data processing systems for logistics are also being studied. Plans call for better processing requirements, procurement functions and technical documentation systems. In addition, authorization, appropriation, apportionment, budgeting, and financial management practices and regulations pertaining to the acquisition of spares are being reviewed. The feasibility of biennial budgeting for all appropriations and programs of the Department of Defense is being studied.

Summary

All of the actions directed by the Secretary of Defense have been accomplished to the extent of establishing plans, policies and procedures. Implementation is an ongoing process, in some cases without finite conclusion.

The assignment and training of 3,500 additional personnel for spares in DOD is planned for FY 1984, and at least 2,300 more are being considered for FY 1985. Programs for modernization of automated data processing equipment and software for logistics management, procurement and data storage will be extended over a number of years.

The Defense Council on Integrity and Management Improvement has recently reviewed the status of our spare parts improvements and concluded that we have moved vigorously to improve our procedures. Efforts will be continued to fully institutionalize the improvements and assure everyday application.

CARL BROTMAN has been a member of the staff of the Secretary of Defense for three years. He was formerly employed with the Army as a contracts negotiator/administrator, procurement analyst, and was the Army Policy Member on the Defense Acquisition Review Council. He has a master's degree in business administration from George Washington University.

Improved Weapon System Reliability

The Key to a Secure Future

By GEN James P. Mullins, USAF

The following article was originally presented as a speech earlier this year during an Airpower Symposium at Maxwell Air Force Base, AL. It appears here in a condensed format. Although primarily geared to a U.S. Air Force audience, it offers some important insights for the Army.

For Americans, technology is the hen which lays the golden egg. That's why we've nurtured it and expanded it, and that's why we've enjoyed newly found powers unlike any ever known before.

One need only consider the technological advances in airpower alone and think of the tremendous capabilities we and our allies now have in the areas of reconnaissance, communications, and target destruction. Also, one need only remember that these are the capabilities which allow us to maintain the peace, and which give us the wherewithal to keep the free world free.

However, more and more, we're discovering that technology is a two-edged sword—one which provides great power, but one which also carries considerable danger—especially the danger of logistics dependency.

Indeed, today, more than anything else, it is logistics dependency which limits the operational capabilities of our forces, and in the process, threatens the ability of this nation to defend its vital interests.

Without doubt, the single greatest impediment to having real combat capability today is the large and growing logistics requirements of our modern weapons systems, a dependency born of sophisticated, immature technologies—a dependency resulting from our fascination with performance goals at the expense of reliability and supportability—and a dependency which could well compromise our strategy and tactics and ultimately, our entire national security policy.

In the past, things were much different than they are today. We enjoyed the luxury of relative security from our potential enemies. We were far away in both distance and time, protected by two oceans which we and our allies largely controlled. Military technology also had not yet made the skies a passageway to our industry, cities, and homes, and had not yet laid them open to attack.

Even in World War II, we were able to wait almost 18 months before launching into any major offensive against the enemy—in effect, making the most of our geographical security, resource independence, and the time allied resistance bought for us, before taking on the Axis powers.

However, the front-line of any future war will not be so remote. For one thing, such a war could well be fought right here in the United States. This is because our potential adversaries now also possess the military technology to quickly bring the conflict to our shores. Even if they chose not to, they could easily threaten, at the source, the many resources our complex, technological society absolutely relies on.

No one can argue that it is technology which gives us enormous capability. It is also technology which has increased the speed at which warfare can happen. It is technology which could bring the fighting and destruction to our homeland and which now creates substantial vulnerabilities inherent in the vital resource dependencies we have today.

However, more than anything else, it is technology which increases the requirement for logistics support because it breeds upon itself. It, in and of itself, creates the need for support which, in turn, generates the need for more technology.

The real solution to the logistics dependency problem, as I see it, boils down to doing away with the need for logistics in the first place—in effect, designing and building systems to be so reliable that they would not break, at least not during a sustained period of conflict.

If we could only think more in terms of such reliability and make the investment up front to design and build more reliable systems, then I'm convinced we'd have them on the ramp.

Just pause for a moment, and think of the enormous, almost incalculable benefits that would accrue from such reliability. Think about the force multiplier we would gain by having, say, F-15's which could deploy without specialized maintenance capabilities, war readiness kits, replacement engines, and the multitude of other things that this system needs to go to war today.

Think about how such reliability could improve the logistics support picture for our forces. Think about the flexibility we'd then have to fight whenever and wherever the need arose. Think about the increased deterrent value such a reliable force structure would provide. Also think about how much more secure the free world would be.

The up-front cost of making this kind of investment in reliability would be high, there's not much doubt about that. But perhaps it wouldn't be as high as many might think. Without doubt, the return in future cost savings alone would stagger the imagination, especially when you consider that we now keep our weapon systems for 20 to 30 years.

Try to imagine how much less our entire defense program would cost over a 30-year period if we could only get a handle on logistics dependency with increased reliability.

Imagine the cost reductions in maintenance. Imagine the potential savings in reduced airlift requirements, from transports to flying hours, and imagine what it would mean if we didn't have to recruit, train, and deploy as many maintenance technicians.

Across the board, we wouldn't need all those facilities, we wouldn't require all that equipment, and we wouldn't have to buy all that material. Avionics intermediate shops would become a thing of the past. Depot purchase equipment maintenance would be an anachronism of mediocre reliability and base precision measurement equipment laboratory requirements would simply fade away.

Frankly, a good part of the entire Air Force supply system would no longer be needed. In fact, base level functions could easily be reduced to fueling, munitions loading, launching, and recovery operations.

The incredible thing about all this is that much of what I'm talking about is well within the realm of possibility and well within our reach. Even today, we already have a good deal of the technology available to build in this kind of reliability.

The same technology which allows us to maintain missiles on alert with verifiable reliability, or blast satellites into a very stressful environment, with no failures and no need for calibration, is already substantially paid for and simply waiting to be applied to our other requirements.

We need only step up to the problem, pay the investment costs up front, accept whatever pain is associated with that and move out on the road to reliability. For like enduring a dose of cod liver oil, this may be the only way for us to ever really get healthy again, not only in terms of having projectible, sustainable combat capability but also in terms of making it affordable, and more acceptable, to many in our society.

In some cases, of course, we've already begun that journey. For example, the ring laser gyro is now predicting between 15,000 and 40,000 hours mean time between failure (MTBF). A recent modification of the Navy F-14 TACAN has increased its MTBF from only 10 hours to 2,000 hours.

Additionally, the Army's Blackhawk helicopter T700 engine breaks so infrequently that its mechanics have trouble maintaining their proficiency. However, this is just a small step in a very long journey. This is because the wide-ranging effort I'm talking about will take awhile to achieve, even if we begin immediately. This is not because we don't have the know-how, but rather, because it takes so long to bring new systems into the inventory.

What this means is that, in the meantime, we must deal with today's harsh realities. We presently have an extensive inventory, the operation of which is being increasingly wagged by a very large, sophisticated, and costly logistics tail.

In the past, of course, at least for us, this wouldn't have posed that serious a problem because we wouldn't have been keeping our systems for all that long. However, modern technology, with its long lead-times and high costs, has effectively changed all that.

There was a day not too long ago when we acquired large numbers of relatively unsophisticated and inexpensive weapon systems—systems which we then kept for an average service life of 10 years. That was a time of "use and replace"—a time when we simply discarded outdated or unreliable systems in favor of newer ones.

Just think of the bombers we built from the late 1940's to the early 1960's: The B–29's, B–50's, B–36's, B–47's (some 2,000 of them), B–58's, and B–52's. Remember that the B–52 is where it all stopped. In fact, much of the new capability we've acquired during the past two decades or so has resulted from modification of existing systems which, I might add, is a modern logistics function.

We are, of course, now seeing some new systems entering the inventory. But we must realistically expect that these systems too will follow a similar pattern with service lives being extended for 20 to 30 years and with logistics support requirements developing over a drawn out period of time because of the inherent unreliability of these systems.

Given this expectation, then, what we must continue to do in the near term is be as smart as possible in establishing support requirements for the systems that we have. This means buying the spares, engines, and piece parts necessary and gearing our strategy and tactics to the world as it is today, to the challenges we may really face, not to those we might hope to face.

We must acknowledge that our strategy and tactics will only work to the extent that logistics will allow. The weapon systems that make our strategies feasible depend absolutely on logistics support—on such things as fuel, munitions, spare parts, and maintenance. Yet, the painful fact is that our current logistics system cannot yet fully support the strategy and tactics we now rely on.

High vulnerabilities, long lead times, extended supply lines, immature unproven systems, and inadequate funding have increased the dangers of logistics dependency. These now stand between us and the true combat capability we need in the modern, military environment.

High technology has, indeed, given us great capabilities—but it has also given us a tremendous logistics tail which dictates what we can do. Yes, that's right. Logistics is the long pole in the tent of today's combat capability—for without it, we have none. In fact, how much combat capability we do have is directly proportional to the amount and kind of logistics we have made available.

However, for us to turn our back on technology to simplify, and thereby reduce the logistics burden would be the same as chopping off our right hand because our fingers hurt. Because technology is our great strength, it's what gives us the power to defend this nation. Although it creates serious problems, especially with regard to logistics, it also offers us the ultimate solution of total system reliability.

My position is, and has been, that the key to security in the future, whether it be our security or the security of others in the free world, will be reliable weapon system technology. Indeed, before we can find the security we seek, we must first develop the reliability we need.

I believe, with enough time, such reliability is inevitable. Oliver Wendell Holmes once wrote, "The mode by which the inevitable comes to pass is effort." That's why, given the challenges we face in the world today, I believe we must now step up to the problem, endure the pain, and put forth that effort—while we still have the time and resources to do so.

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Biotechnology and Its Applications to Military Medical R&D

By Charles Dasey

Unprecedented recent progress in the biological sciences has created an entirely new understanding of the internal functions of living cells and the molecular mechanisms that initiate and control these functions. This knowledge and the new laboratory techniques to study and exploit this knowledge are collectively referred to as biotechnology.

Various aspects of biotechnology now make it possible to manipulate cellular mechanisms. This includes the genetic material within living cells that controls heredity, and thus produces, at low cost, important biological products previously available in only limited quantities.

Enzymes can be isolated, purified, and used in the absence of living cells for biochemical synthesis. It is also possible to create small unique proteins, or to replicate sequences of Deoxyridonucleic Acid (DNA), the nucleic acids that make up cellular genes.

In still other techniques, it is possible to deliver drugs or other biological materials to specific cells by placing the drugs within microspheres or coating them with antibodies against the targeted cells. New methods using biological response modifiers are also available to stimulate or activate the immune system.

The ability to obtain highly specific antibodies produced by the fusion of a cancer and an antibody-producing cell has also created a technological breakthrough in diagnosing and treating infectious diseases.

Biotechnology encompasses all these rapidly improving and expanding capabilities. Until recently, the most important product of this research was basic scientific knowledge. However, practical laboratory and industrial applications of biotechnology are beginning to emerge.

Commercial products created by biotechnological methods are appearing in the market place in ever increasing numbers and varieties. These include medically useful drugs, immunological reagents needed for diagnostic tests, industrially useful chemicals, and some unique biomaterials (tissue glues, artificial skin).

The potential of biotechnology has been recognized by the Department of Defense. In fact, some of the most promising medical leads are already being exploited, as reflected in the DOD infectious disease R&D program, managed by the U.S. Army Medical Research and Development Command, Fort Detrick, MD.

A continuing medical program in biotechnology has been planned to obtain maximum benefit from it. Efforts in infectious disease research utilizing biotechnology will encompass basic research, exploratory development, and advanced development.

In addition to continuing efforts in vaccine and antibody development, there are plans to expand technology applications in programs in detoxification/decontamination, and immune response modifiers.

The Army's Institute of Dental Research is developing unique biopolymers for use as bone replacement material and fracture fixation plates for treatment of severe face wounds, and microencapsulated antibiotics for continuous prevention of infection for up to 14 days.

There is a recognized need to protect our military forces against infectious diseases found in diverse geographic areas and against virulent organisms and biotoxins that might be used as biological warfare agents against these forces. Therefore, a major goal of DOD research is the development and production of vaccines and antisera against bacteria, parasites, viruses, and toxins.

Ideally, a vaccine should contain only that portion of the infectious agent or toxin that would stimulate immunity. Classical vaccine production techniques generally employ whole organisms or toxins and result in products that may be infectious, toxic, allergenic, or contaminated by extraneous impurities.

Production by classical technology of "ideal" vaccines that have none of these associated drawbacks is prohibitively expensive, a fact that has, until now, restricted development efforts.

Genetic engineering, however, has provided the technology to bypass some of these problems. This is achieved by isolating genes or gene segments that code only for production of the "ideal" immunizing components, and the transfer of the selected genes into organisms that are easy to grow. A prime example of the significance of this technology is the DOD research effort to produce a malaria vaccine.

The malaria parasite has a complex life cycle: The infectious stage, a sporozoite, is transmitted to man by a mosquito bite. The sporozoite cannot be grown in culture and can only be obtained by dissection of mosquito salivary glands, a tedious task which makes impossible the collection of vaccine-lot quantities of sporozoites. However, genes that produce proteins found on the surface of the sporozoite (those recognized by the body's immune system) can be isolated and transferred into an easily grown bacterium, *E. coli*.

The *E. coli* will produce essentially unlimited quantities of sporozoite proteins which can be harvested for use as a vaccine. These techniques are being applied at the Walter Reed Army Institute of Research and the Naval Medical Research Insititute in a coordinated effort to produce a malaria vaccine. In addition, these efforts are coordinated with other Federal agencies, e.g., Center for Disease Control, U.S. Agency for International Development and the National Institute for Allergy and Infectious Diseases.

The first DOD attempt to develop a vaccine through recombinant DNA technology was a joint effort begun in 1981 by the U.S. Army Medical Research Institute of Infectious Diseases and Molecular Genetics, Inc. Their intent was to develop a subunit vaccine for Rift Valley Fever Virus. The segment of the virus believed to have antigenic properties has been cloned, and numerous monoclonal antibodies and antibody-producing hybridomas have been identified. An effective subunit vaccine has not yet been produced, but important fundamental knowledge about the pathogenesis of the disease and the nature of the virus has been established.

Biotechnology has also been applied to development of a vaccine against *Bacillus Anthracis*, or anthrax, as a potential biological warfare agent. Cellular components representing the protective antigen, edema factor, and lethal factor have been isolated from anthrax cells. The protective antigen gene has been isolated and successfully inserted into *E. coli*, and grown in culture. This is an important step toward a subunit vaccine for anthrax.

Walter Reed Army Institute of Research scientists have also developed an oral, typhoid/dysentery vaccine which has recently been shown to be effective in human trails. Prior to this application of genetic engineering, effective vaccines were not available for either disease. The potential exists whereby a single microorganism, which is a normal inhabitant of the GI tract, can be used to immunize man against multiple diseases acquired by ingestion.

In addition to these efforts, DOD laboratories are applying genetic engineering to the development of vaccines to protect against traveler's diarrhea, septic shock, botulism, typhus fevers, and several insect-borne virus infections such as dengue and hemorrhagic fevers. All of these are significant military problems.

The number of militarily significant infectious diseases is extensive. However, it has not been possible or feasible to develop protection against all of these diseases. The planned program addresses those diseases with the greatest potential for resolution by genetic engineering.

Recombinant DNA technology can be used to develop microorganisms or their products for the treatment of geographical areas (land or water), materiel, and the personnel exposed to biological or chemical toxins. Products primarily developed for medical application may also assist materiel decontamination and the demilitarization of obsolete or aging agents.

The medical community has known that inoculation with certain types of microorganisms (pertussis, tuberculosis) could confer non-specific, limited protection against unrelated microorganisms. Recently, it has been demonstrated that certain biological substances, e.g., interferons, produced in extremely small amounts by host cells, are at least partially responsible for this non-specific protection.

Through genetic engineering techniques, it is now feasible to produce sufficient quantities of several types of interferon to evaluate their efficacy in the prevention and treatment of infectious disease. Efforts are being directed toward the identification and production of other biologically active substances and immune system stimulants.

A hybridoma is a culturable cell line produced by fusing genetic material of immunized lymphocytes and a tumor (myeloma) cell line. These hybrid cells can produce antibodies with the ability to grow for long periods in culture. These antibodies are termed monoclonal antibodies and are homogeneous, highly specific, and can be produced in large quantities for many years.

In addition to combining with and neutralizing infectious microorganisms and toxins, monoclonal antibodies are also proving to be extraordinary specific diagnostic reagents.

Monoclonal antibodies are also a vital part of the DOD's vaccine development program and rapid identification/diagnostic system for detection of biological warfare agents/disease. These antibodies are invaluable tools for identification and isolation of subcellular components of infectious agents which can subsequently be produced by recombinant DNA techniques for use as vaccines.

This technology is currently being applied to all the major DOD vaccine efforts. The ability to produce large quantities of monoclonal antibodies is essential to the development of rapid identification and diagnostic methodologies.

Monoclonal antibodies, until recently, were obtained from mouse hybridomas. However, current developments in hybridoma technology have made it possible to fuse human lymphocytes with cancer cells to produce human antibodies. These antibodies can confer short-term, specific resistance (passive protection) to a variety of infections and toxic diseases for which vaccines are not currently available, such as dengue and botulism. Human antibodies, in contrast to those produced in animals, do not evoke allergic reactions and are effective for longer periods.

The application of sophisticated technology to biological systems is also increasingly effective in the development of biomaterials. Microencapsulation of antibiotics is accomplished by creating a homogenous mix of antibiotic and biodegradable polymee in the form of microspheres.

Antibiotic is released into a wound over a predetermined period as the polymer degrades. New technology allows any one of several antibiotics to be encapsulated, or a combination of antibiotics, creating an all-purpose wound dressing.

Controlled release of antibiotics is also possible when a microporous polymeric film, immersed in antibiotic, is used as a bandage. Antibiotic is metered into the wound through the tiny pores in the film for up to three days.

The U.S. Army Institute of Dental Research is also investigating bone replacement material and fracture fixation plates made of Krebs cycle polymers which can be absorbed by the body as they degrade. The bone replacement material, successfully tested in laboratory animals, is intended for use in maxillofacial surgery when sections of bone are missing.

The bone material maintains the shape of the jaw during healing. It has also been tested in conjunction with a proteinlipid additive that promotes the early stages of wound healing and bone regeneration. Fracture fixation plates made of polymers which the body can absorb will remove the need for follow-up surgery to remove nondegrading fixation devices.

Significant advances in the application of biotechnology to DOD medical research have been accomplished. These advances in the development of new and more effective techniques for vaccine production, rapid and accurate diagnoses, biological and chemical decontamination, and biomaterials are expected to continue, and lead to further discovery and progress.

CHARLES DASEY is the public affairs officer at the U.S. Army Medical R&D Command. He holds a BA degree in English from Fordham University and is a graduate of the Army's Advanced Public Affairs Course.

A U. S. Army Security Assistance Center Perspective

Release of U.S. Technology to Allied and Friendly Nations

By Willis C. Robinson III

The transfer of U.S. technology occurs regularly as part of allied procurements of U. S. Army weapons and equipment. It is in the national interest to insure that the opportunity for compromise, or the undesirable exploitation of this technology by the foreign recipient is minimized. The following is a discussion of the mechanisms by which this objective is achieved, while simultaneously supporting the legitimate defense needs of allied and friendly nations.

Defense sales by the U. S. Government are conducted primarily in support of national foreign policy and strategic goals, with statutory approval authority for all security assistance requests residing with the Department of State.

Commercial sales of hardware and software, identified as arms, ammunition, and implements of war, are also controlled by the Department of State under the U. S. Munitions Control Program. Both the Security Assistance and the Munitions Control Programs are executed for the U. S. Army by the Army Security Assistance Center, HQ DARCOM, Alexandria, VA. These programs are regulated by the Foreign Assistance Act of 1961 and the Arms Export Control Act of 1976, as amended.

Commercial sales of items which are not strictly identified with military applications (so called "dual use" items) and trade with communist countries are regulated by the Department of Commerce under the Export Administration Act of 1979.

This article will be confined to the U. S. Army Security Assistance and Munitions Control Programs, and will not address Department of Commerce licensing since the Export Administration Act is currently under comprehensive revision by Congress.

Security Assistance Procedures

Clearly, the transfer of U. S. technology is, to varying degrees, a part of virtually all sales of U. S. Army hardware and software to foreign customers, whether done on a government-to-government basis, or through commercial channels. In point of fact, release of U. S. technology via these methods has been an object of critical attention for several years among U. S. Army elements that execute arms transfer programs.

Concern for monitoring and controlling the release of technology and concern for other potentially adverse impacts which might result from such sales was translated into U. S. Army Security Assistance regulations in the late 1970's. As a result, a structured review process exists which provides the means to develop fully coordinated U. S. Army recommendations on specific foreign requests before they are evaluated by higher authority.

Many of the new DOD procedures resulting from recent DOD technology transfer initiatives have been used, on a smaller scale, within the U. S. Army security assistance community for a number of years. They include: a formalized staffing process beginning with an evaluation by the engineering elements who develop and manage the hardware at U. S. Army laboratories and major subordinate commands and ending with a review by OSD; execution of program specific technology assessments identifying risks associated with release of specific technologies; and political-economic evaluations and legal reviews.

It is important to note that Security Assistance and Munitions Control Programs are not generally intended to support the exchange of data and know-how and the sharing of resources, or for soliciting reciprocity in cooperative programs. They exist primarily to provide the U. S. defense community with an organized means to legally respond to requests for defense assistance from allied and other friendly foreign governments.

A distinction must be made between these programs and cooperative R&D programs. There are significant differences in the way these programs are developed, implemented, and managed. Simply stated, security assistance and munitions control involve "customers," not partners.

The Review and Decision Process

Technology is a commodity that is purchased and released only after consideration by the military departments and a final decision by the legally designated authority. For Security Assistance Programs, both Foreign Military Sales and coproduction, this decision authority is delegated to the Defense Security Assistance Agency by the Department of State.

Authority is redelegated to the U. S. Army on a case by case basis to negotiate, conclude, and implement coproduction programs under international agreements, referred to as Memoranda of Understanding, or sales under Letters of Offer and Acceptance.

Figure 1 depicts the DOD review and decision process on Foreign Military Sales cases, coproduction, and the sales of technical data. Security assistance requests from foreign governments are generally sent through U. S. Embassies to the Secretary of State (Bureau of Politico-Military Affairs) and the Secretary of Defense (Defense Security Assistance Agency).

After State-Defense coordination, requests are sent to the U. S. Army Security Assistance Center for action. All negative recommendations concerning foreign requests must be coordinated with the Defense Security Assistance Agency (Directorate for Operations) through Headquarters DA (Deputy Chief of Staff for Logistics).

Army recommendations evolve through the staffing process and numerous factors are incorporated into the final Army position. This decision reflects the interests of the technical community (laboratories,

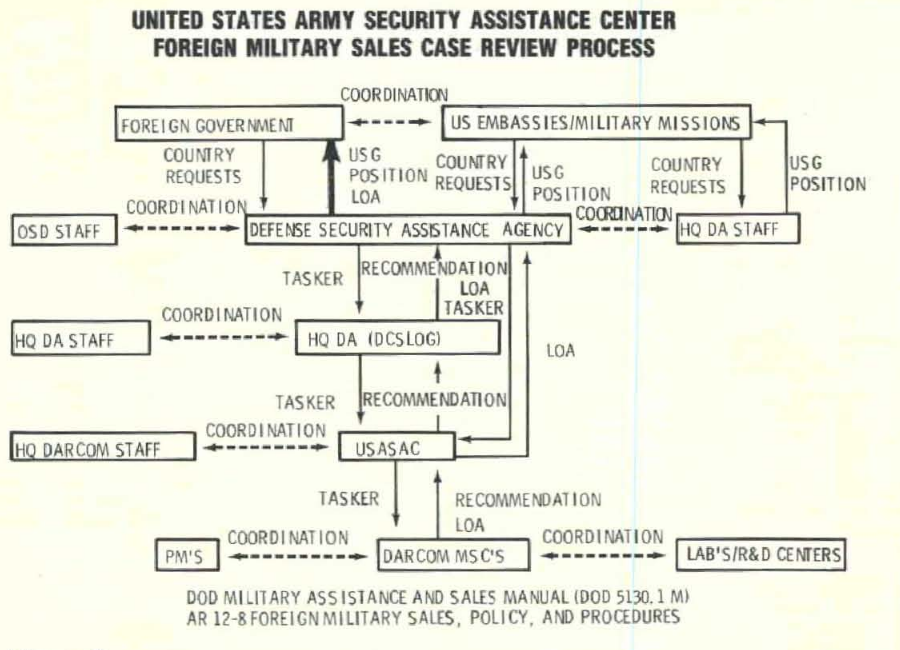


Figure 1.

project managers, R&D activities), legal ramifications, logistics support considerations, and the overall impact on the U. S. Army.

The Army has no authority to act independently on any foreign initiative without approval from OSD and no "prior authorization" is given before a country's request is submitted.

The most common commodities sold through security assistance channels are hardware and U. S. Government owned technical data associated with fielded Army equipment, not R&D items.

The government knows that hardware can be "reverse engineered" and technical data evaluated analytically to obtain know-how which is not intended to be a part of the sale. Therefore, technology release risk and production base impact are a major part of the Army/OSD review process.

Coproduction

Coproduction programs merit special attention in this discussion. Although coproduction is a Security Assistance Program element, which is essentially an alternative procurement method to a simple hardware sale, it can sometimes be a double-edged sword. The benefits of improved international cooperation can be quickly devalued if significant technological advantage is lost through the undesirable release of U. S. know-how.

One should keep in mind that countries do not enter into coproduction programs with the United States simply to acquire defense hardware. They regard coproduction first and foremost as an economic program, and as a means to upgrade their technology base. Furthermore, it is also a "given" that few governments will enter into defense related coproduction programs without considering third country sales.

Sales to third countries actually represent an economic imperative for coproducing countries since indigenous production requirements are usually insufficient to support amortization of the coproduction investment. Add to this the fact that a local defense industrial base is created or augmented, and it's easy to see that a long term need is generated to maintain that base in a state of readiness (just as the U. S. defense industrial base must be "fed" with continuing production requirements). This is fundamentally a technology release problem which must receive consideration prior to approval of all coproduction initiatives.

Third country sales from coproduction programs also tend to proliferate technology and capabilities in a way that is totally removed from U. S. Government influence. Accommodations must be reached between the coproducing parties which minimize the adverse impact of third country sales on the U. S. Government.

If a prospective coproducing country is a poor risk in terms of living up to agreements, then potential consequences of program implementation should be fully assessed.

Memoranda of Understanding

Consequently, controls on technology releases are established through the negotiation of Memoranda of Understanding before the program is approved. These international agreements provide the only comprehensive means by which the U. S. Government maintains active participation and is able to monitor the execution of coproduction programs. This has a direct beneficial impact on the "technology transfer issue."

The need for the U. S. Government to be an active participant in coproduction programs does not stem strictly from a "protectionist" point of view. There is also a benefit to the coproducing country because it facilitates, on a reimbursable basis, access to U. S. Government support services such as configuration management, quality assurance, testing, production engineering, and follow-on logistics support.

Implementation of programs under such agreements is the most effective means by which we can simultaneously participate in and monitor the end use of the capabilities which we provide to the customer.

Memoranda of Understanding function also as comprehensive statements of work delineating the mutual obligations of government participants for the duration of the program. As with any program involving the exchange of information, the accomplishment of work, expenditure of funds, maintenance of records, and accountability for performance and reporting systems are crucial. The Memoranda of Understanding are the vehicles for establishing reporting systems through the identification of reporting requirements, the designation of project officers, and the establishment of a program management structure.

Munitions Control

As indicated earlier, munition control cases involve the commercial export of hardware, technical data, and know-how which are identified on the U. S. Munitions List as arms, ammunition, and implements of war.

The U. S. Army Munitions Control Program is designed to review and recommend approval or disapproval of export license applications referred to the U. S. Army by the Department of State. This covers the license requests for manufacturing agreements, transfers of material and services, conduct of promotional activities, demonstrations, and related technology release through commercial channels.

Regulation of munitions control activities is defined in the State Department's International Traffic in Arms Regulations, commonly known as the ITAR. Department of State policies strictly govern actions and decisions on all commercial munitions list export applications.

Of the 8,000 or so cases involving Army materiel processed by the State Department each year, the U. S. Army reviews about 2,000. The State Department approves or disapproves the remainder, based upon precedent cases or other factors out of the purview of the U. S. Army.

The U. S. Army Munitions Control Program is supported within the Army with a staffing and review process which parallels that of the Security Assistance Program, although decision elements above DARCOM are different. The practical advantage of this, from the standpoint of technology release issues, is that the same people in DARCOM who review Security Assistance Programs, review munitions control cases. The review process has four basic goals: prevent export sales from interferring with Army programs; prevent the export of critical technology; consider rationalization, standardization and interoperability implications of proposed sales; and provide Army views on the national security impact of proposed exports.

Figure 2 shows the mechanism by which these goals are achieved. It is primarily the quality of the review at the hardware proponent level that determines whether or not the goals cited above are realized.

As with security assistance reviews, the input to the decision process begins with those closest to the hardware and technology, and works its way up through functional staff elements to eventually become a coordinated Army recomendation to be submitted to OSD (Under Secretary of Defense for Policy).

Once OSD approves a recommendation it is forwarded directly to the Department of State, Office of Munitions Control, which has sole authority to approve or disapprove the license application.

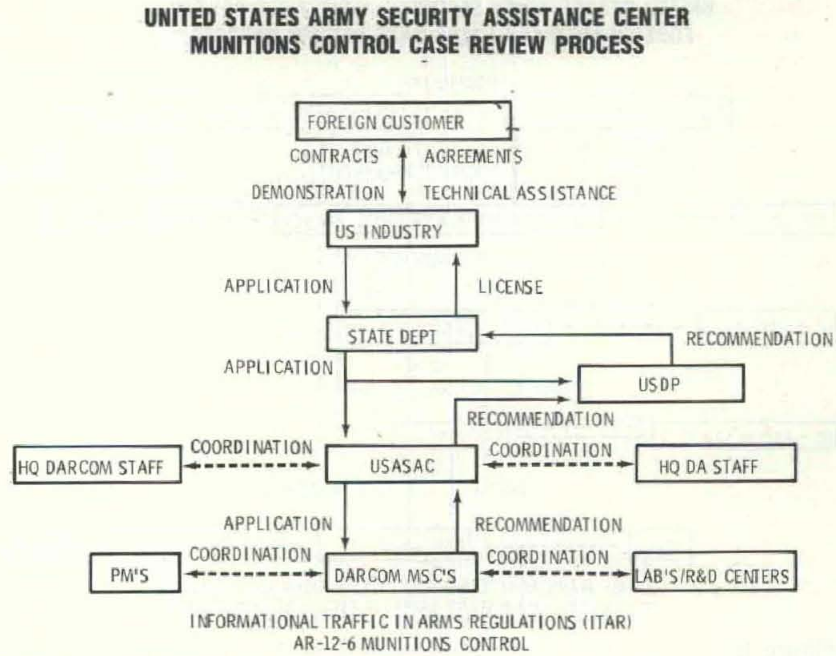


Figure 2.

Army Evaluation

Specific elements of the Army evaluation are: identify items and data and their intended end use; determine the current national security classification of the items or data and decide if release would lead to the disclosure of classified military information; determine the impact on Security Assistance Programs; assess impacts which can be related to DA R&D, production, procurement, and supply for U. S. Armed Forces; describe the effect on readiness of U. S. forces and the U. S. production base; assess the significance of articles proposed for export in relation to any technology release issues which may apply; and conduct an operations security review to determine if articles can be released.

The U. S. Army is given 20 work days to complete its assessment of each case and forward a recommendation. Considering the fact that cases must be sent to various locations across the United States, all concerned must, and do, exercise good management practices in discharging their responsibilities to make the system work.

There is a uniform awareness of the need for objectivity, caution, and fairness among all Army reviewers since mistakes can be costly (literally and figuratively) to the customer, to the U. S. contractor, and to the U. S. Government.

Summary

The U. S. Army Security Assistance Center and other Army elements in the review process are performing a crucial service for their country and friendly and allied nations relative to Security Assistance and Munitions Control Programs.

In the clamor that has arisen over "technology transfer," many people have failed to realize that the two major "legal" methods of executing defense sales abroad have been operating for some time under established controls which have prevented unwanted technology leakage, while simultaneously serving legitimate defense interests.

Few problems occur or persist when initiatives are subjected to established procedures. It is when the system is circumvented that most of the problems arise. These programs have always operated on the premise that informed decision making can only be based upon complete and up to date information applied on a case by case basis.

Regardless of the future scope and limitations of U. S. Army transfer policies, the systems and procedures described here will continue to operate, not just to protect U. S. technology, but to support the interests of the U. S. Government and its allies in a manner that provides maximum benefit to both sides.

WILLIS C. ROBINSON III is Chief of the International Programs and Technology Management Division, U. S. Army Security Assistance Center. He holds bachelor's and master's degrees in industrial engineering from California Polytechnic State University and Texas A & M University, respectively, as well as a bachelor's degree in German and Russian language from Florida State University. He is a graduate of the U. S. Army's Production Engineering Intern Training Program and is a senior member of the Institute of Industrial Engineers.

TACOM Builds Mine-Clearing Vehicles

The U.S. Army Tank-Automotive Command (TACOM), Warren, MI, has begun fabricating two prototypes of a remote-controlled mine-clearing vehicle now under development. The project is part of a joint developmental effort that also involves the Army Engineer School and the Belvoir R&D Center, Fort Belvoir, VA, and the Army Armor and Engineer Board, Fort Knox, KY.

Referred to as the Robotic Obstacle Breaching Assault Tank, the vehicle would accompany assault forces, and deploy mines by launching rocket-propelled lines of explosives into mine fields. Upon landing, these explosives would dentonate sequentially across the mine field and cause nearby mines to explode, thereby clearing a path for other vehicles.

The Army currently does not have a vehicle designated for mine clearing in its inventory. Assault vehicle crews have had to rely on combat engineers using hand-held metal detectors and bayonets to locate mine fields.

The robotic prototypes will consist of modified M60A3 tanks. The Engineering Support Directorate of TACOM's R&D Center is fabricating the prototypes, using as a guideline a concept vehicle produced and tested last year at Fort Knox. Modifications will include replacing the turret with an armored podlike structure that will protect the explosive lines.

Other changes will involve mounting a mine-clearing roller assembly on the front of each vehicle. Weighing 10 tons, this assembly will ride along the ground six feet ahead of the tracks and detonate any mines in its path not destroyed by the explosives.

Mounted to the rear of each robotic tank will be a lightly armored box containing a device that will mark cleared lanes for other vehicles by dispensing small candles that produce chemically induced light. Also, each vehicle will have a control system to permit the operator to guide it and launch the explosive lines from a remote location.

The pod in each prototype will house two metal containers, which will each carry a coiled, 350-foot-long explosive line. Engineers have evaluated alternative ways of carrying the explosive lines. It was determined to design the pod to carry horizontally packaged line charges.

Each pod will also contain two launching rockets—each being connected to one of the explosive lines and mounted to the underside of the roof of the pod. During launching, the roof will pivot open to provide the proper level of elevation for the rockets.

When a rocket is fired, it will quickly uncoil the line from its container and carry it over the mine field. After the line travels 150 feet from the vehicle, a lanyard attached to the inside of the container will then stop the explosive line's foward motion and force it to land.

After detonation of the line, the robotic tank operator will then remotely guide the vehicle through the cleared lane to explode any mines still present. At the same time, he will activate the lane-marking device.

When the Robotic Obstacle Breaching Assault Tank prototypes are completed—in about a year and a half, they will undergo eight months of testing at Aberdeen Proving Ground, MD, and Fort Knox. The final design will be produced at Anniston Army Depot in Alabama. Anniston will produce 142 of the vehicles for immediate deployment.

The preceding article was authored by John DeWald, a senior combat vehicle engineer at the U.S. Army Tank-Automotive Command (TACOM) and George Taylor III, a technical writer/editor, TACOM.

ROBAT Mine-Clearing Vehicle with pod containing explosive lines in down position.

New TACOM Dynamometer May Improve Engine Test Procedures

By Robert J. Watts and George Taylor III

The U.S. Army Tank-Automotive Command (TACOM), Warren, MI, and Hamilton Test Systems, a subsidiary of United Technologies, have jointly developed an automated dynamometer test-cell control system for use by Army depots to inspect rebuilt engines before returning them to service. A great improvement in engine test facility efficiency is envisioned.

The system is called the Universal Depot Inspection System and two prototypes are now operating successfully at Mainz Army Depot, West Germany. In September 1983, TACOM awarded a competitive contract to Hamilton to produce systems for domestic facilities.

Under terms of the contract, the firm will build and install four systems at Red River Army Depot by the end of 1984. Also, a contract option to buy an additional three systems, two more for Red River and one for Tooele Army Depot in Utah, was exercised by TACOM in March.

During a conventional dynamometer test-cell setup, the operator first moves the engine into the cell and mounts it in place by use of a crane or engine cart, depending upon which Army depot is performing the testing.

The next step is to "dress" the engine. This means attaching the engine test points to the various transducers, hydraulic lines and interconnecting cables. These connections are required to feed electric signals representing measurements of oil pressure, engine speed and torque, coolant temperature and other parameters into the signal conditioning electronics for dial gauges, which are monitored by the operator.

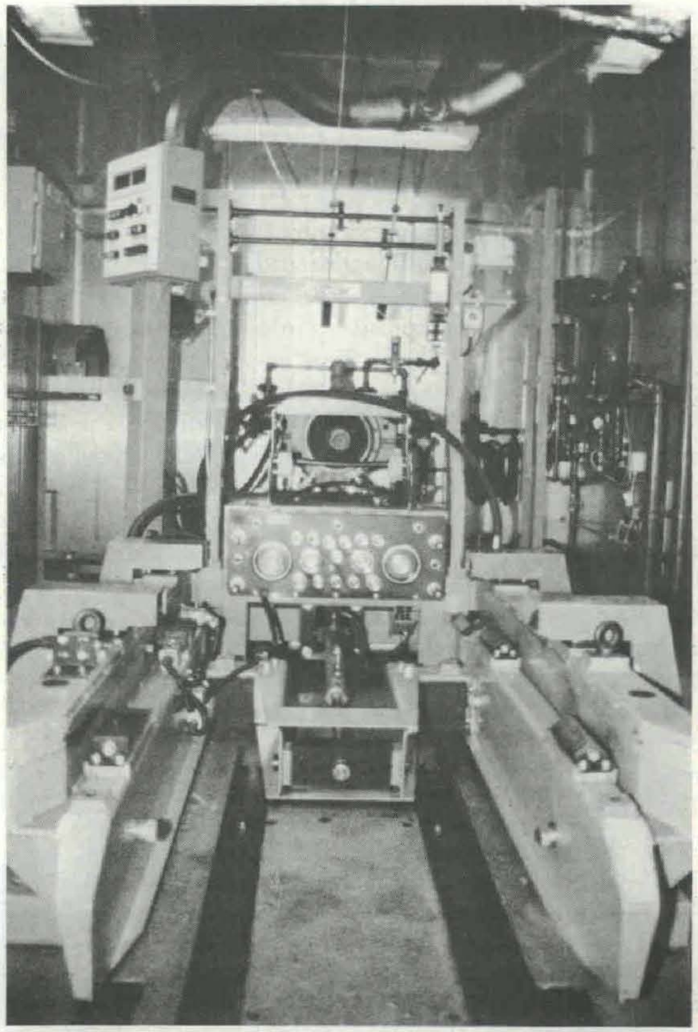
The operator next couples the engine to the dynamometer drive shaft and connects the test-cell services, such as the air intake, fuel and coolant, needed to run the engine. This is a very labor-intensive and time-consuming procedure. Depending on the type of engine being tested, the procedure can take up to two hours.

The operator then starts the test sequence, and must remain at the cell controls throughout its entire length, which exceeds two hours. All acceptance test documentation must then be manually recorded by the operator.

The new Universal Depot Inspection System is designed so that the time-consuming engine dressing and undressing are done outside the test-cell on a mobile engine handler or trolley. With this arrangement, the hour or more normally required to set up an engine in a cell can be reduced to 10 minutes, thereby nearly doubling the inspection capacity.

Additionally, the new system can be programmed for fully automated control and monitoring of tests. It also provides both hardcopy and computer-compatible documentation of the dynamometer test results.

Besides performing the usual final performance checkouts of rebuilt engines, the improved depot inspection system will, for the first time, permit routine preshop engine inspections to identify overhaul requirements.



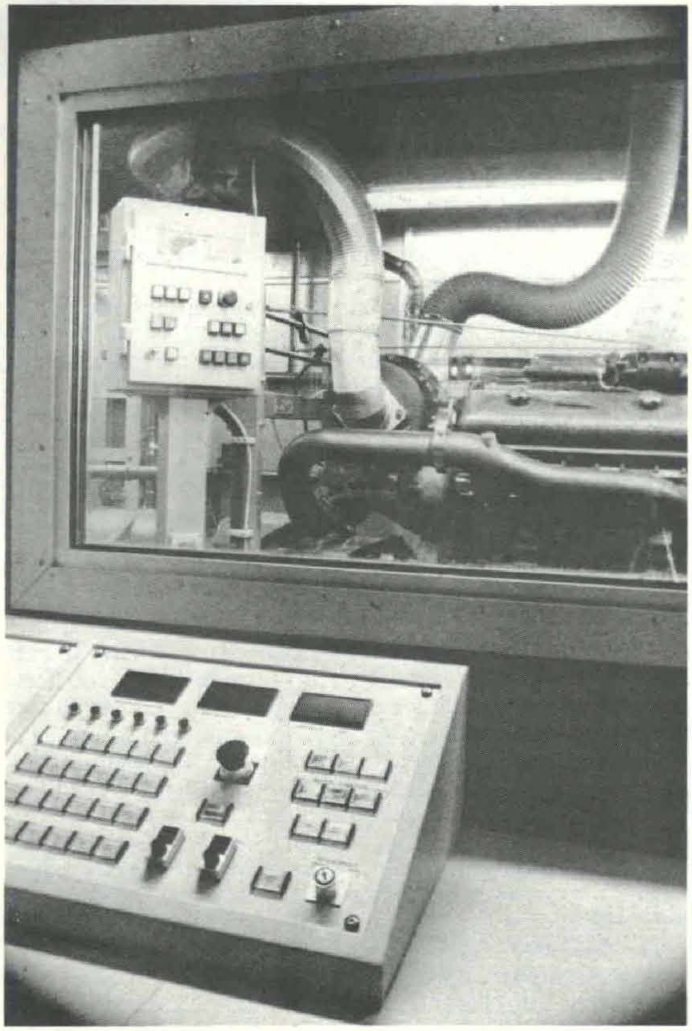
Test stand with hydraulic ram and matchplate facilitates in-cell hookup time of less than 10 minutes from trolley cell entry until initiation of test. The combination of engine handler and test stand automated hookup increases dynamometer test cell utilization for engine performance inspection by more than fifty percent.

Currently, Army depots are only able to put a small percentage of engines received from the field through preshop inspections. This is because the capacity of their test cells is limited. They have their hands full just testing the engines they rebuild.

The Universal Depot Inspection System features modular construction that permits a variety of test configurations. It consists of an automated inspection and diagnostic system, two mobile transducer consoles, two operator control consoles, two test bed systems and an edit console.

The automated diagnostic system is a mobile, self-contained, computer-controlled data processor. It provides an automated capability to control and monitor two engine dynamometer test-cells simultaneously. It also includes a magnetic disc storage unit that stores engine inspection test results and a teletypewriter which can produce printout copies of the results.

The universal system provides one mobile transducer console for each test cell. This unit makes it possible to use the automated unit to perform out-of-cell diagnostics on engines mounted in vehicles or on separate pallets, as well as in-cell testing.



Operator's view of both control panels and the engine under test.

One operator control console and one test bed system for each dynamometer cell of the two-cell system are also part of the depot inspection system. The operator control console contains all necessary hardware for initiating automated dynamometer and engine test monitoring when used with the automated diagnostic system. Additionally, should the diagnostic computer fail, it allows the operator to control and monitor the tests manually.

Located outside the test cell, this console includes a video display unit which enables communicaton between the automated diagnostic system processor and the operator, while in the automated control mode. The operator uses the video unit to enter engine/operator identification and visually observed information, as well as to request engine test/sequence status information during testing. The video display is also used to inform the operator of his required actions and to display alarm or shutdown information.

The operator control console also includes a control panel which provides all controls and digital displays for manual operation of the system. Additionally, the control console contains electronic circuitry that receives and processes incoming transducer signals and feeds them to the panel digital displays and the automated inspection and diagnostic system computer. Digital displays are provided primarily for use during manual operation, but are also active during automated operation.

The test bed system includes a permanent in-cell control panel, engine throttle controls, an engine test bed assembly and three mobile engine handlers. Also part of the test bed is a termination cabinet. This cabinet contains various permanent in-cell transducers and is the junction box that connects the Universal Depot Inspection System modules, including the mobile transducer console, to the engine and to the dynamometer.

The edit console is intended for use by supervisory personnel to create or alter diagnostic system computerized test schedules needed to verify that rebuilt engines meet performance requirements. It has a printer for entering new instructions into the diagnostic computer, and a video unit which confirms that the computer has logged the instructions.

To test an engine in a dynamometer cell which is controlled by a depot inspection system, the operator first enters a description of the type of engine to be tested into the diagnostic computer from the operator control console video unit. After a video message appears, indicating that the information has been logged, the operator moves a dressed engine mounted on a mobile engine handler to a load/unload point at the test-cell entrance. The appropriate button on the in-cell control panel is then pushed and a hydraulic mechanism draws the engine handler into the test bed assembly so that a match plate on the handler engages a match plate on the test bed assembly.

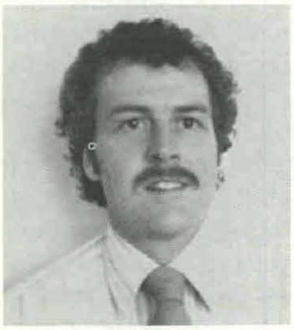
The plate engagement automatically connects all test equipment and cell services to the engine, except for cranking system battery power, exhaust-system and air-intake services, the throttle and fuel cutoffs and dynamometer drive shaft. These are connected manually

AIDS is a data processor that can simultaneously control and monitor two engine test cells. It stores test data on magnetic discs and prints hardcopy test results for both in-cell and out-of-cell engine testing.

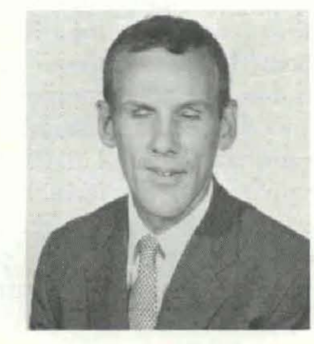
with quick-connect couplers.

After all connections have been made, the operator starts the automated test sequence. He is now free to dress or undress other engines on the two remaining mobile engine handlers, while the Universal Depot Inspection System modules control, monitor and log the engine test data during the dynamometer acceptance test cycle.

Inspection systems now being built are being designed for testing Detroit Diesel Allison 6V53 and Army-designed LD/LDS/LDT 465 engines. Plans are now under way to automate additional test cells at Mainz, Red River and Tooele, as well as at Letterkenny Army Depot and Army facilities in Korea. The Universal Depot Inspection Systems for these cells will be designed to test a variety of engines, including the 1790-cubic-inch Teledyne-Continental Motors power plant used in the Army's M60-series tanks.



ROBERT J. WATTS is a project engineer and group leader in the Army Tank-Automotive Command's (TACOM) Product Assurance Directorate.



GEORGE TAYLOR III is a technical writer and editor at TACOM.

Air Defense Engagement System Simulates Battlefield Scenarios

White Sands Missile Range, NM, one of the most sophisticated test ranges in the free world has tested most of the Army's air defense missile systems, dating from the Nike Ajax. Who, though, evaluates how well test crews perform with the system in the field?

According to Dr. John Lockhart, psychologist and team leader with the U.S. Army Research Institute Field Unit at Fort Bliss, TX, little information is available for making such an evaluation. When White Sands does tests, it does not usually include complete weapon system crews and command units operating in a realistic battlefield environment. It is impractical because of the cost of range time and dedicated aircraft. Also, there is no ready supply of enemy aircraft to provide the realism of a modern battlefield.

Instead, psychologists such as Lockhart must look at piecemeal data, trying to view the whole picture from just the pieces. This has forced them to make assumptions, which they do not like to do, especially when dealing with the life and death situations of war. Training, doctrine and tactics are based on these assumptions and if they are wrong it could lead to disaster on today's battlefield.

Dr. Lockhart and his team have devised a simulation system which will give scientists the needed data on troop activities such as search, detection, aquisition, tracking, lock-on and firing. The system is called Realistic Air Defense Engagement System. The data can be used to validate current training, doctrine and tactics or to develop them for new systems.

Currently, Lockhart and his team are testing the system at Condron Field, six miles southeast of WSMR's main post. The key to the system is a group of radio-controlled, propeller driven, one-seventh scale model aircraft. The models sound like chain saws but are built to resemble a variety of friendly and enemy aircraft, including the U.S. F-16 and Russian MIG-27.

There are also non-flying, one-fifth scale versions of the U.S. Cobra and Russian HIND-D Helicopters.

The idea is to move an air defense unit into the test area, put the soldiers on alert and have them react to any situation as if it were the real thing. Meanwhile, the institute's psychologists and the sophisticated computer system watch, record and measure the unit's actions.

The various battlefield scenarios are played out using model aircraft instead of the real thing. Initially the planes will be flown by expert radio-controlled aircraft pilots, with plans calling for eventual computer control. The hostile planes will fly using Warsaw Pact maneuvers and tactics.

Because the aircraft are subscale, the rest of the test activities can be scaled down in size. For instance, real enemy aircraft might be expected to attack at an altitude under 200 feet. Lockhart's models will fly at one seventh that, at 25 to 30 feet off the ground.

The contractor for this effort is Science Applications Inc. Three years of actual testing and data gathering are scheduled to begin after validation testing is completed. Data will be collected from the Redeye, Stinger, Vulcan and Chaparral weapon systems and their crews. Later, information will be gathered on Roland, Night Chaparral, Stinger-POST and Sergeant York systems and crews.

The $960,000, 3-year contract includes the computer hardware and software, the vans and the radio-control system for the models. The computer keeps track of and controls the aircraft, runs the various battle scenarios, records crew events and does calculations to determine if a hit was made against any aircraft.

Data Collection Program Can Assist Logistics Planners

How much does it cost to run an M1 tank for a year or a mile? How many mechanics are needed to support the M1 at the various levels of maintenance? What parts are being consumed in high quantities?

The preceding questions, along with innumerable others are asked every day by logistics planners. Rather than just waiting for the problems to occur and attempting to solve them within the normal course of events, logistics planners and others can take advantage of a proactive program designed to develop management data.

Known as Sample Data Collection, the program, as prescribed by AR 750–37, AR 750–1 and further explained in DA Pamphlet 700–24, is designed to collect information that is not available through other sources. It is generally conducted by a private contractor to reduce collection burden on military personnel. Executive agent for the program is the DARCOM Materiel Readiness Support Activity, Lexington, KY.

The data collection program is the only existing system at the unit level that looks at the wide spectrum of operation and support factors such as: adequacy of integrated logistic support and logistic support analysis; how to determine reliability, availability, maintainability and durability and reliability centered maintenance characteristics; operating and support costs; necessary product improvements; future materiel requirements; improvements to predictive models; assessment of operational performance; quality of test and evaluation plans; results of warranty programs; maintenance personnel requirements; repair parts provisioning; and test measurement diagnostic equipment requirements.

The M1 Sample Data Collection Program began in 1982 and is continuing under a contract issued and administered by the U.S. Army Tank-Automotive Command at Warren, MI. Compliance with provisions of the contract is monitored by the Test Measurement Diagnostic Equipment and Analysis Office, which also produces the Scope of Work document which details the specific requirements for contract performance.

At present, three tank battalions, involving 58 tanks each, are undergoing sample data collection. They are the 2nd Battalion 67th Armor, Fort Hood, TX, the 2nd Battalion, 64th Armor, Schweinfurt, Federal Republic of Germany and the 3rd Battalion, 64th Armor, Schweinfurt.

Each tank company has a full-time collector who records every maintenance incident from crew through depot level. Collectors use six different forms. This data is then converted to computer input and sent by telephone to a data bank located in Arlington, VA. This bank is maintained under a separate contract.

In the case of Germany, the telephone hookup is enhanced by use of the INFONET satellite to provide data within 48 hours. These data are made available to authorized subscribers by telephone terminal or magnetic tape. Among the present subscribers are the M1 Project Manager, contractors, Army Armament, Munitions and Chemical Command, Army Materiel Systems Analysis Activity and RCA.

A semiannual report is produced by the DARCOM Materiel Readiness Support Activity which uses a magnetic tape supplied each six months. This report provides a summary of the data produced by the collectors. The summary includes: average miles and hours per quarter and per year; number and miles between maintenance actions; times to perform maintenance; number and hours of scheduled and unscheduled maintenance; maintenance ratios; fuel and oil consumption; repair parts consumption and costs; and operation and support summary.

Of the three types of sample data collection (free flow, semicontrolled and controlled), the controlled approach is the one used by the M1 program. It is the most accurate and requires the collector to be very knowledgeable in unit maintenance and Prescribed Load List procedures. Review of The Army Maintenance Management System forms and repair parts forms is essential.

The collector must also understand and observe intermediate forward and rear and depot level supply and maintenance systems (USAREUR only). Collectors must do this in a manner that does not disturb or influence maintenance or supply personnel.

Collectors are not allowed to assist or make comments to maintenance personnel. In order to gain accurate data, collectors must collect data both in garrison and when the unit goes to the field and to track recoverable components back through supply and maintenance channels.

For roughly half the price of one tank we are able to gather a variety of useful information to support hundreds of present and future M1 tanks. Benefits gained from the Sample Data Collection Program are:

- Increased emphasis on rebuild/overhaul rather than purchase of new parts. The majority of repair parts costs are for recoverable components that can be repaired at savings of 60–70 percent over new.
- Development of a data base upon which to examine and project operation and support requirements.
- Creation of an awareness at the "front line" that what happens there is important at the national level.
- Establishment of a forum for the development of standardized maintenance analysis and planning factors.

Research material for the preceding article was provided by Thomas J. Holly, Jr. and Brian Suma, Maintenance Directorate, U.S. Army Tank-Automotive Command (TACOM), and Mike Fecek, PM Office, M60 Tank, TACOM.

AMMRC Provides Diverse Engineering and Fabrication Services

In addition to its management of materials and mechanics research programs, the Army Materials and Mechanics Research Center (AMMRC) Watertown, MA, serves the DOD community in other capacities. One of these little publicized activities offers direct support to project managers and systems developers by providing comprehensive engineering and fabrication services required at various stages of development.

During past years, AMMRC's facilities (described below) have played a major role in providing both selected prototype hardware and total preproduction systems. Program managers have recognized the benefits of manufacturing their development components at the research center responsible for managing and conducting materials research and development programs.

Available facilities coupled with the in-house problem solving capabilities offer an unmatched resource within the Army. Current systems actively being supported include the XM-785 nuclear projectile (prototype manufacturing of complete system and accessories) and forging of 735 fuze components.

Forging

AMMRC's metalworking facilities offer a unique combination of metalforming equipment. Vertical hydraulic presses range from 500 to 2,000 tons. The largest, having hot die capabilities, is used for closed die forging. Cogging and back extrusion are generally accomplished on a 1,000-ton open die press.

Drop hammers rated at 500 and 3,500 pounds are available for both closed die forging and general metalworking applications. A three-inch diameter upsetter and a small general purpose two high hot or cold rolling mill (20-inch max width) are also available.

Gas and electric batch and rotary furnaces are used for the metalforming operations and in support of subsequent heat treat requirements. Direct extrusion capabilities (1,000 ton) are being brought on line and will soon be available.

Machining

The machine shop has a full range of capabilities and is able to rapidly respond to the needs of commodity commands in the development of new ordnance systems. Activities include preparation of diverse items such as: test specimens, prototype components for various weapon systems, tooling for metalworking, and special laboratory fixtures and equipment required for the in-house research and development programs.

The broad spectrum of capabilities is made possible by the availability of both standard machine tools and many unconventional units with unique capabilities. Standard tools include a large complement of lathes, milling machines, shapers, grinders, power saws, and drill presses. Units with unique capabilities include electrospark discharge machines, ultrasonic impact grinding machines, hydraulic tracing copy lathes, an optical curve generator grinding machine, and assorted free abrasive grinding and lapping machines.

Depleted Uranium Facilities

AMMRC's metalworking facilities can process, under controlled conditions, depleted uranium alloy castings into forged barstock or components. This facility has in the past for example, forged depleted uranium artillery shell components and kinetic energy penetrators. In addition, the main machining facility is supplemented by a special controlled facility for machining uranium and beryllium alloys.

Melting/Heat Treating

Special facilities are available for melting and heat treating reactive metals. Button melters, using a nonconsumable electrode suitable for preparing small melts of experimental compositions or master alloys, are in service. Vacuum furnaces, with an 800-pound capacity having provisions for oil or water quenching at controlled rates, partially support these facilities.

Other facilities available for the prototype development of emerging weapon systems include: hot and cold pressing units with capacities of 7 and 10-inch diameter, operable at 200 tons and 2,000 °C as well as electroplating equipment.

Organic Materials

AMMRC also has a prototyping capability in its Organic Materials Laboratory which can process both thermoplastic and thermosetting matrix materials and is experienced with glass, carbon and aramid reinforcements. Available equipment includes filament winding, pultrusion, injection molding, extrusion, and vacuum forming in addition to hand layup.

Curing facilities include a variety of laminating presses (50, 100, 300 ton), ovens and an autoclave. AMMRC has produced prototypes ranging from launch tubes for rockets to vehicle components, in addition to production of test specimens with a documented history for use in both in-house and external test programs.

Additional information on these services may be obtained from Roger Gagne, AUTOVON 955-5579, Commercial (617)923-5579, or Dr. Bernard Halpin, AUTOVON 955-5100, Commercial (617)923-5100.

Ammunition Inspection Device Uses Compton Detectors

Development of a more automated and less costly system for inspecting Army ammunition is in progress at the U.S. Army Armament, Munitions and Chemical Command's Armament R&D Center, Dover, NJ.

Identified as the Automatic Inspection Device for Explosive Charge in Shell, it is an automatic, filmless radiographic system for inspecting a large variety of ammunition, ranging from 40mm to 8-inch rounds. It is located in the Armament R&D Center's Radiological Facility, which is equipped to support nondestructive testing programs.

The system uses Compton scattering detectors to provide a 3-dimensional analysis of the explosive filler. It can also find base separations, and detect voids with diameters as small as one-sixteenth of an inch. The term Compton refers to Arthur Compton, the American physicist who discovered the change in wave length which occurs with scattering X-rays.

"This is the most significant advancement in inspecting artillery ammunition in 40 years since X-rays were used in World War II," says Emmett Barnes, a physicist with the Armament R&D Center's Product Assurance Directorate. Barnes explains that certain types of defects cannot be seen on film, but the new device can find all defects and also perform an automatic computerized analysis. He adds that considerable cost savings will also be achieved by eliminating the use of X-ray film.

The shell is placed in the hydraulically-driven mechanical handling subsystem for the start of the scan. Radiation generated by an accelerator is focused into a narrow beam which is directed through the shell. Radiation scattered by the charge within the shell is detected and converted into electronic signals for computer processing.

By allowing each detector to measure only a small volume within the shell, highly localized density changes are quickly and accurately measured. The scan pattern brings the total internal volume of the shell past the inspection point. Measurements obtained by this method are largely unaffected by the thickness of the steel shell wall.

The automatic inspection device also provides a written inspection report for each shell and it graphically displays the data using a color graphics monitor. This is displayed similar to a medical CAT scanner. The graphics display can be used to gain quick insight into the results of analysis changes as well as for a process control.

The system was developed as part of the Army Manufacturing Technology Program. The Product Assurance Directorate and the Production Base Modernization Agency provided funds for the project. According to Barnes, current plans call for a production system for the Iowa Ammunition Plant in the 1986 timeframe.

Emmett Barnes, physicist, loads shells into AIDECS (Automatic Inspection Device for Explosive Charge in Shell) prior to automated evaluation of explosive charge. After scanning the projectile, the device will provide a complete report on any defects found and make an accept/reject decision according to the military specifications for the shell.

Army Employee Terms Arms Control Job 'Highly Satisfying'

Mention arms control and, for most people, the picture that comes to mind is of representatives from the top echelons of several governments meeting in a stately hall in some European capital. Issues far too technical for ordinary mortals to grasp are being negotiated in lengthy, formal sessions.

Few think of a federal employee with a daily office job in Huntsville, AL, as being part of the arms-control process. Nevertheless, there is a nitty-gritty side to it, in addition to that of high-level parleys. One need only talk to Dr. Thomas Patton at the Ballistic Missile Defense (BMD) Organization in Huntsville's Research Park. Patton is the Arms Control and Treaty Advisor to the BMD Organization. Moreover, he is the Army's only full-time advisor on those subjects.

Patton occupies an office no different from that of his BMD coworkers, and he participates frequently in meetings with them. But Patton's working vocabulary sets him slightly apart from the rest of the BMD workforce. It is sprinkled with bits of a special jargon—terms such as "mobile launcher," "1974 Protocol," "treaty verification," and "Standing Consultative Commission."

Such terms have special meaning to Patton, even if they're a bit mystifying to others. His specialty is to interpret the broad language by which nations make long-term agreements like arms control treaties.

For instance, there's the U.S.-Soviet Anti-Ballistic Missile (ABM) Treaty of 1972, which Patton deals with most. The treaty initially allowed each nation to have a limited ABM system to defend its national capital and another to protect an intercontinental ballistic missile (ICBM) launch area. A 1974 protocol to the treaty limited each nation to only one of these systems, either in defense of the capital or an ICBM launch area.

That may sound clear-cut and straightforward to adhere to. In fact, Patton said, the treaty and protocol are replete with language which is "deceptively simple."

"The ABM Treaty, unlike most treaties, stipulates what *is* permitted," he explained. "The text of it is specific about some things, but in other areas it uses very broad terms. That means that, in determining what we can or cannot do, we have to have an understanding of what the parties to the treaty *intended* to control."

Patton cited what he says has been "one of the knottier problems" in maintaining treaty-compliant programs.

"Article V prohibits each side, among other things, from developing, testing or deploying mobile land- based ABM systems or components. What exactly does 'mobile' mean, though? Does it just mean that a system can't be on wheels? Or, does it mean that a system, or even components, must be permanently fixed and can't ever be moved by any means?"

Questions such as this directly affect the features which can be considered by the planners and engineers with whom Patton works as they propose ballistic missile defense system concepts and conduct a research and development program.

Patton, who has held the BMD Arms Control and Treaty Advisor post since it was created two years ago, said the job is a highly satisfying one for him.

Data System Eases Container Design Efforts

Designing and acquiring new containers for shipping and storage of weapons and other defense items is often a costly and time consuming procedure. However, this need not be the case, thanks to an existing system which is available for use by the Department of the Army and other DOD agencies and activites.

Known as the Container Design Retrieval System, it is a computerized data base operated by the U.S. Air Force Armament Development and Test Center, Eglin Air Force Base, FL. Its basic objective is to save time and money by reducing design and test efforts for containers of new items, and by identifying for reuse, container assets already available in the DOD's inventory.

The retrieval system's data base contains more than 14,000 shipping and storage container designs that have been successfully employed for a wide variety of DOD items.

When properly used, the system offers the potential of saving a program manager large sums of money which might otherwise be spent on duplicating earlier designs. The system has already reportedly saved the Department of Defense more than $23 million in container development and production costs.

Established by AR 700-16, the retrieval system can be implemented by incorporating MILSTD 1510 in contracts. This results in a requirement on the contractor to conduct an inquiry into the data base prior to designing any long-life reuseable container. The Container Design Retrieval System Management Office must also be provided with a copy of all drawings for long-life containers.

Staffed by packaging engineers and specialists, the retrieval system management office also validates container designs against hardware designs and locates useable surplus containers that could be modified to support hardware delivery schedules.

Additional information on the Container Design Retrieval System may be obtained from: Ted Stretmoyer, DARCOM Packaging, Storage, and Containerization Center, AUTOVON 795-7648 or commercial telephone (717) 894-7648.

ProLog '84 Display Shows Logistics Capabilities

ProLog '84—Progress in Logistics—A Transportation Center and School-sponsored demonstration held earlier this year at Fort Eustis, VA, provided a display of current and future Army capabilities to distribute supplies in a theater of operations coinciding with Army 21 tactics.

Present sustainment capabilities were included, such as conducting logistics-over-the-shore operations where fixed ports are denied or not available, conducting fixed port operations, and distributing supplies in a theater of operations. ProLog '84 also raised the curtain on the Army's future logistics distribution system as some of the newer and more exciting state-of-the-art developments were demonstrated.

The Belvoir R&D Center's central role in the Army's quest to sustain itself now and in the future was also graphically displayed. Most of the equipment demonstrated in ProLog '84 was a product of the Belvoir R&D Center's technical developmental efforts.

Products of the Center's Logistics Support Laboratory in materials handling, marine, and water and petroleum distribution equipment were featured in the logistics-over-the-shore operation and fixed port container discharge display that made up the event.

Rough terrain forklifts were used to offload breakbulk supplies from the Center's lighterage and the 140-ton crane was used to offload containers from another Center development, the Lighter, Air Cushion Vehicle, 30-ton.

The highly-maneuverable and mobile 50,000 pound Rough Terrain Container Handler, adapted and procured by the Center, was used to marshall containers on the beach. A Center-leased item, a 65-ton crane, was used to load and unload the Center's Army Milvan containers from trucks in the container marshalling yard. This crane is being considered by the Army because it can efficiently store containers where land is restricted.

Center-connected equipment was also the highlight of the logistics-over-the-shore static display. It featured petroleum distribution equipment, including underwater pipelines, a tactical petroleum terminal, hoseline, fuel pumps, firefighting equipment, railroad tank cars and fuel dispensing equipment.

The fixed port display included such Center items as the temporary container discharge facility with its 250-ton crane, the 140-ton crane, floating crane, forklifts, landing craft, tugboats, barges for liquid and deck cargo, railroad cars and diving equipment.

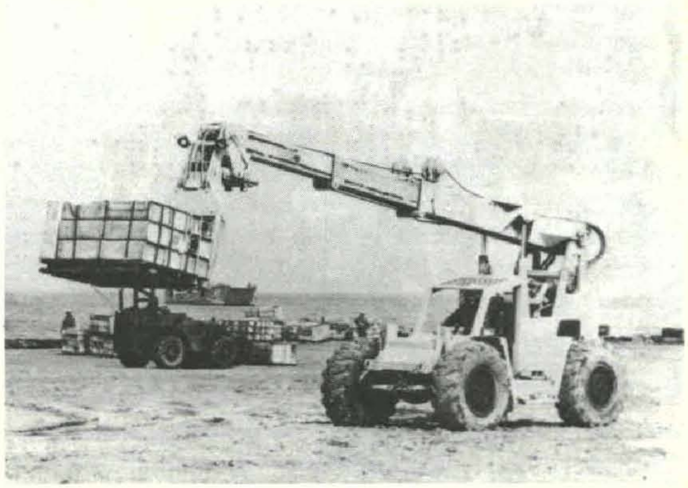
The future glimpse included the Center's variable reach forklift, a candidate to replace the military designed 6,000-pound rough terrain forklift, now used extensively in the field. The variable reach forklift has a boom extending to 30 feet, allowing the operator to load and unload palletized ammunition, missile pods and other supplies from 20-foot shipping containers.

The highlight of ProLog '84's glimpse of the future was the Palletized Loading System. It was originally leased by the Center for the 9th Infantry Division where it has been evaluated.

The palletized system uses a truck to combine an efficient payload-to-weight ratio with a quick and efficient cargo handling capability. In operation, the truck uses its hydraulic arm to load and unload flatracks onto itself and its companion trailer. This combination can carry up to 30 tons of supplies and distribute them on the battlefield.

The Palletized Loading System's unique capability to recover itself when mired and to repel itself through marginal mobility terrain was also demonstrated. Its potential in an integrated battlefield distribution system is being assessed.

The Palletized Loading System.



A variable reach forklift.

2 Firms Receive Licensing Rights for CERL Inventions

The Department of the Army has granted exclusive licensing rights for two inventions developed at the U.S. Army Construction Engineering Research Laboratory (CERL) to two firms in the Midwest. The two licensing agreements are the first of their kind within the U.S. Army Corps of Engineers laboratory system.

Assistant Secretary of the Army for Research, Development, and Acquisition Dr. J. R. Sculley signed over the licensing rights on the products to the presidents of the two firms. National Standard Corp. of Niles, MI, received rights to the Weld Quality Monitor, and APS Materials Inc., of Dayton, OH, received rights to the Ceramic Anode.

The licensing arrangement provides for a joint program between CERL and National Standard Corp. to continue research and development on the Weld Quality Monitor. Both corporations will pay a five percent royalty to the federal government for use in further research. In return, both firms will have exclusive rights to manufacture the inventions.

The Weld Quality Monitor is a technological breakthrough in that it identifies the quality of a weld as it's being placed. Frank Kearney, inventor of the Weld Quality Monitor, points out, "the existing technologies for determining the quality of a weld are all applied after a weld has been placed." Use of the device can prevent the costly reworking of defective welds which in some cases is five times as expensive as their initial placement.

The Ceramic Anode is a result of CERL's corrosion research efforts. One Ceramic Anode will protect 100 square feet of bare metal from rusting, or up to 10,000 square feet of painted metal. It can be installed at one-half the cost of the previously used silicon-iron anode, is 1/500th of the weight, yet provides the same protection as the larger anode.

COL Paul J. Theuer, Commander and Director of CERL, says, "these licensing arrangements will ensure the commercial availability of these Army products to both the Army and private industry."

The Weld Quality Monitor has already been designated for Army use in the production of tanks and weapon systems, and in the construction of some civil works structures. Other potential applications in the private sector include the construction of pipelines, nuclear reactors, and building construction. The Army will use the Ceramic Anode to prevent corrosion of water towers, underground piping, and locks on navigable waterways.

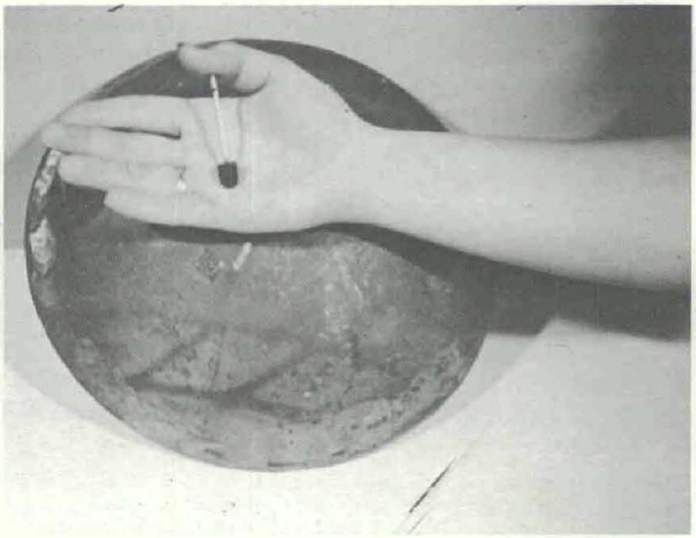
The Construction Engineering Research Laboratory holds three patents on the Weld Quality Monitor. One patented device, the Opto-electronic System, was developed with assistance from personnel at the University of Illinois. This system detects contaminants and other potential problems in the welding process.

Other patented items include a microcomputer-based process data system for analyzing data on the welding process and a device for measuring the speed of a manually placed weld. CERL holds a single patent on the Ceramic Anode.

Working with the University of Illinois and the American Public Works Association, CERL has made three of its computer programs available to state and municipal governments and private industry.

These programs assist users in putting together environmental impact statements, identifying the amount of energy used by a building, and maintaining road surfaces.

Bob Weber of the U.S. Army Construction Engineering Research Laboratory monitors information on welding parameters as part of field tests of the prototype Process Data System of the Weld Quality Monitor.



The Ceramic Anode (in hand) is 1/500th the weight of the larger silicon-iron anode it replaces.

24 ISEF Winners Get Special Army Awards

Purple peas, teenage appraisals of the opposite sex, and the effects of gamma rays on marigolds are research topics that, even with the Army's broad-based interests, it would have difficulty funding. But they may prove to be just as vital to military success 20 years down the road as laser-weapon technology or the "smart bomb."

The importance of research on purple peas, sex, and marigolds lies in the experimenters rather than the experiments. They are just three of nearly 600 projects, most on more esoteric topics, by students who competed in the "Olympics" of high school science fairs—the 35th International Science and Engineering Fair (ISEF), held in Columbus, OH, in May. Twenty-four students received special Army awards.

"The Army derives important benefits from its participation in the international and the regional and state science fairs leading up to it," said Doris M. Ellis of the Army Research Office, Research Triangle Park, NC, who is project officer for the ISEF program. "Among other payoffs, we encourage youngsters to pursue technical careers, and we make the young scientists aware that the Army offers challenging careers at R&D facilities across the country," adds Ellis.

CPT Ruth C. Engs, an Army judge at the ISEF, added the following observation: "Unfortunately, Army people sometimes are stereotyped as nonintellectual. By participating as judges, we help break that stereotype with the students and the general public."

"My entry in the Vermont state fair was one of the influences that got me involved in a technical career," CPT Engs noted. Currently, professor of health and education at Indiana University, she serves with the USAR as Deputy Surgeon of the 123rd ARCOM, Indianapolis, IN.

At all levels of the science fairs, each student prepares an exhibit, typically including several tall display panels that describe and illustrate the project. Many exhibits also include a computer terminal or a mechanical device or model that the young researcher has constructed. Reports describing the experiment or invention also are included.

Based on their exhibits and interviews, students are judged for creative ability, scientific thought and goals, thoroughness, skill, and clarity of expression. Some students publish the results of their expermiments in scientific journals. Some are encouraged to apply for patents. All have devoted long hours—often over several years—to their projects, and all rate discussions with the judges as a highlight of their fair experience.

Thirty-five scientists and engineers, including active Army and USAR personnel and civilians were selected to judge the Army awards at the ISEF. "But we need hundreds of Army judges for the 250 regional and state fairs," Ellis said, adding that "anyone involved with technology is welcome to participate."

"Most Army representatives find judging to be an enjoyable experience," said MAJ Jack I. Laveson, MSC-USAR, who coordinates recruiting of reserve component judges. "Ideally," he said, "the Army should be represented by eight to 10 judges at each fair."

Judges may be Individual Mobilization Augmentee (IMA) or Individual Ready Reserve individuals or may come from R&D IMA detachments, Army installations or ROTC units. Retirement points may be awarded to USAR personnel for participation.

Operation Cherry Blossom Winners: **(from left to right) Silvita M. Pulido (Alternate); Hiranya Jayatilleke (Winner); MG Jere W. Sharp, DARCOM; and Rachelle F. Folse (Winner).**

At the 1984 ISEF, 585 students—each a winner of a regional or state fair—exhibited their projects. The young scientists represented 45 states, Puerto Rico, and six foreign countries. Their projects were viewed by 900 professionals, each of whom had a PhD or equivalent in the field he or she judged. The judges represented the ISEF and more than 60 award-making organizations, including all of the military services, other federal agencies, professional societies, universities, and corporations.

The two top Army winners for 1984 received expense-paid trips to a Tokyo science fair as U.S. youth science ambassadors. They were Hiranya Jayatilleke, 17, a senior at the Bronx High School of Science, Bronx, NY, for "Continuous Countercurrent Extraction of Ethanol Fuel by n-octyl Alcohol," and Rachelle F. Folse, 17, a senior at Edward Douglas White Catholic High School, Thibodaux, LA, for "Discovery of a General Solution to a Linear Diophantine Equation."

Winner of an Army-sponsored trip to the London International Youth Fortnight was Maxwell J. Brothers, 18, a senior at Bloomington High School North, Bloomington, IN, for "Mathematical Analysis of Several Improved Low-Energy Compton Scattering Models."

The three top winners and the nine other Superior Achievement Award winners received expense-paid week-long trips to Army laboratories related to their fields of interest. Twelve other students received Meritorious Awards. The Association of the United States Army presented $100 each to winners of the Tokyo and London trips.

MG Jere W. Sharp, DARCOM Deputy Commanding General for Resources and Management, presented the Army awards at the ISEF.

Advanced degrees are not required for judges of state and regional science fairs. Readers interested in serving as judges are invited to contact the U.S. Army Research Office, P. O. Box 12211, ATTN: DRXRO-SO, Research Triangle Park, NC 27709, or phone (919) 549-0641, FTS 629-3890, or AV 935-3331.

From The Field . . .

BMD Command Contracts Total $18 Million

The Army's Ballistic Missile Defense (BMD) Systems Command has awarded contracts totalling nearly $18 million to four companies for the concept definition phase of its High Endoatmospheric Defense System Program.

Receiving contracts for approximately $4.5 million each are Boeing Aerospace Co., Seattle, WA; Lockheed Missiles & Space Co., Sunnyvale, CA; McDonnell Douglas Astronautics Co., Huntington Beach, CA; and Martin Marietta Corp., Orlando, FL.

The concept definition effort will be an approximately nine-month study by the four contractors, working independently, to define the system specifications. The contractors are also required to define the management and technical efforts required to develop the system.

After the concept proposals are received, the best concept, or a combination of features from two or more concepts, will be used as the basis for a functional demonstration of a high endoatmospheric interceptor. Selection of a contractor for the functional demonstration will be an unrestricted competitive procurement which is planned for mid-1985.

The new system would operate in the upper reaches of the atmosphere, with a non-nuclear interceptor, to defend against strategic ballistic missiles. Targets which could be protected include U. S. strategic forces, urban, industrial and other military targets.

Tobyhanna Provides 24-Hour Assistance

Tobyhanna Army Depot, PA, operates a 24-hour hotline assistance service for its field customers. Tobyhanna is the Army's largest communications-electronics depot.

Hotline numbers are AUTOVON 795-7900 and Commercial (717) 894-7900. Prompt response is guaranteed.

Officials receive approximately 50 calls per month for technical advice on hundreds of depot-managed systems, which include radio, radar, navigation, night vision, electronic warfare and satellite communications equipment.

NVL Sponsors Tests of New Radar System

Detecting, tracking and engaging up to three moving targets is the thrust of an ongoing test at the Materiel Testing Directorate (MTD), Aberdeen Proving Ground, MD, sponsored by the Army Night Vision and Electro-Optics Laboratory at Fort Belvoir, VA. An MTD test team is conducting feasibility tests on the Surveillance and Target Acquisition Radar for Tank Location and Engagement system.

The radar system is used for the acquisition of targets. It senses and tracks moving targets on the test range and, because of its processing unit, has the capability to pick up more than one target, according to Joe Sova, chief of the Weapons Systems Section at MTD.

The system is mounted on the HIMAG test vehicle and it becomes an integral component of the vehicle, according to CPT Patrick Linehan, a test director at MTD.

The ongoing test is designed to demonstrate the feasibility of the radar to complement the current Tank Thermal Sight under severely limited visibility conditions. The target acquisition radar is designed to detect and track moving targets using the doppler shift principle. It can be an asset to troops confronted with limited visibility, according to Linehan.

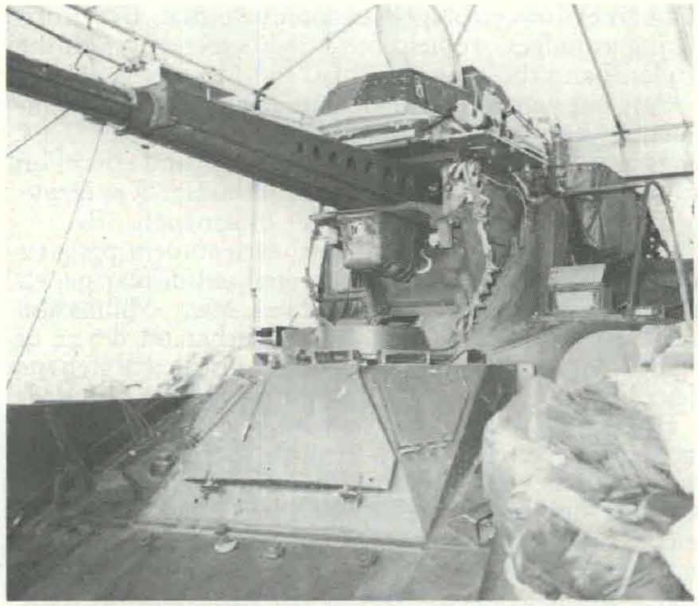
The radar symbology is displayed on an existing Tank Thermal Sight display which is operated concurrently. An equally important aspect of the program is the Field Instrumentation System which provides both qualitative and quantitative performance information. It consists of video and digital recording equipment to collect, analyze and evaluate the target acquisition and tracking capabilities of the radar system.

During the current feasibility testing, the surveillance and target acquisition radar fires at M47 remote control tanks. The gunner closes his palm grip and puts the radar into a search mode.

The video display allows the gunner to see the targets in front of his vehicle. Through the use of video graphics, the gunner places the number one priority target into a box projected onto the screen, and then presses the track button and the radar locks onto its first priority target vehicle.

If more than one target is in the vicinity, the radar system's processing unit allows the gunner to automatically go into track on the second target after squeezing the trigger to engage the first target. The process is repeated if a third target is in the area.

The radar's processing unit allows it to engage moving targets simultaneously and fire 75mm rounds two seconds apart.



The STARTLE radar processing unit is mounted on the HIMAG tank and it is considered to be an integral component of the tank.

ETL Prototype Will Analyze Terrain Data

Scientists at the U. S. Army Engineer Topographic Laboratories (ETL) are assembling a prototype terrain data extraction and analysis system which will help make automated topographic support a battlefield reality.

This Terrain Analyst Work Station will use digital techniques to extract, interpret and display terrain data. The system takes advantage of recent advances in microcomputer technology, analytical photogrammetry, computer-assisted photo interpretation and geobased information processing. These technologies will eventually allow soldiers in the field to produce and update digital terrain data bases.

The Defense Mapping Agency plans to supply digital topographic data for the terrain analysis community and other Army users. These data, however, may not always be available for every site where battles may be fought.

Combat itself can drastically change the natural landscape, making terrain information that was accurate yesterday obsolete in a matter of minutes. The terrain work stations's capabilities can fill the gaps which may exist between the information that's available and the coverage that's needed.

Analysts will be able to extract terrain elevation and feature data from a variety of sources—including maps, charts, aerial photographs and satellite imagery. They can then digitize this information and use it to update existing data bases or create new ones.

ETL scientists are rapidly assembling the hardware and software needed to make the work station a prototype terrain data management tool. The system's central 32-bit microcomputer will have two disk drives and related peripherals. Much of the software which will be used for the project has already been developed in the laboratory and contractual efforts are under way to convert these programs on the Terrain Analyst Work Station.

Project engineers expect to have the system ready for laboratory tests by June 1985. They plan to take the system into the field for a series of "real world" demonstrations later that year.

Test results and feedback from these demonstrations will allow researchers to define and perfect the terrain data extraction and management techniques needed for a comprehensive digital topographic support system.

The automated capabilities planned for this system will make it easy for the Army's topo units to produce quick, accurate information about the terrain. ETL scientists are working to field such a system by the end of the decade.

Lectures Address Acoustic Technology

Transfer of Army expertise in acoustic technology to the U.S. helicopter industry was the basic objective of a series of lectures and workshops held late last year at the U.S. Army Research and Technology Laboratories' (Army Aviation Systems Command) Aeromechanics Laboratory, Moffett Field, CA.

Presented by Aeromechanics Laboratory scientists Dr. Frederic Schmitz and Dr. Yung H. Yu, the lectures addressed the theme of helicopter implulsive noise. Attendees included representatives from Sikorsky Aircraft, Boeing-Vertol, Hughes Helicopters, Kaman Aircraft, and two NASA Ames Research scientists.

The agenda encompassed basic compressible aerodynamics and theoretical and experimental acoustics. Emphasis was on the noise generating mechanisms of helicopters. The two most annoying and easily detectible noises, high speed implusive noise and blade-vortex interaction noise, were considered in depth.

Experimental measurement techniques which use the YO-3A aircraft as a flying measurement platform were also discussed. The concept of using the "quiet" YO-3A as a measurement platform was originally developed by the Aeromechanics Laboratory and is now operated by Ames solely for the purpose of measuring helicopter noise.

YO-3A "quiet aircraft" (at right) is loaded with special equipment to record the noise from the AH-1 Cobra helicopter's blades in a flight test program.

Some results from recent experiments in two of the largest acoustic wind tunnels in the free world, CEPR-19 in France and DNW in Holland, were also reviewed. These experimental results will provide important information for researchers and designers of new helicopters.

An invitation was offered to the attendees to return to the Aeromechanics Laboratory in one year to assess the long term benefits of the acoustics lecture and workshop.

Army Evaluates New Data Storage System

A new automated storage and retrieval system for mapping information, called Microfix, is being evaluated under a joint effort by the Belvoir Research and Development Center and U.S. Army Forces Command.

Microfix will assist terrain analysts in processing, storing and retrieving terrain data on a more realistic real time basis. It will serve as a transition between the manual systems currently in use and the fully automated systems of the future. The new system is fully menu driven and can be operated by soldiers with a minimum of computer training.

Microfix consists of a microcomputer and 10 subsystems that have been tempest certified and made rugged for field use. Expansion cards enable the central processing unit to control the devices and a 128 kilobyte random access memory card more than doubles the computer's memory, giving the system greater data processing capacity.

Software for the system was prepared by the Georgia Institute of Technology. One package covers processing and formatting. Another allows the operator to run diagnostic test programs. The information retrieval system enters, sorts and maintains the data base and generates battlefield reports.

The graphic intelligence analysis system allows the operator to display order-of-battle and spot reports and search through map displays recorded on video disks and zoom in and out from regional scale maps to highly detailed area maps.

The video disk is capable of storing 57,000 frames of mapping information in analog format. Unit symbols and graphics can be modified using another program, while the collection planning aid keeps track of the collection plan and formats tasking requests. Topographical support software is used to maintain a library for document location and retrieval.

Thus far, the Belvoir R&D Center has purchased six of these systems for evaluation at a cost of $35,000. These units are currently located at Fort Bragg, NC; Fort Lewis, WA; Fort Shafter, HI; the U.S. Military Academy; the Defense Mapping School and the Belvoir R&D Center's Combined Arms Support Laboratory. Operator training was completed in February and the results of the evaluation should be ready early next year.

CRDC Establishing Systems Technology Centers

The Army's Chemical Research and Development Center (CRDC), Aberdeen Proving Ground, MD, is seeking sources of expertise from academia to establish chemical systems technology centers.

The technology centers will provide an opportunity for members of U.S. institutions of higher learning to collaborate with CRDC in its research programs.

Technical areas of interest to CRDC's technology center include programs related to chemical and biological sensors, air filtration, aerosol technology, systems analysis/dynamics, biotechnology, and catalysis applicable to detection and identification, physical protection, and decontamination.

Interested academic institutions can request a Qualitative Requirements Information Package from the Commander, Chemical Research and Development Center, ATTN: DRSMC-CLY-L (A), Aberdeen Proving Ground, MD 21010.

Career Programs...

DA Aproves MAM Master's Program

Headquarters Department of the Army recently approved a cooperative master's degree program in Materiel Aquisition Management (MAM) with the Florida Institute of Technology (FIT). Selected officers who attend the Logistics Executive Development Course or the Command and General Staff College can receive 18 credits for successful completion of these courses. The credits can be applied toward the MAM degree with FIT.

While attending the Logistics Executive Development Course and the Command and General Staff College, officers also take two elective college courses for six credit hours, giving a total of 24 credit hours needed for attendance at the FIT. With these prerequisites complete, officers in the program are sent for six months to the Florida Institute of Technology Extension Center at Fort Lee, VA. Upon completion of an additional 24 hours at the FIT, officers receive the MAM master's degree.

Officers in the MAM (ASI 6T) program should be interested in the opportunity. Florida Institute of Technology is exploring this opportunity for graduates of the Program Management Course at the Defense Systems Management College, Fort Belvoir, VA.

Army Establishes Aviation Logistics School

The U.S. Army Aviation Logistics School has been established at Fort Eustis, VA, as part of the Army's Aviation Branch implementation effort. Resources were furnished by the U.S. Army Transportation School which was formerly responsible for aviation logistics development and training. MG Aaron L. Lilley, Jr is commandant and COL Albert B. Luster is assistant commandant for both the U.S. Army Aviation Logistics and Transportation Schools.

The new school signifies the emerging prominence of aviation as a combat arm, and is dedicated to supporting the new branch and coordinating aviation logistics with the Army's overall logistics program. School responsibilities include all career management field 67 and Officer Specialty Code 71 training development, combat development, and resident/nonresident instruction.

The Aviation Maintenance Officer Course is also being redesigned to establish an Aviation Logistics Officer Course for Specialty Code 71 officers.

ARDC Expands Resident Research Program

The U.S. Army Armament Research and Development Center, Dover, NJ, has awarded a $4.385 million contract to the National Research Council (NRC) for continuation and expansion of the Resident Research Associateship Program at the Armament R&D Center and the Chemical R&D Center (CRDC), Aberdeen Proving Ground, MD.

During a 4-year period, the NRC will pay salaries and administrative costs for about 90 associate spaces which will be filled annually by personnel at the PhD level who will work in the Large Caliber Weapon Systems Laboratory, Fire Control and Small Caliber Weapon Systems Laboratory, and the Ballistic Research Laboratory, which is at Aberdeen, as well as CRDC.

The NRC's Resident Associate Program provides advanced research opportunities in government laboratories for postdoctoral scientific personnel. The intent is to give the associates a chance to perform advanced research, while at the same time aiding the laboratory in its R&D efforts.

Last year, the NRC placed some 1,000 associates in 15 major research organizations, including what was then the U.S. Army Armament Research and Development Command. To be selected as associates, individuals must have doctorate degrees and be thoroughly screened by the NRC and the Armament R&D Center or Chemical R&D Center.

Once chosen, each associate is assigned a laboratory program representative to handle administrative duties and a research advisor who acts as a mentor. To effectively evaluate the usefulness of the program, the NRC requires the associate to report on research experiences, and the laboratory to evaluate the associate's performance.

Associates do research in aerodynamic flow of flying projectiles; theoretical mechanics of energy propagation; chemical and physical reactions of propellants, explosives and flames; physics of material response to dynamic loads for explosion, penetration and blasts; surface chemistry and physics pertaining to contamination and decontamination of chemical biological agents, and organic chemistry investigations of toxic chemical agents.

Additional information on the program can be obtained from George Cherenack at (201) 724-6324.

Awards...

Ambrose Presents 1983 Army Pace Awards

Army Pace Award recipients LTC James F. McNulty and Sharon A. Weinhold are flanked by (left) former Secretary of the Army Frank Pace, Jr., and Under Secretary of the Army James R. Ambrose.

Under Secretary of the Army James R. Ambrose has presented the 1983 Pace Awards to LTC James F. McNulty, Office of the Deputy Chief of Staff for Research, Development and Acquisition, and Sharon A. Weinhold, Office of the Comptroller of the Army.

Established in 1963, the Pace Awards are named in honor of former Secretary of the Army (1950–53) Frank Pace, Jr. Special recognition is given annually to one military officer and one civilian employee for outstanding achievement.

Primary consideration for the award is based on completion of a significant task or staff assignment which has benefitted the Army. This may include improvement in a service, financial savings or a significant technological or military development.

LTC McNulty was cited for his performance as the Department of the Army System Coordinator for the Pershing II Missile Program. His effective management of the program resulted in the successful scheduled deployment of the Pershing II. McNulty is a graduate of the U.S. Military Academy and the Army Command and General Staff College.

Weinhold, a budget analyst, was recognized for developing several budget execution procedures which resulted in cost benefits to the Army. She is a graduate of the University of Wisconsin and has an advanced degree from American University.

As a result of their selection for the Pace Award, McNulty and Weinhold will attend the 1983–84 session of the Alfred P. Sloan Fellows Program at Massachusetts Institute of Technology.

Brandon Receives BRL's Zornig Award

The Army's Ballistic Research Laboratory (BRL) has presented the 1983 Zornig Award to Freddie J. Brandon, an aerospace engineer, in recognition of his technical contributions to antiarmor programs.

Brandon is employed in the Free Flight Aerodynamics Branch in BRL's Launch and Flight Division. He has worked at BRL since July 1960.

Established in 1959, the Zornig Award is presented annually to a BRL employee in recognition of outstanding technical, administrative, or mechanical accomplishments. The award honors Army COL H. H. Zornig, who directed ballistic research at Aberdeen Proving Ground from 1935 until 1941. Zornig was largely responsible for the establishment of BRL in 1939.

Brandon was cited for his technical management of the aeroballistics phase of kinetic energy projectile development and his broad emphasis and support role for projectile testing. He has been very effective in obtaining large customer programs and in continued customer support for BRL. He also serves as an Army consultant for aeroballistics and flight structural design.

Personnel Actions...

Thompson Assumes Command of DARCOM

GEN Richard H. Thompson has assumed command of the U.S. Army Materiel Development and Readiness Command (DARCOM), concurrent with his promotion to 4-star rank. He succeeds GEN Donald R. Keith who has retired from the Army following more than 35 years of active service.

Prior to assuming command of DARCOM, GEN Thompson was Deputy Chief of Staff for Logistics (DCSLOG), Department of the Army. This followed tours as Commander, U.S. Army Troop Support and Aviation Materiel Readiness Command, and then Assistant DCSLOG. He also served in ODCSLOG from 1975–1977 as Director of Supply and Maintenance and from 1973–1975 as Director of Logistics Plans, Operations and Systems.

GEN Thompson's earlier career assignments included Commander, Defense Logistics Service Center and Commander, Defense Property Disposal Service, Defense Supply Agency; and Commander, U.S. Army Inventory Control Center, U.S. Army Vietnam.

Graduated from the College of the Ozarks with a BA degree in social science, GEN Thompson also holds a master's degree in public administration from George Washington University, and is a graduate of the National War College, Armed Forces Staff College, Air Command and Staff College, Quartermaster School Advanced Course, Infantry School Advanced

Course, and the Adjutant General School Advanced Course.

His military honors include the Legion of Merit with two Oak Leaf Clusters (OLC), Bronze Star Medal, Joint Service Commendation Medal, and the Army Commendation Medal with two OLC.

Anderson Takes Over as TECOM Commander

MG Andrew H. Anderson, former Deputy Commander, VII Corps, U.S Army Europe, has assumed new duties as Commander of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD.

Backed by more than 30 years of active military service, MG Anderson holds a BS degree in history from Park College, and an MS in personnel administration from George Washington University. His military schooling includes the U.S Army War College, Armed Forces Staff College, and the Army Command and General Staff College.

During 1980–81 he was Deputy The Inspector General (Inspections and Compliance), Department of the Army. He commanded the Army Tank-Automotive R&D Command from May 1979 to November 1980, and was Deputy Commander of the Army Tank-Automotive Materiel Readiness Command from September 1977 to May 1979.

Other assignments have included Director, Combat Systems, Office, Deputy Chief of Staff for Combat Developments, Army Training and Doctrine Command; Chief of Staff, 1st Armored Division, U.S. Army Europe; and Commander, 1st Armored Division Support Command, U.S. Army Europe.

MG Anderson is a recipient of the Silver Star, Legion of Merit with Oak Leaf Cluster (OLC), Distinguished Flying Cross, Bronze Star Medal with two V Devices and three OLC, Air Medal with V Device, Army Commendation Medal with V Device and three OLC and the Purple Heart.

Heiberg Chosen as Army Chief of Engineers

MG E. R. Heiberg III, Program Manager of the Ballistic Missile Defense Program, Office of the Army Chief of Staff has been selected to succeed LTG Joseph K. Bratton as Chief of Engineers, U.S. Army Corps of Engineers. Heiberg has also been nominated to receive his third star.

Heiberg's previous assignments have included service as the Deputy Chief of Engineers; Director of Civil Works, Office of the Chief of Engineers; Deputy Chief of Staff, Engineer, U. S. Army, Europe; Military Assistant and Executive to the Secretary of the Army; Chief, Manpower and Structure Team, Planning and Programming Analysis Directorate, Office of the Army Assistant Vice Chief of Staff; and Special Assistant and Executive Assistant to the Director, Office of Emergency Preparedness under the Executive Office of the President of the United States.

MG Heiberg has also held command assignments in the United States and overseas as Division Engineer with the Corps' Ohio River Division; District Engineer with the Corps' New Orleans District; and as Commander of the 4th Engineer Battalion, 4th Infantry Division in Vietnam.

He is a 1953 graduate of the U.S. Military Academy and has earned three master's degrees, including one in civil engineering from the Massachusetts Institute of Technology. He is also a graduate of the Army Command and General Staff College and the Industrial College of the Armed Forces.

MG Heiberg has served as one of seven Presidential appointees to the Mississippi River Commission, and has also served as president of the Coastal Engineering Research Board and as chairman of the U.S. Section, Permanent International Association of Navigation Congresses.

Among his military awards are the Distinguished Sevice Medal, Silver Star, three Legions of Merit, Distinguished Flying Cross, Bronze Star Medal, seven Air Medals and two Army Commendation Medals.

Other General Officer Assignments

The Department of the Army recently announced the following general officer assignments:

LTG Donald M. Babers, DCG for Materiel Readiness, HQ DARCOM, was named as Director, Defense Logistics Agency, Alexandria, VA. MG Lawrence F. Skibbie, Communcations-Electronics Commander, will become DARCOM DCG for Materiel Readiness.

MG Claude W. Kicklighter, DARCOM Chief of Staff, was selected as CG, 25th Infantry Division, HI. MG Eugene S. Korpal, Director of Personnel, Training and Force Development, HQ DARCOM was picked as Deputy, The Inspector General (Investigations, Assistance, and Compliance), Washington, DC. MG James G. Boatner, Office of Commander, Berlin, will take over as DARCOM Director of Personnel, Training and Force Development.

MG Arthur Holmes Jr., DCSLOG, was chosen as Commander, Tank-Automotive Command, Warren, MI. BG Bruce R. Harris, CSA, was named as CG, Communications System Agency/Project Manager, Defense Communications Systems (Army)/DCG Army Communications Command, Fort Huachuca, AZ. BG Robert D. Morgan, CECOM, will assume duties as CG, Communications-Electronics Command, Fort Monmouth, NJ. BG Jimmy D. Ross, DCSLOG, was assigned as Chief of Staff, HQ DARCOM.

Army RD&A Magazine Survey Results

The staff of the *Army RD&A Magazine* would like to express appreciation to the more than 400 individuals who participated in our readership survey. A total of 904 surveys were mailed directly to selected military and civilian recipients of the magazine.

Our survey group was obtained by taking a systematic random sample of personnel who receive the magazine on an individual basis. This group is comprised primarily of active and reserve officers who hold initial or additional specialities of R&D, Nuclear Energy or Procurement, or an additional skill identifier of Materiel Acquisition Management. A small segment of government and non-government civilians is also contained in this group.

We were pleased with the survey response rate (46 percent) which we feel gives us a valid sample.

The survey consisted of 16 questions plus a comments section. What follows is a brief analysis of those portions of the survey believed to be of greatest interest to our readers.

We were not suprised to learn that the magazine is not read in its entirety by all readers. However, we were very pleased to learn that 68 percent of our audience does read between half and all the publication. It appears that the majority of our readers find the magazine to be generally atuned to their interests.

In recent times, the magazine has tended to place a bit more emphasis on management oriented articles. However, judging by our reader responses regarding personal preferences, it seems that hardware articles are preferred to management ones (31 percent versus 18 percent). The other 51 percent prefer both equally.

The credibility of the information contained in the magazine is always a key concern to the staff. In view of this, we were very encouraged to find that 79 percent of our readers agree that the authors are knowledgeable experts in their professions. A vast majority of respondents also said the information they found in the magazine was very useful.

The magazine has recently made a conscious effort to devote less space to personnel and award articles and more space to R&D topics. Apparently, this de-emphasis is in line with reader preferences. By far, the most read departments are "From the Field" and "Capsules," which collectively were preferred by 51 percent of our readers. We will continue to devote more space to those topics desired most by our readers.

Relative to the departments, we must confess that we were a bit suprised to find that, in comparison to the feature articles, the departments were preferred by 15 percent of our target audience, and that 60 percent prefer both equally. In the past few issues, we have tended to de-emphasize the departments in favor of feature articles.

Thirty-nine percent of the returned surveys contained suggestions and comments regarding the content and layout of the magazine. Although we cannot incorporate all of these suggestions, we will give consideration to those that are feasible. Some of the recurring comments and recommendations were as follows:

- Put more emphasis on problems and their solutions and less emphasis on successes.
- Select more articles from outside of DARCOM.
- Publish more on state-of-the-art programs.
- Provide more career information, such as possible R&D assignments.
- Publish more technical information.
- Publish less technical information.
- Use larger print and modernize layout.
- Decrease articles on personnel and awards.
- Publish shorter feature articles.
- Include more data on test results.

Clarification on Some Misused Acronyms

The Army RDA Magazine staff recently received a letter from the Deputy Director of Deployment, Joint Deployment Agency at MacDill Air Force Base, Tampa, FL, which addressed a problem that the magazine staff has been struggling with for years. The problem is the proliferation of unnecessary and confusing acronyms in our language and the resultant misuse of related but distinctly different acronymns. The letter concerned three particular acronyms and their definitions. We provide them below for your edification with the full knowledge that a similar effort for all confusing acronyms which we use in the RD&A community would require more volumes than we could publish in a year.

JDC: The Joint Deployment Community consists of those headquarters, commands, and agencies involved in the planning, execution, and sustainment of deployments of U.S. forces and materiel to a theater of operations or objective area.

The JDC consists of the Office of the Joint Chiefs of Staff, the Services, certain Service major commands, unified and specified commands, the Defense Logistics Agency, the Transportation Operating Agencies (Military Airlift Command, Military Traffic Management Command, and Military Sealift Command), the Joint Deployment Agency, and a joint task force, where appropriate. In plain English, the Joint Deployment Community consists of those players required to deploy forces and materiel in support of military plans.

JDS: The Joint Deployment System is a command and control information management system to support the worldwide deployment of U.S. military forces, with their equipment and supplies. JDS provides deployment planning and execution support to all unified commanders and joint task force commanders within the Worldwide Military Command and Control System (WWMCCS).

The JDS includes procedures, communications and automatic data processing for distributed data bases tied together by the WWMCCS Intercomputer Network, for the purpose of planning, coordinating and monitoring air, sea and land movement of U.S. forces and materiel during military operations in emergency or crisis situations and exercises.

Simply stated, the JDS is a command and control information system which is used by all the players in the Joint Deployment Community. While an operating system today, the Joint Deployment System is still under development and will achieve full operating capability in FY 1985.

JDA: Joint Deployment Agency is a field operating agency of the Joint Chiefs of Staff (JCS), with the mission to coordinate deployment activities among the Services and commands, and to develop, maintain and operate the Joint Deployment System.

In March 1979, the JCS established the Joint Deployment Agency, collocated with the United States Readiness Command at MacDill Air Force Base. The JDA is a separate and distinct organization and serves the U.S. Readiness Command (like all other CINCs) as a member of the Joint Deployment Community.

In October 1981, the JCS revised the terms of reference of the Joint Deployment Agency, increasing its authority in peacetime contingency planning, in time-sensitive execution planning, in deployment execution, and in sustainment of forces in theater.

The Joint Deployment Agency acts as a focal point for deployment-associated transportation management and decision-making information, for providing data on deployment estimates and on the implications and alternative courses of action to the supported commander and the JCS, and for formulating recommendations to the National Command Authorities. While an extension of the JCS, JDA provides assistance to the Joint Deployment Community worldwide.

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