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5. We recommend increasing the present limited efforts to develop homing missiles, and homing devices in interceptors, for attacking jamming sources.

4. ATOMIC WARHEADS FOR AIR DEFENSE

Military Utility

Atomic warheads can provide a capability for increasing the kill probability to 90 per cent or greater from a single pass against a maneuvering enemy bomber. Because of the large lethal radius of these weapons, their terminal guidance can be simplified or eliminated, thereby increasing the reliability of the system and decreasing the vulnerability to electronic countermeasures. In addition, atomic warheads would force the separation of enemy targets and thus prevent close enemy bomber formations which tend to saturate and render ineffective defense systems using conventional explosives.

Ground-to-air missile systems, such as Nike B, have an altitude capability greater than 60,000 feet. If air-to-air rockets were fired from an aircraft in climb, they would provide a kill capability at altitudes above the ceilings of our present interceptors, i.e., up to 50-60,000 foot altitudes. Future air-to-air atomic missiles could provide a very high altitude kill capability even though the interceptor ceiling was limited.

These weapons not only destroy aircraft by air blast and gust, but the nuclear radiation also kills crews at ranges much beyond those at which the aircraft will be damaged. In almost any type of defensive attack, the probability of killing the bomber crew will be essentially 100%, a fact which should provide a strong psychological weapon. However, since even supra-lethal doses of nuclear radiation probably would not produce incapacitation in less than 2-5 minutes, the radiation could only be relied upon to prevent a successful attack when interception occurred at some distance from the target area.

The desirability of destroying an enemy weapon, in addition to the delivery aircraft, has taken on new importance in the age of megaton yields because of the potentially large area which would be covered with radioactive fall-out from a surface burst. More exact information on the vulnerability of enemy nuclear weapons is needed. However, if an atomic defense warhead were exploded so as to place the enemy aircraft within the fireball (400 foot radius for 2 KT at 40,000 feet), then the probability of destroying any nuclear weapon therein should be very high. No other defense weapon has this ability, since the probability of weapon destruction with an HE warhead is considered to be low. A further effect peculiar to atomic warheads is their ability to reduce the yield of presently designed megaton weapons to a few kilotons by preinitiation at ranges far greater than those at which physical damage would occur. Thus, if an atomic warhead had just succeeded in destroying an enemy bomber at 40,000 feet, the bomb being carried would fail to function properly as much as five minutes later if the plane crashed with the weapon intact, armed, and fuzed. This effect is an important consideration in planning defense against possible enemy ICBM's. However, the effectiveness of preinitiation against enemy weapons of unknown design will always be questionable.

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Operational Problems

The increased lethal range of nuclear warheads is not obtained without producing new operational limitations which must be overcome. For example, in the use of an air-to-air nuclear rocket at high altitudes, the nuclear radiation forces the attack to be carried out at a range sufficient to protect the interceptor pilot. As a result, some of the advantage of the larger lethal radius may be reduced by the resulting increased fire control error. For an attack with a 2-KT warhead at 50,000 feet, the launching range between the interceptor and the target must be about 4 miles in order to avoid all risk of injury to the attacking pilot. Because of this demand for remote launching, the air-to-air unguided rocket requires certain special fire control characteristics. Recent studies indicate, however, that the atomic warhead can be made compatible with presently available and programmed interceptors, such as the F-86B and F-102, with only minor modifications to the existing fire control systems.

Because of the denser air at low altitudes, the safe launching range will be shorter (less than 2 miles at sea level). Thus, no special fire control problems will occur for low altitude defense. However, for low altitude use over inhabited areas, care must be exercised in order to prevent damage or casualties to friendly personnel. A 2-KT weapon could not be detonated below 3,000 feet without producing important damage to residential structures. Careful consideration must therefore be given to the selection of optimum impact areas when atomic weapons are being used to defend against low altitude attack. In any case, such damage would be insignificant compared to the damage which would be produced if enemy weapons were detonated. Over the ocean, atomic warheads could be used at low altitude without any restrictions.

Fissionable Material Requirements

Atomic warheads can be produced at relatively low cost for inclusion in both air-to-air and ground-to-air armament. The major requirement is for yields of about 2 KT, but higher yields might be desired in some situations.

To establish an early capability, it might be possible to arm a defense force by 1957-58 with weapons employing of Oralloid equivalent of fissionable material. At a cost of , such a capability would cost between

To supply an expanded air defense system completely with atomic weapons such as that proposed in the ADC requirements plan for 1960 would require the allocation of about of Oralloid equivalent of fissionable material. A conservative estimate of the total investment cost of the fissionable material for such a program would be about . This material, as is true of all nuclear weapons, would be recoverable in the event that the material were not used in warfare. Since the

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total number of enemy aircraft is not likely to exceed a thousand, and since the kill probability for these warheads is nearly 100%, only a small fraction of the total number of warheads would be expended in actual warfare. Thus, even further additions to the total allocation would increase only the investment cost, not the actual expenditure of fissionable material. If all the air defense weapons were actually fired, the total kilotonage would be approximately that of a single strategic weapon. Thus, the radioactivity which would be added to the atmosphere by the use of the warheads is of no consequence at all.

Development Programs

The Atomic Energy Commission has an active program for developing low yield, small diameter atomic warheads which would be suitable for use in the proposed air defense weapons systems. Effort is being placed on obtaining maximum nuclear efficiency, nuclear safety, and minimum maintenance. The use of new techniques, such as boosting, could still further reduce the fissionable material requirements given in the preceding paragraph on "Fissionable Material Requirements." The warhead development program should have no difficulty in providing satisfactory atomic warheads within the time schedules of the other components of the system.

At the present time, the Air Force is sponsoring a program to develop an air-to-air atomic rocket (Ding Dong) which might become operational in 1957-58. This program should be vigorously supported with a view to having at least a limited capability available by that date. Such a capability would have immediate psychological advantages in addition to their military worth. This weapon should be planned for use in the F-36, F-102 and all other suitable interceptors.

The Army and Navy have programs for development of surface-to-air atomic missiles (Nike-B and Talos-W) which could be available in 1958-59. These should also be expedited since they offer promise of materially increasing the U.S. air defense. The Air Force Bomarc program, which could produce a longer range atomic defense missile, has experienced considerable slippage. (See the November 1954 Progress Report to NSC 5408.) Every effort should be made to halt this slippage or to expedite the development of suitable alternatives.

Consideration should be given now to the inclusion of atomic warheads as the major armament in future air defense weapons systems. It may be possible not only to increase the kill probability but at the same time simplify and increase the reliability of the overall system. All interceptors should be made compatible with this type of weapon. Special consideration should be given to the value of atomic warheads in solving both the high and low altitude defense problems. Their relative usefulness in future air-to-air guided missiles is worthy of particular attention. Every effort should be made to determine and to exploit the capabilities of atomic warheads for actually destroying enemy weapons.

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Operational Doctrine

The effective use of atomic warheads in air defense requires a doctrine of instant use as soon as a hostile attack has been confirmed. To accomplish this, fissionable material must be allocated and deployed to a large number of different air defense missile and interceptor bases. The air defense forces must be granted advance authority for the instant use of the atomic warheads wherever needed over the land areas of the United States and Canada. This calls for the establishment of realistic rules of engagement, the conclusion of satisfactory treaties with Canada, and the realistic indoctrination of the public to the importance and relative hazards involved in their use. The forthcoming high altitude shot of Operation TEAPOT in the spring of 1955 will undoubtedly focus attention on this problem, so a public information program should be established using this as a point of departure. Such a program could have the dual objective of allaying public fears and informing our enemies and allies that we are using our atomic capability for defensive purposes.

Conclusions

Nuclear weapons are the most effective armament with which we can equip our air defense forces. They provide the most direct and reliable method of achieving the high kill probability against single aircraft that modern air defense demands, of creating a potent defense against saturation type attacks, and of actually destroying the enemy nuclear weapons. Recent studies have shown that the air-to-air atomic rocket can be made compatible with existing and programmed interceptors, such as the F-86D as well as the F-102. The investment cost of fissionable material for both ground-to-air and air-to-air nuclear warheads is a small fraction of the total cost of the air defense system. The radioactivity which would be added to the atmosphere by the large-scale use of nuclear defense warheads would be no more than that from a single high yield strategic weapon and would cause no dangerous fallout.

Recommendations

We recommend that nuclear warheads be adopted as the major armament for our air defense forces and that this step be implemented by:

1. Expeditious development, procurement, and deployment of sufficient weapons, initially the programmed air-to-air rocket (Ding Dong) and nuclear version of Nike B, to provide a high kill capability at an early date. (Note: The November Progress Report to NSC-5408 estimated that Ding Dong would become operational in FY '57 and Nike B in FY '58. Maximum effort must be made to maintain these schedules.)
2. Commencement of negotiations with Canada to provide defense forces with authority for instant use of atomic warheads wherever needed over Canada.
3. Use of the high altitude shot at the next atomic test series as a springboard for a public information program with the dual objective of allaying possible fears and informing our enemies and allies that we are using our atomic capabilities for defensive purposes.

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