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# MILITARY OPERATIONS IN SPACE (U)

## SUMMARY

January 1963

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# MILITARY OPERATIONS IN SPACE

## SUMMARY

The fundamental mission of the Department of Defense, and therefore of the Air Force, is to prepare for the military operations essential to protection of the vital interests of the United States. Until recently, these preparations have been based on land, sea, and air forces. The development and deployment of the intercontinental range ballistic missiles have extended potential military operations beyond the earth's atmosphere.

There should be two major objectives in the formulation of a basic approach to military operations in space. The first must be to augment the existing military capabilities of earth-based forces by suitable military forces in space. The second major goal must be to achieve the military in-space patrol capabilities essential for protecting U.S. activities in space and to prevent attacks from space upon the United States and her Allies.

Early military capabilities will be limited to operations at the lower orbital altitudes. Thus, the principal military interest at this time must be to make sure that the near-earth region will not be dominated by a hostile power. This emphasis on near-space activities is different from the fundamental program objectives of NASA; even the early NASA efforts are directed toward deeper space. Furthermore, it is not imperative that the NASA systems operate on a repetitive, economical, and reactive basis.

The basic difficulties, hazards, and costs of putting men into space raise questions concerning their value in military space systems. Therefore, an investigation of the extent of man's use in military space systems must be conducted as an

integral part of the National Space Plan. Specifically, present efforts must be directed toward establishing the necessary technological base and gaining military operating experience in space. Then manned military operations in space can be achieved with the shortest possible delay whenever firm missions and requirements are established.

The basic military strategy of the Free World has been founded, in recent years, on technological superiority in all combat media. It would be difficult to conclude that all of the probable military applications of Soviet advances in space technology could be countered by land, sea, and air forces alone. Thus, military systems which operate in space are now and will increasingly become a necessary part of a flexible force structure.

Certain military tasks may require the use of space systems, while others may be performed with the aid of space systems at lower relative costs than by ground-based systems alone. Decisions to employ space systems for military purposes will be based upon these considerations and upon the knowledge that space systems in concert with other systems will provide a more effective total force structure.

Early military space operations, including support operations, fulfill distinct military needs and will result in a more effective total force structure. These include: (1) target identification and location, (2) warning of ballistic-missile attack, (3) detection of nuclear detonations, (4) geodetic measurements, (5) aids to terrestrial navigation, (6) meteorological observation, (7) global communications, (8) active defense against satellites, and (9) R&D operations in space.

Also, future military support operations probably will be required in space. Examples include space-environment monitoring, logistic and rescue operations in space, and crew training.

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Finally, certain future military space operations now seem to offer distinct advantages over nonspace operations. These are: (1) ballistic-missile defense, (2) command and control in space, (3) strikes from earth orbits, and (4) space-based satellite surveillance and tracking.

Each of these possibilities has technical problem areas. These problem areas, with a more detailed discussion of the capabilities, are treated at somewhat greater length under individual headings in the full paper.


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# MILITARY OPERATIONS

# IN SPACE (U)

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# I. INTRODUCTION

The fundamental mission of the Department of Defense, and thus of the Air Force, is to prepare for the military operations which are essential for protection of the vital interests of the United States. Until recently, these preparations have been based upon the concept of employment of land, sea, and air forces. The development and deployment of the intercontinental range ballistic missile has extended potential military operations beyond the earth's atmosphere, and, today, both military and civilian systems operating largely in space have come into being.

As these developments have taken place, our national interest in space has grown accordingly. A large measure of this interest has been in potential military applications of space, because it was recognized early that space systems can enhance present military capabilities and that they offer possibilities in the future for further enhancement of the military power and effectiveness of the United States. Implicit in these motivations toward a wider use of military space systems is a need to know, and a need to prepare for actions to counter, military capabilities in space achieved by the Soviet Union.

The purpose of this paper is to examine—and to clarify where indicated—the reasons which have led to the firm conviction that military space operations are basic to satisfying certain U.S. needs.

Certain military tasks may require the use of space systems, while others may be performed in space at lower relative costs. Decisions to employ space systems for military purposes will be based upon these considerations and upon the knowledge that space systems in concert with other systems will provide a more effective total force structure. However, since the uses of space are at the very earliest stages of development, it is prudent and necessary to plan,

not only for applications clearly visible now, but also for future applications indicated by advances in military space technology now only vaguely foreseen. Thus, as a preventive against any nation achieving a position in space which could threaten the security of the United States, a broad range of military capabilities must be and are being developed.

Development of these capabilities requires both the early military exploitation of space, wherever this is technically and economically indicated, and the rapid development of new military space technology. Because of the uncertainty of the time required by the U.S.S.R. to develop a possible space-based challenge to the security of the United States, each of these goals should be pursued at a rate consistent with the maximum rate of technological growth and the available resources.

## II. APPROACH

In the formulation of a basic approach to military operations in space, it has become increasingly clear that there are two major objectives toward which attention should now be directed. Convincing evidence indicates that the present military capabilities of the United States can be improved by the use of military space systems. Therefore, the first major objective must be to augment the existing military capabilities of earth-based forces by the employment of suitable military forces in space. Equally apparent is the possibility of future, hostile Soviet actions, either in space or from space. Consequently, the second major goal must be to achieve the military in-space patrol capabilities essential for protecting the civilian and military activities of the United States in space and for preventing attacks from space upon the United States and her Allies. To a degree, these two broad objectives determine the character of both immediate and future military operations in space.

Considered judgment of Soviet actions leads to the conclusion that the earliest threat which could arise would result from activities in the near-earth regions of space (see Appendix A). Further, early capabilities will be limited to military operations at the lower orbital altitudes. Hence, the principal military interest, at this time, must be ensuring that the near-earth region will not be dominated by a hostile power. Nevertheless, certain early military operations will extend to synchronous orbital altitudes; e.g., military satellite communications. Present indications are that future possibilities also will arise for military missions in the deeper space environment.

That the assigned role of the Department of Defense defines a logical element of the National Space Program becomes clearer when DOD's objectives are compared with the fundamental program objectives of the National Aeronautical

and Space Administration. The basic direction of even the early NASA efforts is toward deeper space. NASA's lunar program, for example, requires that the APOLLO system operate through the near-earth environment—although not necessarily that it operate on a repetitive, economical, and reactive basis within that environment. This distinction is a fundamental difference in approach between civilian and military activities in space planned at present and establishes a meaningful basis for deciding which elements of the National Space Program relate more closely to civilian and which to military space developments and operations.

The basic difficulties and hazards, as well as the costs, of putting men into space raise questions concerning the value of men in military systems in space. After much study, it is the opinion of the Air Force and of major segments of the scientific and industrial community that men will probably prove essential in certain future military space systems. This is particularly true at the lower orbital altitudes, of prime military interest where the problems of radiation exposure appear surmountable. Therefore, an investigation of the extent of the use of men in military space systems is important to national security and must be conducted as an integral part of the National Space Program. Specifically, present efforts must be, and are being, directed toward establishing the necessary technological base and gaining military operating experience, so that manned military operations in space can be achieved with the shortest possible delay whenever firm missions and requirements are established.

There is a consistency between the view that military space systems—both manned and unmanned—must be developed for needs evident now and the view that effort must be aimed toward new opportunities by creating a viable and broad base of new technology. Both undertakings provide insurance against an uncertain future.

It is well understood that the basic military strategy of the Free World has been founded, in recent years, on technological superiority in all combat media. Retention of this superiority is even now being challenged by the major space efforts and accomplishments of the Soviet Union. It would be difficult to conclude that all of the probable military applications of Soviet advances in space technology could be countered by land, sea, and air forces alone.

The possibility of thermonuclear war has led the Department of Defense to place increasing emphasis upon achieving military capabilities which can provide a controlled and measured response at the level of force appropriate to the threat. A future Soviet threat in or from space must be met and disposed of without devastating nuclear exchanges on the earth's surface. For this very basic reason, military systems which operate in space are now, and will increasingly become, a necessary part of a flexible force structure.

The following section discusses probable applications of systems toward which effort must be directed now to achieve the fundamental objective of the Department of Defense; i.e., to make the essential military preparations required for the protection of the vital interests of the United States.

## III. MILITARY SPACE APPLICATIONS

The developing of space technology provides means for improving and maintaining the Nation's defenses as well as for ensuring the availability of space for peaceful purposes. To capitalize upon these means requires that full advantage be taken of existing technologies to meet early military needs and to obtain operating experience and proficiency in the use of military space systems. Research, exploratory development, and advanced development programs must be conducted in such a way as to achieve the technical gains responsive to operational needs and to ensure that the military potential of new technologies will be promptly identified. As an outgrowth of research and development programs so conducted, early decisions can be made to pursue vigorously engineering programs for operational capabilities ensuring the security of the Nation.

Decisions in development and operational employment must include consideration of space systems in relation to all systems. With certain exceptions, the following discussion is primarily directed toward military applications of earth-orbiting systems. Its purpose is to show: (1) that early military space operations, including support operations, fulfill distinct military needs and will result in a more effective total force structure; (2) that future supporting military operations probably will be required in space; and (3) that certain future military space operations now appear to offer distinct advantages over nonspace operations.

### A. Early Military Space Operations

Certain early contributions of space systems have been generally accepted. During the next 5 to 7 years, space systems could provide superior capabilities in the applications discussed below.

1. Target Identification and Location

"The United States has, and will continue to have for the foreseeable future, a high-priority requirement for reconnaissance of the Soviet Union and other desired areas." This quotation is from a 1960 report of the United States Intelligence Board (USIB), which concluded that it was essential that the United States develop and maintain an operational satellite reconnaissance system possessing a wide range of capabilities. Development, based upon the employment of unmanned satellites, is now under way.

The need for military reconnaissance is essentially twofold: (1) a one-time need for on-demand observation of either localized areas or specific points and (2) a need for periodic observation of whole areas of military interest (e.g., the Sino-Soviet land mass). The second aspect (i.e., periodic observation of areas) is required to:

-a Determine the current status and activity levels of military installations and their weapons

-b Detect and determine the locations, nature, and relative importance of military installations for targeting purposes

-c Acquire basic intelligence needed for military planning, including such data as the physical characteristics of missiles and aircraft, weapon deployment patterns, and radio frequencies and other characteristics of radar and radar control links, and for detection and evaluation of new weapons and other items of military significance.

In the future, manned and unmanned suborbital and recallable satellites may prove useful for on-demand reconnaissance, particularly in securing post-strike damage assessment information. However, it is in the second application given above that early military reconnaissance of

the earth's surface can be, and needs now to be, conducted from space. The acuteness of this need and the problems inherent in the employment of nonspace systems are exemplified by the considerable difficulty and risk associated with U-2 overflight and RB-47 peripheral intelligence collection programs. Within an early period, unmanned earth satellites can provide a large share of reconnaissance information by methods which are now considered politically acceptable. It has been concluded, therefore, that the employment of unmanned satellites for military reconnaissance of the earth's surface is a significantly better way to collect some critical intelligence data important to defense needs associated with maintaining capabilities for a selective and controlled response.

2. Warning of Ballistic-Missile Attack

Early-warning satellites are unique in their ability to come sufficiently close to enemy launch areas to permit the detection of ballistic missiles during boost. They can also relay, with minimum delay, data to ground readout stations which can be defended against enemy attack or interference; e.g., bases in the United States, Canada, or the United Kingdom. Thus, their capabilities will provide early-warning times (before impact) of these magnitudes: 20 minutes or greater for ICBM's having about 30 minutes time-of-flight and 85 minutes for extended range ballistic missiles (ERBM) having about 90 minutes time-of-flight.

In the future, the use of triangulation and multiple satellites containing infrared sensors should allow launch position to be determined within 8 nautical miles. The system would require the use of relatively few early-warning satellites and could furnish global coverage. It would permit detection of ICBM, ERBM, or IRBM attacks against the zone of interior, and possibly even third country attacks against the zone of interior and other countries. A system such as this is considered to be operationally feasible by 1969, although expanded efforts will be needed to obtain sensors having adequate signal-to-background-noise

characteristics, particularly against intermediate range ballistic missiles. In addition, data transfer between early-warning satellites via space-based communications relays, would be required.

In contrast, BMEWS or other ground-based radar systems can be only individually positioned for surveillance of specific avenues of attack and can detect only the attack of specific types of missiles against specific target areas. For example, BMEWS coverage can be either overflown by ERBM's or under flown by low-angle ICBM's. However, the implementing of present plans for improvements to the present BMEWS would obviate some of these deficiencies. The addition of gap-filling radars and an extended range, high-angle ballistic missile and satellite detection system would provide improved surveillance capabilities.

One possible way that early warning of an IRBM raid on the continental United States could be obtained as quickly as with a global, space-based system would be to construct a battery of phased-array radars along the Southern, Eastern, and Western boundaries of the United States plus North-looking BMEWS gap fillers. Although a system such as this would also provide more accurate impact prediction than would some possible space systems, it would give shorter warning times of ERBM attacks and less accurate data concerning enemy ICBM or ERBM launch positions. Adequate ERBM warning would probably require construction of massive radar installations along the Southern border of the USSR and China, although radars located on islands near the South Pole could possibly prove adequate. However, a ground-based network of these dimensions would almost surely prove to be less cost-effective than a space-based system when the political and technical problems associated with logistics and data transmission from globally separated sites are considered.

Detection of missiles during their passage through the ionosphere by high-frequency, forward-scatter radiation may

be possible, although difficulties in reducing the high false-alarm rates caused by natural phenomena appear formidable. Also, this technique cannot provide information concerning missile launch—or impact—position location with the degree of accuracy expected from space-based systems.

Countermeasures against radar systems are likely to be more effective than those which appear practicable against IR sensors in space; and, although it seems possible to reduce the cross-sectional area of missiles by three orders of magnitude (with respect to BMEWS radar), reductions in missile IR radiation as seen by space-based sensors of only one order of magnitude are believed possible.

3. Detection of Nuclear Detonations

As long as on-site inspection of nuclear detonations remains politically unacceptable, means must be available for remote detection of any nuclear explosions. Ground-based or aircraft techniques exist, or are being developed, to detect explosions underground, in the atmosphere, or in near-space where large-scale effects are produced in the upper atmosphere. It may also be possible that low-orbit systems designed for use in detecting IR radiation from missile launches (e.g., systems which are now undergoing experimentation) may be able to confirm the occurrence and location of such explosions. Detonations farther out in space can be conducted in a way which precludes observation from either ground-based stations or low-orbit systems designed for earth surveillance of ballistic-missile launchings. It is judged that detonations could be detected over line-of-sight distances of many thousands of miles from an unmanned orbital platform containing available nuclear radiation instrumentation. By these techniques, continuous monitoring of cislunar space from two space platforms appears possible.

Future capabilities may be achieved for discriminating between the radiation from nuclear detonations and natural

phenomena, for determining the type and size of a nuclear explosion, and for locating either single or multiple events with respect to the earth's geographic coordinate system.

4. Geodetic Measurements

Improved geodetic data are a fundamental need for accurate targeting of intercontinental range ballistic missiles, particularly in counterforce strikes. Also, improving prediction of the perturbations of a near-earth satellite is dependent upon obtaining better information on irregularities in the earth's shape and in its gravitational field. Some of this knowledge has already been gained through observing over long periods perturbations in the orbital paths of satellites. Results from these observations have demonstrated the value of special-purpose satellites carrying radio and optical beacons for acquiring geodetic data. In some cases, it may be the only way to acquire the data. These methods may reduce the present errors of perhaps 100 to 400 meters between intercontinental data planes to perhaps 8 meters or less.

At present, the potential accuracy in the locating of identifiable points in Eurasia with respect to the Department of Defense World Geodetic System varies from about 100 feet to 4 nautical miles. In many potential target areas, the uncertainty is on the order of from 0.5 to 1 nautical mile, and the accuracy of elevation at these locations also presents serious difficulties for effective, future strike systems.

There are other areas, however, where even these accuracies are not attainable. In these areas photographic reconnaissance satellite techniques may provide means for relating points in unfriendly territory to bench marks in friendly territory. Other than by actual invasion of enemy territories, however, even these techniques cannot provide all required data. A relatively few specially instrumented satellites at altitudes of 1,000 miles above earth and using long focal-length photography can identify and locate

by simultaneous comparison with star backgrounds permanently identifiable points anywhere in Eurasia to within a few hundred feet in the horizontal plane.

5. Terrestrial Navigation

If a frequency-stabilized radio signal is transmitted from an earth satellite, the Doppler shift in the signal can be determined. Reception and measurement of the shift which results from the orbital motion of the satellite permit the determination of the geographical position of the receiver, regardless of its location on the earth's surface. In this system, the satellite broadcasts data on its ephemeris, which has previously been determined and relayed to the satellite by a ground station. Compensation for the additional non-Doppler shift in signal caused by passage through the ionosphere can be obtained by transmission and reception at two frequencies, since the ionospheric shift is frequency dependent.

Navigation by use of a satellite Doppler system has certain advantages over other present and possible navigation systems. Operations can be conducted in all kinds of weather; transmissions are not required from the vehicle to be navigated; accuracies comparable to other position-location techniques are possible; and knowledge is not required of the direction of either the local vertical or an azimuth reference. Because angle data are not required, stabilized antennas are not needed.

The extension of this navigational procedure to airborne strategic bomber applications will require the adaptation of the receiving equipment to aircraft weight limits and the adaptation of the computing procedure to take account of aircraft height. A minimum airborne navigation capability will be available by late 1964 from the satellites being developed to meet present naval navigational requirements.