Military Grapples with the Chaos Factor

The Joint Chiefs want $7 billion, in part to protect communication links from the electromagnetic chaos of nuclear war

The Joint Chiefs of Staff have drawn up a $7-billion wish list that addresses one of the most intractable and poorly understood of all the perceived deficiencies in the national defense: the lack of reliability of the military's systems for electronic command, control, and communications, especially under conditions of nuclear war.

Within the military and the Congress, there has been growing awareness of the systems' vulnerabilities. And last month, the General Accounting Office, a longtime critic of the present military systems, issued a report calling them fragile and inflexible.*

In a recent letter to Secretary of Defense Caspar W. Weinberger, the Joint Chiefs suggested myriad improvements that should be made during the next 5 years to ensure that the President and military commanders can keep in touch with the armed forces in the event of a nuclear war. The magnitude of the Joint Chiefs' request is unprecedented.

Though some details and programs are classified, an outline of the proposed $7 billion upgrade was revealed through interviews with contractors, congressional aides, and Pentagon officials. It includes the acquisition of communication satellites, airborne command posts, and ground networks. Many of the improvements are good, logical choices. As is often the case in the military, however, the list emphasizes projects that are expensive and surrounded by a certain glamour. Not on the list and apparently not yet addressed by the Pentagon are a few simple changes that would, according to former government officials, radically improve the reliability of command, control, and communications, which the military calls its C^3 system. This consists of a worldwide network of telephones, command posts, special circuits, and satellites used to link military and civilian leaders with the U.S. armed forces.

A prime cause of the vulnerability of present communications systems is electromagnetic pulse (EMP), which occurs in the aftermath of a nuclear explosion. Defense strategists say a single Soviet warhead detonated 200 miles above Nebraska would blanket the United States with an EMP of 50,000 volts per meter, shutting down the power grid, performing an electromagnetic lobotomy on computer memories, and knocking out unprotected communication systems from coast to coast (*Science*, 29 May, p. 1009; 5 June, p. 1116; and 12 June, p. 1248). The chaos produced by EMP would make it difficult if not impossible for the President to contact and direct the strategic U.S. nuclear forces.

High-altitude EMP was discovered nearly two decades ago, but the dimensions of the threat have been slow to dawn on Pentagon planners because of the evolution of technology. Military awareness of the EMP threat has always lagged a constant distance behind the increasing vulnerability of technology spun off by the semiconductor revolution. During the late 1970's, it was discovered that integrated solid-state circuits are 10 million times more likely to be knocked out by EMP than are vacuum tubes.

As the Soviet ability to destroy conventional underground command posts (such as NORAD headquarters under Cheyenne Mountain in Colorado) has increased during the past decade with the putative rise in the accuracy of missile targeting, the U.S. military has taken to the air, because flying command posts have been thought most likely to survive a nuclear strike. The Strategic Air Command (SAC) keeps its "looking glass" plane constantly circling over the Midwest, and the President has a similarly equipped command post constantly on alert at Andrews Air Force Base outside Washington, D.C. A critical weakness among these and dozens of other U.S. airborne command posts is that only one of these aircraft is "hardened" to withstand the chaos-producing effects of EMP. (Unfortunately, the hardened plane is easily identified by a conspicuous bulge on its back that contains an antenna for satellite communications. The Soviets presumably know when this plane is grounded.) This hardening deficiency is addressed in part by the Joint Chiefs. They request that three Boeing 747's (known as E4a's) operated by SAC be hardened, along with a fleet of backup command planes known as EC-135's. But because EMP hardening is expensive, adds weight, and is not very glamorous, several other logical candidates for hardening are not likely to be upgraded. One of these is the Navy's TACAMO aircraft that constantly prowl over the oceans to relay messages to U.S. submarines.

The big dollars on the Joint Chiefs' wish list go to a new generation of early-warning and communication satellites, emergency satellite launchers (so the military can loft new satellites to replace ones knocked out by the Soviets), and new installations for coastal radars.

Also addressed by the Joint Chiefs is the vulnerability of the present fixed ground stations of the early warning satellite system to terrorist and direct conventional attack. They call for a speedup in procurement of mobile, truck-mounted satellite terminals, which cost about $32 million each. According to William J. Perry, former undersecretary of defense for research and engineering, these are "easily proliferated and indistinguishable from other service vans."

The trend to mobility in the military's command and control systems has an added advantage; as mobile systems they would no longer be tied to the U.S. commercial power grid, which would

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*"Countervailing strategy demands revision of strategic force acquisition plans," (MASAD-81-35, U.S. General Accounting Office, Washington, D.C., 5 August 1981).

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quickly fail if subjected to EMP. Mobile units also rely on radio links rather than the more vulnerable land lines that the military rents from American Telephone & Telegraph, the sole U.S. common carrier with which it does business. EMP hardening of the AT&T system is considered impossible because of its size.

Even with the new emphasis on airborne and mobile ground systems, underground command posts have not been abandoned. On the chance that they might not be the object of a direct nuclear hit but only incapacitated by power outages, a move is afoot to supply them with backup and specially hardened power systems. This is considered so important that the Senate Armed Services Committee has added $5 million to the Administration's fiscal 1982 budget request for "power upgrades at key C^3 facilities."

One way of increasing the reliability of the military's telephone lines is through redundancy, through the interconnection of a variety of commercial carriers into the military network. Among other things, this would give a technical heterogeneity that would increase the odds that at least one carrier might weather an EMP attack. (On a more mundane level, competitive procurement would also probably lower the Pentagon's telephone bill.) This is probably the simplest, most straightforward way to enhance the reliability of the military's ground-based network. In 1979 President Carter stressed this by issuing Presidential Directive 53, an unclassified order encouraging such "connectivity" with a variety of commercial carriers so that "forces can support flexible execution of retaliatory strikes during and after an enemy nuclear attack."

Despite the presidential pressure and the apparent advantages, the military still has not procured any lines from the growing horde of specialized common carriers in the United States. The Defense Communications Agency has formed a "working group" to study the issue, but outside vendors are discouraged. "We've talked to them," says Orville Wright, President of MCI Communications Inc., one of the new specialized carriers, "but the talk has been very small indeed. They seem to be light years away from making any kind of decision."

Some of the steps proposed by the Joint Chiefs to decrease the vulnerability of the military's communication links are major, some are modest. Whether they will add up to a secure network is the critical question. Many of the programs, if funded, will not produce new equipment until the 1990's, and, even then, the efficacy of the improvements could be firmly estabished only after the fact of a nuclear confrontation. Given the patchwork that now exists, the prospects are not all that encouraging. More, the numerous upgrades and the acquisition of new systems to stem the communications gap are continuously undercut by the technological creep that created the vulnerability to an EMP attack in the first place: the semiconductor revolution. The ubiquitous chips, microprocessors, and integrated circuits that have penetrated so many facets of military procurement will only become more numerous. Frost & Sullivan, a New York–based market forecasting firm that specializes in military electronics, estimates that the U.S. military will double its purchases of semiconductors between 1980 and 1985. Whether these delicate devices with their inability to handle surges in voltage can be protected in critical systems is a question perhaps more basic than whether big new systems can reduce vulnerability. In the meantime, the EMP threat looms ever larger as the electronics revolution moves forward.—WILLIAM J. BROAD

Airfield Alarms Astronomers

The Air Force wants to build a new airfield in Altar Valley, Arizona, only 9 miles away from Kitt Peak National Observatory, where there is the world's largest collection of telescopes. Officials at Kitt Peak and the observatory's sponsor, the National Science Foundation, are worried that a new airport, a source of both light and air pollution, could severely compromise operations.

The Air Force is waiting for the first draft of its environmental impact statement before making a final decision about the site. Meanwhile, Kitt Peak director Geoffrey Burbidge has been rounding up support from the Arizona congressional delegation and the governor's office in an attempt to convince the Air Force to rethink its plans. The Air Force wants to build a supplement to the Davis Monthan field near Tucson, and the quest has gained urgency since an Air Force plane went down on the campus of the University of Arizona 3 years ago.

Kitt Peak did not learn that Altar Valley was the site of choice for a new airfield until June, when reports appeared in the local press. The proposed new airfield, which is to be completed by spring 1983, would include a 10,000-foot runway and various buildings. Although the present plan is to operate the field only during the daytime, conduits for runway lights are included in the plan, and Burbidge has been unable to extract assurances from the Air Force that the strip will not operate at night.

Kitt Peak, which is home to a half-dozen university-owned telescopes as well as the federal ones, has 18 telescopes making observations around the clock. During the day optical telescopes make infrared observations, and solar observations are made with the world's largest solar telescope. Optical and infrared observations are made at night. Turbulence and particulate emissions from jets can interfere with infrared scanning of the atmosphere. Increases in particulate matter would jeopardize a long-term study monitoring atmospheric constituents that is being conducted by Battelle Institute.

The greatest potential threat to the observatory is that airport lights will interfere with nocturnal optical observations. Light pollution from the city of Tucson is kept under control by an ordinance that requires reflectors on street lamps to throw the light downward. The new airport would be one-sixth as far from the observatory as Tucson, and could cause almost 40 times as much light interference. Burbidge adds that the airfield's security lighting alone "would have the same effect as approximately 25 to 30 years of the projected growth of Tucson." The remaining useful life of Kitt Peak is estimated to be more than 50 years if the population of the area continues to grow at the present rate.

The Air Force has promised to give weight to the concerns of the observatory, which is preparing quantitative estimates of the effects of the proposed airstrip for inclusion in the environmental impact statement. The first draft is expected to be completed in October.—CONSTANCE HOLDEN

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