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REPORT

ON

INCREASED MILITARY PARTICIPATION IN THE NON-NUCLEAR PORTION

OF THE ATOMIC WEAPONS FIELD

RG 326 US ATOMIC ENERGY COMMISSION

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By the

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I. STATEMENT OF THE PROBLEM

1. To determine to what extent the Department of Defense could undertake to assist the Atomic Energy Commission in the non-nuclear portion of the atomic weapons program, and to indicate the steps that should be taken to utilize most efficiently the combined capabilities of the Atomic Energy Commission and the Department of Defense in the atomic weapons field.

II. INTRODUCTION

2. This report of the Joint AEC-DOD Study Group, hereinafter called the Group, contains a presentation of programs and tasks in which the AEC contemplates military assistance, a presentation of current and potential capabilities of the military to perform those tasks, and areas and tasks wherein the AEC could use and the military can give additional assistance.

For the purpose of this report, the Group construes the non-nuclear portion of any atomic weapon to comprise all components and gear exclusive of the fissionable material and the actual components necessary to obtain a nuclear explosion. The nuclear portion would include the firing circuit, detonator circuits, sphere case, H.E., pit, tamper, and nuclear capsule.

3. The discussion covers the following:

a. Present assistance by the Department of Defense.

b. Areas and specific tasks in which the AEC contemplates asking for assistance.

c. Steps to increase combined capabilities of Department of Defense and Atomic Energy Commission in the atomic weapons field.

4. More detailed information relating Service participation and competence in the developmental and production areas of the atomic weapons program is presented in the attached Tabs. These are:

a. Tab A, consisting of a chart and Parts I, II and III, indicates the participation and competence of the three Services.

b. Tabs B, C and D are listings and descriptions of the functions of the facilities and agencies in the Army, Navy and Air Force, respectively, that are competent to participate in the program.

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5. Tab E is a copy of the memorandum from the Director, DMA, to the AEC members of the Group. It provided them guidance in their development of the specific tasks in which the AEC contemplates asking for military assistance.

6. Correspondence related to the establishment of this study of increased participation by the Department of Defense in the atomic weapons program is listed below. Copies are available in the files of the Military Liaison Committee and the Atomic Energy Commission.

a. Memorandum for the Chairman, AEC, from the MLC, subject: "Military Guidance in the Atomic Weapon Field," dated 18 July 1951 urged the Commission to make maximum use of military facilities and assistance.

b. A letter dated 12 September 1951 to the Chairman, MLC, from the Chairman, AEC, stated that the Commission would be pleased to explore with the Chairman of the MLC appropriate military assistance.

c. A letter dated 18 October 1951 on this same subject from the Chairman, AEC, to the Chairman, MLC, proposed formally that joint discussions be conducted with a view to determining to what extent the Department of Defense could undertake to assist the Commission in the non-nuclear portion of the weapons program, and that it believed such a study would indicate the steps that should be taken to utilize most efficiently the combined capabilities of the Department of Defense and the Atomic Energy Commission in the atomic weapons field.

d. A letter dated 31 October 1951 from the Chairman, MLC, to Chairman, AEC, in reply to the Commission's letter of 18 October advised that the Deputy Secretary of Defense was asking each of the three Services to review departmental facilities and to discuss the extent to which additional atomic weapons tasks might be undertaken.

e. A letter dated 14 November 1951 from the Chairman, MLC, to Chairman, AEC, advised that the Department of Defense was in accord with the AEC proposal for the establishment of a joint study group and nominated representatives. The letter further stated that these representatives were not authorized to commit their respective Services.

f. A memorandum dated 4 December 1951, subject: "Increased Military Participation in the Atomic Energy Commission Program" from the Joint

Study Group to the Chairman, AEC, requested the Commission to indicate the possible areas wherein the AEC contemplates or needs additional military assistance.

g. AEC reply dated 5 January 1952 from the General Manager, AEC, to Secretary of Joint Study Group stated that the Division of Military Application has furnished guidance to the AEC members of the Study Group. A copy of DMA memorandum to AEC members is attached as Tab E.

7. An Interim Report of the Joint AEC-DOD Study Group was published and distributed on 27 November 1951 to the Chairman, AEC, and to the Chairman, MLC. Affirmation of the conclusions and recommendations in the Interim Report was requested by the Study Group in the letter of transmittal forwarding the Report. Informal guidance to the members of the Group indicated it would be desirable to list the specific tasks on which the military might be asked to help, other tasks in which military could help, and those DOD facilities which might be applied toward assisting the AEC in the non-nuclear portion of the weapons program.

V. DISCUSSION

Present Participation of Department of Defense

8. The present tasks being performed by the Department of Defense for the AEC, as indicated in Tab A, are being accomplished per negotiations between various materiel departments of the separate Services and various agencies of the AEC. The selection of these activities to perform tasks has been on the basis of technical competence for the specific problem. Where these tasks are developmental in nature for a specific weapon, they necessarily have to be integrated into the complete effort which is accomplished by the Sandia Corporation and the Sandia Weapons Development Board. There are areas such as the manufacture of HE components and detonators that fall into the sphere of influence of Los Alamos and for which that laboratory furnishes all the technical supervision rather than the Sandia Corporation. Other tasks, such as those performed by the Special Weapons Command in dropping weapons at Salton Sea, are strictly of a service nature. It has been the philosophy of the AEC to get competent agencies of the various Services to perform tasks in their specific areas where practical and desirable under the circumstances.

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9. The present procedures for providing Department of Defense assistance to the AEC, while not wholly satisfactory to the Department of Defense, have an obvious advantage for the Atomic Energy Commission. This advantage lies in the fact that the AEC has but to go direct to any military agency and request assistance which is readily given when the capability exists in that agency without serious conflict with other responsibilities. On the other hand, Department of Defense evaluation of such assistance to the AEC, where it has a significant impact on Department of Defense requirements, is essential to assure maintenance of the proper relationship between AEC tasks and those currently performed by the Department of Defense. The exercise of Department of Defense control of workloads will become increasingly important as Department of Defense participation is expanded.

10. The status of the Sandia Corporation is currently of importance to the problem of greater military participation in the atomic weapons program and must be considered. In addition to developing non-nuclear components of atomic weapons, the Corporation is utilized by the AEC as a field agency to carry out certain operations, to carry out procurement and production functions, as a coordinator of various military and civilian efforts, and as an evaluator and monitor in many areas to protect the interests of the AEC. There has been considerable question in the military as to the competence of the Corporation to handle so many roles. Some untenable situations have also arisen due to the conflicting nature of the varied tasks assigned to this organization. It does not appear appropriate, for example, that the Corporation be in a position to evaluate work of the military when it is in competition with that work. There are strong suggestions that the developmental capabilities of the Corporation have been substantially diluted by its efforts in the procurement, production, coordinating, contracting, evaluating, inspecting, monitoring, and other incidental fields. It is believed that the Sandia Corporation has appreciable competence and considerable potential in the area of research and development of novel ordnance applications, and furthermore, that its activities should be confined to such effort. In this capacity the Sandia Corporation would have the role of opening new approaches.

General Areas in which Department of Defense Assistance is Contemplated

11. The AEC has indicated to its members of the Group those areas in which it contemplates asking for assistance as follows:

a. Special applications such as atomic depth charges for air, surface and sub-surface launching against submarines; atomic torpedoes for anti-submarine and anti-shipping use; 16-inch atomic projectile for precision shore bombardment; and air-to-ground and ground-to-ground rockets with atomic warheads.

b. Compatibility of weapon with vehicle such as aircraft and missiles with particular emphasis on the marriage of atomic weapons to supersonic aircraft.

c. Environmental testing of completed weapons.

Specific Tasks and Military Competence

12. Under those three areas which the AEC furnished in its guidance to the AEC members of the Group and the Group's broad interpretation of "compatibility," there are listed below specific tasks where assistance by the Department of Defense is desired. These tasks are matched with the Services having interest and competence. Tab A indicates that the Department of Defense is, in fact, either participating in these tasks and many other related tasks on its own initiative or possesses the competence to accomplish those items which may be initiated in the future. Functional descriptions of Department of Defense facilities with competence to assist in or assume responsibility for carrying out these tasks are attached as Tabs B, C and D.

a. Compatibility of TX-5 with F-88 (USAF).

b. Compatibility of TX-11 with designated aircraft (USN and USAF).

c. Universal suspension and sway-bracing development (USN and USAF).

d. Optimum sizes and shapes determination for external carriage (USN and USAF).

e. Handling and test equipment development for TX-10, TX-11 (USN).

f. Development of ultimate fuzing for guided missiles under present arrangements (USA, USN and USAF).

g. Complete non-nuclear development of atomic depth charges, mines, and torpedoes, and test and handling equipment therefor (USN).

h. Development of retarded fall devices (USAF and USN).

i. Environmental testing of complete weapons (USA, USN and USAF).

j. Compatibility of Mark 7 to F3H (USN).

k. Compatibility of Mark 7 to F84-G (USAF).

l. Compatibility of TX-13 to applicable service aircraft (USAF and USN).

m. Development of handling equipment for atomic warheads for all rockets and guided missiles approved by the Department of Defense for marriage with atomic warheads (USAF, USN and USA facilities as necessary and coordinated by AFSWP).

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Military Assistance in Special Application Weapons

13. In this category the AEC has utilized the capabilities of the military in developing and producing the penetrating and artillery-fired weapons, and should envision the further use of military assistance on weapons such as an atomic depth charge, atomic torpedo, or a 16" atomic projectile. It is apparent that the military has built up considerably more experience in these types of weapons than any existing civilian contractor. It is interesting to note that the special purpose weapons now being developed by the military for the AEC resulted from military initiative backed up by comprehensive study, justification and detailed requirements. It is probable that other "special purpose" weapons will also be conceived and justified by the military in sufficient technical detail by systems analysis so that a logical result would be the development of the weapon by the military. Development of special purpose weapons by the military will not materially affect the workload of civilian AEC contractors, and would augment the over-all development effort applied to atomic weapons. In any case, the military has shown its capability to develop projectiles, rockets, penetrating weapons, depth charges, mines, and torpedoes, and others. In event of radically different concepts of new "special applications" a military development capability would undoubtedly stem from the versatility of its experience and facilities.

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14. The designation of a weapon as a special purpose weapon may be difficult in the future. Should the Department of Defense in its systems studies determine the need for and feasibility of a free-falling bomb whose

configuration may be peculiar to a specific vehicle, it should not be restricted from utilizing its capabilities for the development of that weapon.

Compatibility

15. Written guidance to the AEC members of the Group on the subject of compatibility states as follows: "Here it seems logical that where the characteristics of the vehicle are predominant in the problem, the responsibility for compatibility should rest with the builder of the vehicle." These words are subject to two possible interpretations. One is that the designer of the vehicle is responsible for modifying the vehicle to make it compatible with the warhead or weapon. The alternate interpretation is that the wording, "responsibility for compatibility" implies that the control rests with the Service having primary interest in the weapon system and includes also the control of development of those components of the weapon or warhead which affect the performance characteristics of the vehicle. The Group considers the latter interpretation as the only practicable one and, consequently, feels that in such a case as that of an externally carried weapon on high speed aircraft where the shape of the aerodynamic case of the weapon materially affects the performance of the aircraft, the agency responsible for the aircraft development should have the prerogative of either dictating the development of or actually developing the case. Similarly, where the delivery techniques of the carrying aircraft or missile predominate, the fuze performance must be compatible with such delivery techniques. Compatibility will always require compromise solutions. It is certain that tasks in the above areas must necessarily be the subject of separate negotiations defining responsibilities and insuring over-all integrity of design.

16. The AEC indication that military assistance is contemplated in the area of compatibility of weapons with vehicles and suggestion that the responsibility for compatibility should rest with the builder of the vehicle when the characteristics of the vehicle predominate in the problem are considered logical, particularly in view of the fact that the increasing complexities of vehicles and their systems seem to far outweigh the difficulties in creating a satisfactory warhead. However, compatibility should be used in a broad sense and should encompass the compatibility of a warhead with the weapon;

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and the compatibility of a weapon and its fuzing not only with the vehicle, but with the weapon system, its handling equipment, assembly and storage facilities, packaging and the technical competence of military personnel. Responsibility for compatibility, thus, is held by the Group to include development control of certain weapon components and ancillary equipment.

Environmental Testing

17. The AEC contemplates asking for assistance in the area of environmental testing of complete weapons where the Department of Defense possesses the background, facilities, and personnel to accomplish this task prior to or with operational suitability tests. Environmental tests of complete weapons developed by or for the AEC is the responsibility of the AEC and properly must be accomplished prior to certification for war reserve. Utilization of Department of Defense facilities has been extensively practiced in the past and is desirable when appropriate in order to avoid duplication of facilities. There is the probability that applicable AEC tests performed by the AEC, or by the Department of Defense for the AEC may be considered retroactively by the military as part of operational suitability testing. With this view in mind, the AEC and the Department of Defense could profitably cooperate during tests in order to expedite stockpiling.

Department of Defense Participation in Associated Fields

18. Although military participation has been requested and used to accomplish the majority of work in conducting tests for weapon performance and for weapons effects, this area was not formally stipulated as one where additional military assistance is desired. The group feels that the military could provide greater assistance to the Commission in the conduct of these tests. Weapons effects tests are considered to be of primary interest to the military and should be a responsibility of the Department of Defense. Tests performed primarily to ascertain weapon performance or to conduct research into weapon phenomenology are a distinct function of the AEC.

Steps to Increase Capabilities in the Atomic Weapons Field

19. Project Assignment - On component projects or tests requested by the AEC and to be developed or tested with AEC funds, the AEC should continue to

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have the prerogative of selecting those Service laboratories in which it desires to have such work accomplished. This procedure should be accomplished with the understanding that where some suggested assignment of workload interferes with high priority projects within that particular laboratory, the Department of Defense retains the prerogative to suggest another Service laboratory which the AEC can use for its purpose. When the AEC requests assistance on major projects, such as the development of special purpose weapons and major components, the Department of Defense should retain the prerogative of selecting which Service shall have this development responsibility.

20. Military Initiative in Weapon Development - It is evident that the military can contribute to the atomic weapon program not only by increased collaboration with the AEC, but by initiating research and development into new weapons systems and the weapons associated with them. It is pointed out that to date only two special purpose weapons exclusive of guided missiles and rockets have evolved from the initiative of the Department of Defense. In both of these cases the major responsibilities for developing these weapons were delegated to the Services under the ultimate responsibility of the AEC.

21. Legal Aspects - It is the opinion of the Group that the existing laws and arrangements authorize the Department of Defense to conduct research and development on non-nuclear components and assemblies, irrespective of their configuration as bombs, rockets, guided missiles, drones or special purpose weapons. A joint legal validation of this opinion would be an important step in maximizing the over-all effort. There is nothing in the present arrangements or law that prevents or discourages in any way Department of Defense studies and development on non-nuclear portions of atomic weapons for application to the various requirements of the Department of Defense. It is the belief of this Group that the reluctance of the Services to explore new atomic weapons and their applications has been due in part to a restricted interpretation of the Atomic Energy Act, which states in Section 6, subsection (b) that,

> "It shall be unlawful for any person to manufacture, produce, transfer, or acquire any equipment or device utilizing

fissionable material or atomic energy as a military weapon, except as may be authorized by the Commission. Nothing in this subsection shall be deemed to modify the provisions of Section 4 of this Act or to prohibit research activities in respect of military weapons, or to permit the export of any such equipment or device."

22. It is evident to the Group that "development" with respect to "equipment or device utilizing fissionable or atomic energy as a military weapon" is not included in the list of operations which are unlawful unless authorized by the Commission. Since the Act does not prohibit "research activities in respect of military weapons," the Department of Defense can, in the opinion of the Group, lawfully enter into both "research and development" as defined in subsection (c) of Section 18 of the Act. Furthermore, the term "equipment or device utilizing fissionable material or atomic energy as a military weapon" as construed by subsection (f) of Section 18 is interpreted by this Group to apply to the nuclear portion, less the capsule, as it is delineated earlier in this report. Apparently the military is inhibited in no way from prosecuting research and development of any equipment or device utilizing fissionable material as a military weapon, and certainly is not prohibited in research and development of the many possible varieties of non-nuclears.

23. Coordination within the Department of Defense - As the Services increase their assistance to the AEC and initiate projects of their own in the atomic weapon program, it will become necessary that the tasks and phases be fully coordinated. Although individual competence exists in the separate services for the accomplishment of most developments, there is at present no over-all Department of Defense agency with authority to accept, allocate and coordinate tasks now being performed by the AEC. There is little doubt that the lack of a definitive, authoritative and quick-moving organization in the military has retarded military participation, has resulted in military effort being subordinated to a civilian contractor, and has been a factor in the military's defaulting to the AEC in stipulating the configuration of weapons.

Increased participation by the Department of Defense in the weapons program should be justified not only by the availability of facilities and talent, but by the establishment of a more effective control than presently exists. It appears that the chartering of a Department of Defense agency toward this end is necessary. Furthermore, it is apparent that any agency with such powers vested in it must be capable of rising above the interests of individual Services and should possess outstanding competence in the atomic ordnance field.

24. It is to the national interest that the Services participate as much as possible, particularly in those areas where the Department of Defense has existing facilities and greater experience. In some fields, like the development of ballistic shapes, aerodynamics, testing, power supplies, handling equipment, and packaging, it is evident that Department of Defense laboratories and personnel possess broad experience through long association with the many problems from weapon conception to delivery. There is little doubt that in many instances it is more appropriate to delegate control of a development to the Department of Defense than to vest it in a civilian contractor. It is strongly indicated that, pending a clear determination of ultimate responsibilities, the Atomic Energy Commission and Department of Defense should attempt to define responsibilities before projects are accepted and begun. Such a clarification would improve the joint AEC-DOD effort, would improve relationships and might obviate the military's having subordinate responsibilities in areas where it has the major interest.

25. Procurement and Production - The Department of Defense does relatively little production in its integral facilities in relation to the total production under military cognizance; however, there are many laboratories, depots, arsenals, gun factories, and navy yards which are manned by personnel of extraordinary qualifications. These installations are, or would be, exceptionally useful for development fabrication and for use as job shops. The majority of military production is accomplished by civilian industry and toward this end the three Services through years of experience have developed competent procurement organizations for administering contracts from negotiation through acceptance. The procurement organization of the Department of Defense is so extensive that it covers practically the entire industry of the United States,

and its standardized procedures are familiar to all important contractors. The Atomic Energy Commission is currently using military procurement assistance to a limited extent. This assistance could be considerably expanded with little additional burden on the military.

Determination of Course of Action and Responsibilities

26. There appear to be three general courses of action, any one of which could be taken to increase the over-all capabilities for the development and production of atomic weapons. These are:

a. Expansion of AEC development and procurement facilities to handle all or the greater part of the atomic weapons program.

b. Increasing assistance by the Department of Defense as requested by the Atomic Energy Commission under existing arrangements.

c. Delegation of primary responsibility to the Department of Defense for the development and procurement of non-nuclears. This course does not involve the transfer of control of completed weapons from the Atomic Energy Commission to the Department of Defense.

It is apparent that there must be a clear division of weapon development and production responsibilities between the military and the Atomic Energy Commission in order to maximize the capabilities of the Department of Defense and the Atomic Energy Commission in the best interests of the over-all national effort. Before initiation of an expansion program in the atomic weapons field, it is considered essential that a decision be reached as to the ultimate division of responsibility. Such a decision would permit intelligent planning and the effective programming of this expansion.

V. CONCLUSIONS

27. It is concluded that:

a. The Department of Defense is now participating to a large degree in many phases of the nuclear and non-nuclear portions of the weapons program.

b. The Department of Defense possesses competence to participate in those areas contemplated by the Atomic Energy Commission and those tasks listed in paragraph 12.

c. A capacity exists within the Department of Defense to ultimately assume responsibility for the complete non-nuclear program, provided the transfer of work and responsibility is supported by adequate programming, budgeting and sufficient time for reorientation of effort within the Department of Defense.

d. Under existing law and arrangements, the Department of Defense has the authority and shares the responsibility for conducting research and development on non-nuclear components of atomic weapons.

e. The combined capabilities of the Atomic Energy Commission and the Department of Defense in the atomic weapons field can be maximized by a more specific delineation of ultimate responsibilities in the field of atomic weapons.

VI. RECOMMENDATIONS

28. In order to utilize most efficiently the combined capabilities of the Atomic Energy Commission and the Department of Defense in the atomic weapons field, it is recommended that:

a. The Atomic Energy Commission immediately request the Department of Defense to provide increased assistance in those areas and tasks indicated in its guidance to the Atomic Energy Commission members of the Group with special accent on wider participation in those tasks listed in paragraph 12, above, which involve compatibility.

b. Those projects in which the Department of Defense is currently participating should continue under existing arrangements with an increase in utilization of Department of Defense facilities where appropriate.

c. The Atomic Energy Commission be free to negotiate with individual Services in requesting minor services such as assistance in the development of components of weapons or in environmental testing.

d. Participation in the form of responsible work on major projects, such as the development or production of a complete weapon or major component, be requested by the Commission through the Department of Defense rather than by direct approach of the Atomic Energy Commission or its contractor to any Service.

e. The Department of Defense designate an organization in the Department of Defense to coordinate military participation.

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f. The Department of Defense initiate detailed analyses of its facilities and workloads so that increased participation with the Atomic Energy Commission or primary participation in the program can be undertaken with a minimum disruption of other military tasks.

g. The Department of Defense direct each of the Services to provide the maximum practicable assistance to the Commission within its capabilities and competence.

h. The Atomic Energy Commission direct its field agencies and contractors to provide the maximum practicable assistance to the Department of Defense in its participation in the atomic weapons program.

i. The Atomic Energy Commission utilize to the maximum extent practicable the existing procurement organization of the Department of Defense for the placement and supervision of production contracts.

j. The Department of Defense actively budget for and pursue studies and developments to determine new atomic weapons systems.

29. In order to maximize the combined capabilities of the Atomic Energy Commission and the Department of Defense in the development and production of atomic weapons, it is recommended that a decision be made as to:

a. The responsibilities that may be exercised by both the Department of Defense and the Atomic Energy Commission under existing laws.

b. The ultimate assignment of responsibilities in the atomic weapons field.

30. Minority Report

Captain John T. Hayward of the Study Group takes exception to the following:

a. Recommendations c and d, Paragraph 28. He believes the Atomic Energy Commission or its contractors should be free to negotiate with individual services in requesting any assistance, either major or minor, in the development of components of weapons, testing, or any associated tasks, and that the idea that the AEC or its contractors would go to the Department of Defense for a determination as to which service would do a major task is unrealistic. He

agrees that the ultimate acceptance of a program or part of a program would rest with the DOD and that this, in no way, should prevent direct approach to any of the services or their facilities.

b. Paragraph 18, Department of Defense Participation in Associated Fields, and paragraph 21, Legal Aspects. He does not believe that these subjects were relevant to the task assigned to this Group. He does, however, believe strongly that a clarification of the responsibilities under Public Law 585 is necessary to enable the Department of Defense to plan intelligently and to budget for its part in the atomic weapons program.

A

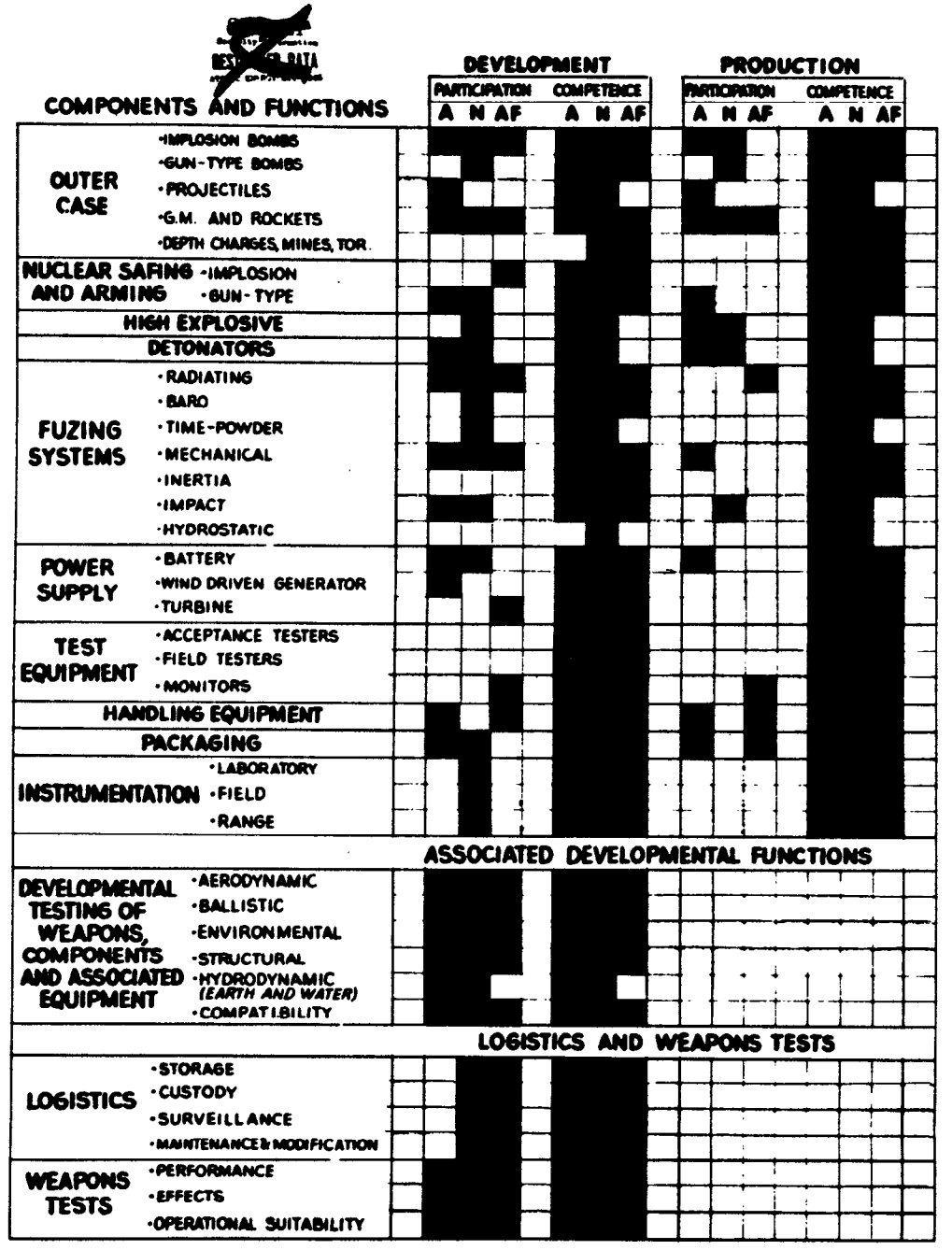
TAB A

DEPARTMENT OF DEFENSE

PARTICIPATION AND COMPETENCE IN THE

ATOMIC WEAPONS FIELD

CHART OF DEPARTMENT OF DEFENSE
PARTICIPATION AND COMPETENCE IN THE
ATOMIC WEAPONS FIELD



PARTICIPATION: Areas indicated are those wherein military facilities have been or are being used to assist the AEC. No quantitative value is indicated. The assistance rendered in some cases consists of performing the complete task.

COMPETENCE: Areas indicated are those wherein the military has competence to participate in the atomic energy program. This competence is based on the facilities and talents that are available. Where competence is indicated a known capacity exists, and in some instances without requiring a reorientation of work load.

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TAB A - PART I

UNITED STATES NAVY PARTICIPATION AND COMPETENCE IN THE ATOMIC WEAPONS PROGRAM

The U. S. Army and its technical services have established many facilities and become thoroughly experienced in the development and production of countless weapons and weapons systems. The facilities and talents available to the Army are competent to participate to a large degree in the atomic weapons field.

The information presented herein relates the past and current participation and the competence of the Army to the development and production of specific weapon components, to atomic weapon logistics, and to associated functions.

1. OUTER CASE

a. Implosion Bombs

(1) Development

(a) The Army Ordnance Corps develops practice bomb cases that are exact replicas of cases for stockpile weapons. Ordnance facilities and personnel are used to assist in the development of most of the implosion weapon cases. As there is no phase of this development effort that is not done for comparable weapons full competence in this area is well established.

(2) Production

(a) The Army Ordnance Corps is currently responsible for the production of practice bombs, which involves the procurement of outer cases essentially identical to cases being procured by the Atomic Energy Commission.

b. Gun-type Bombs

(1) Development

(a) The Army has not participated in the development of the non-nuclear elements of gun-type atomic bombs, but competence to handle any part of this program is well known.

(2) Production

(a) Competence and facilities to do this sort of work exists in Army Ordance.

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c. Projectiles

(1) Development

(a) In the development of the TX-9, Army Ordnance has demonstrated know-how and competence to assume full responsibility for any task of this nature. This work draws on metallurgists, ballisticians, gun experts, powder specialists, and in general, the whole spectrum of talents required to design and prove new artillery.

(2) Production

(a) Army Ordnance is currently responsible for the production of this weapon under contract to the Atomic Energy Commission. This work is being performed largely at Army Ordnance facilities.

d. Guided Missiles and Rockets

(1) Development

(a) Army Ordnance capabilities in the field of guided missiles and rockets is well known, both from projects they now have under contract and the arsenal capabilities like that of Redstone, where the large number of German experts on the government payroll give them an exceptional competence and flexibility.

(2) Production

(a) All missile and rocket production requirements are the responsibility of the agencies developing the vehicles concerned. The Army has several such vechicles under development.

e. Depth Charges, Mines, etc.

(1) Development

(a) Except for land mines, the Army has no present participation in tasks of this nature, but ordnance competence could be applied to such development effort, if required.

(2) Production

(a) Atomic weapons of this nature are not currently in production, but competence to assume this production is in the Army Ordnance

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2. NUCLEAR SAFING AND ARMING

a. Implosion

(1) Development

(a) Army Ordnance is now participating in development tasks in this area in connection with the development of missiles and rockets at least to the extent of developing what must be done to safe or arm the warheads in these vehicles. Since such problems are largely mechanical in nature, competence to solve them exists in the Ordnance, even to the extent of working on cored charges, if such assistance to the Atomic Energy Commissic became necessary.

(2) Production

(a) The Army is not currently involved in the production of nuclear safing and arming devices for implosion weapons, but there is nothing so highly specialized in the nature of such devices that Army Ordnance could not assume responsibility for producing these items. This is particularly true if the safing device is some sort of time mechanism with which the military has had extensive experience.

b. Gun-Type

(1) Development

(a) Army Ordnance has been fully responsible for the development of the safing and arming for the TX-9, and is obviously competent to extend this effort to similar tasks.

(2) Production

(a) Army Ordnance is currently responsible for the production of the nuclear safing and arming devices necessary for the TX-9.

3. HIGH EXPLOSIVE

(1) Development

(a) Army Ordnance is not now participating in the development of the high explosive elements of implosion weapons; however, individuals involved in t[redacted]tion program have from time to time contri-

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buted to the making of better HE components. Years of development work on explosives has established a very competence in this area.

(2) Production

(a) Army Ordnance is now giving the Atomic Energy Commission assistance in the production of HE components of atomic weapons. This assistance may be expanded or contracted as may be required. Such work is now being carried out under over-all Atomic Energy Commission responsibility; there is little to be gained in lessened administrative burden by having the military assume full responsibility for this production, since it is fundamental to the success of the nuclear functioning of the weapon and must remain an Atomic Energy Commission responsibility as long as the responsibility for nuclear components remains with that agency. One gain in ease of operations could be realized by release from present "Q" clearance requirements.

4. DETONATORS

(1) Development

(a) Although the Atomic Energy Commission has requested no assistance from the Army Ordnance in the development of detonators, such assistance has actually been given in the process of producing them. The Ordnance has contributed design changes that have made them easier to produce, and technical changes that have improved thei functioning. Competence in this area is born of years of experience.

(2) Production

(a) The Army Ordnance is now producing these components for the Atomic Energy Commission. The remarks just made under "high explosive" apply.

5. FUZES

a. Radiating

(1) Development

(a) The Army Signal Corps has from time to time contributed consulting service to the Atomic Energy Commission in connection

with the design of radiating fuzes since there is such a wealth of radar experience in that organization. Signal Corps experts have recently participated in the Rebecca project and, as a result, have submitted a proposal to the Atomic Energy Commission for a complete redesign of the MC-1 fuze. Army Ordnance has accumulated experience in this field in their work on proximity fuzes. The principal Ordnance contractor, the Bureau of Standards, has been participating for some time on the radiating fuze development program of the Atomic Energy Commission.

(2) Production

(a) The Army is not now assisting in the production of radiating fuzes, but procurement assistance is furnished for some fuze components on the request of the Atomic Energy Commission. Since these are not essentially different from radar devices from a procurement point of view, competence to assume this procurement exists in the Army without any serious increase in current workloads.

b. Barometric

(1) Development

(a) The Army is not now participating in development work on these fuzes, but competence to do so exists in both the Ordnance and the Signal Corps. The latter agency has done a considerable amount of work in microbarometric studies that could be applied to assist in solving this fuze problem. Also, the Ordnance Corps has carried out development of a barometric fuze for use in conventional bombs and related items.

(2) Production

(a) The Army is not assisting in the procurement of baro fuzes for atomic weapons, but competence to procure these items exists. Similar items are now part of the procurement program of Army Ordnance.

c. Time Powder

(1) Development

(a) Army Ordnance is not participating in the development of a time powder fuze for atomic weapons, but they have done so much work on similar fuzes that experience and competence must be taken for granted.

(2) Production

(a) Competence to produce this type of fuze exists in the Army Ordnance.

d. Time Mechanical

(1) Development

(a) Army Ordnance experience in the development of fuzes of this type is well known. The fuze for the TX-9 is time mechanical and the fuze for the HONEST JOHN rocket will probably be such a fuze.

(2) Production

(a) The time mechanical fuze for the TX-9 is now being produced by the Army Ordnance.

e. Inertia

(1) Development

(a) The Army is not participating in any inertia fuze program, but competence in this type of mechanical device exists in Army Ordnance.

(2) Production

(a) Competence to produce such devices or assist in such procurement exists in Army Ordnance.

f. Impact

(1) Development

(a) Army Ordnance is not now participating in the development of impact fuzes for the Atomic Energy Commission, but considerable work on this problem is being done with the possibility of ultimate application to the TX-9, the HONEST JOHN, or the family of guided missiles.

(2) Production

(a) No impact fuzes for atomic weapons are now in production, but competence to produce such devices is in the Army Ordnance.

g. Hydrostatic

(1) Development

(a) Army Ordnance is not participating in the development of this type of a fuze for an atomic weapon, but competence exists to assist in this effort.

(2) Production

(a) No hydrostatic fuzes for atomic weapons are now in production, but competence to produce such devices is in the Army Ordnance.

6. POWER SUPPLY

a. Battery

(1) Development

(a) The Atomic Energy Commission has been given considerable assistance in solving battery problems by the Signal Corps, and their competence in this area is well known. Considerable competence exists in the Army Ordnance in the development of reserve type batteries for proximity fuzes.

(2) Production

(a) Assistance in the procurement of batteries is now being furnished by the Army Signal Corps.

b. Wind Driven Generators

(1) Development

(a) Army Ordnance is currently developing wind driven generators for proximity fuzes and some of this effort may be applied ultimately to fuzes for missiles that will carry atomic warheads. Considerable experience and competence exists in this area.

(2) Production

(a) These items are not now in production for atomic weapons, but may some day provide the power source for fuzing, arming, or

firing. Such items are currently being produced by Army Ordnance for fuzing purposes.

c. Turbine

(1) Development

(a) The Army is not participating in turbine power sources for atomic weapon fuzes, but has some turbine experience that could be applied to this task.

(2) Production

(a) Turbine power sources for fuzing purposes are not an Army interest at the present time, but introduce no special problems. Competence to produce is assumed.

7. TEST EQUIPMENT

a. Acceptance Test

(1) Development

(a) No unique acceptance test equipment is involved in the development of the TX-9 so that the Army has no program in this area other than the ultimate requirement to develop test equipment for fuzes that the Army may develop. Competence exists in the Ordnance and Signal Corps for development of almost any type of electronic or mechanical test equipment.

(2) Production

(a) No Army assistance other than on components is now being furnished for this item, but similar equipment is procured by the Army. Assistance in this procurement could readily be furnished.

b. Field Test

(1) Development

(a) The same remarks apply as for acceptance test equipment from the point of view of the development of weapons. Equipment for effects tests is covered under that subject.

(2) Production

(a) No Army assistance other than on components is now being furnishe

for this item, but similar equipment is procured by the Army. Assistance in this procurement could readily be furnished.

c. Monitoring Equipment

(1) Development

(a) The TX-9 has no requirement for monitoring equipment and none is under development in the Army. Competence to assist in the development of electronic monitoring equipment exists in the Ordnance and Signal Corps.

(2) Production

(a) No Army assistance other than on components is now being furnished for this item, but similar equipment is procured by the Army. Assistance in this procurement could readily be furnished.

8. HANDLING EQUIPMENT

(1) Development

(a) Army Ordnance is developing TX-9, rocket and missile handling equipment as will be needed for the weapons and missiles it is developing. It has long experience in this area from the work done to design and produce bomb and ammunition handling equipment.

(2) Production

(a) Gear for handling and assembly of the TX-9 is now being produced by the Army Ordnance. The Army will produce handling gear for the guided missiles it develops and has competence to produce whatever gear is needed for handling the warheads concerned.

9. PACKAGING

(1) Development

(a) Every Army technical service has packaging problems peculiar to the type of equipment for which it is responsible. Packaging problems in connection with the TX-9 will be handled by Army Ordnance; capability to furnish other packaging assistance of almost any type exists in one technical service or another. Particular competence is available in the field packaging for air

transportability.

(2) Production

(a) Army Ordnance is providing the packaging needed for the components of the TX-9. Packaging competence for all sorts of items from food to bulldozers exists in the Army. Particular competence for special application such as air transport is available, and should be utilized by the Atomic Energy Commission to the maximum extent practicable.

10. INSTRUMENTATION

a. Laboratory

(1) Development

(a) The Army is not now participating in the development of laboratory equipment for the Atomic Energy Commission, but a broad competence for instrumentation development exists in the various laboratories of the technical services.

(2) Production

(a) The technical services of the Army produce or procure laboratory equipment similar to that procured by the Atomic Energy Commission, but no service has any particular program to do this for the Atomic Energy Commission. If such procurement assistance is needed, it can be easily provided by the service with particular interest in the item to be procured.

b. Field

(1) Development

(a) The Army is not now participating in the development of laboratory equipment for the Atomic Energy Commission, but a broad competence for instrumentation development exists in the various laboratories of the technical services.

(2) Production

(a) The remarks made under laboratory instrumentation apply equally well to this type of instrumentation. The guided missile programs, as well as the assistance that has been furnished for

[redacted] instrumentation at atomic weapons tests, has developed a broad Army competence in this field.

c. Range

(1) Development

(a) Although the Army is not now developing range instrumentation for the Atomic Energy Commission, it has been required to do a great deal of this type of work in connection with its projectile, rockets, and guided missile development work.

(2) Production

(a) The remarks made under field and laboratory instrumentation apply here.

11. DEVELOPMENT TEST OF WEAPONS, COMPONENTS, ETC.

a. Aero

(1) Although the Army Ordnance has not been asked to assist the Atomic Energy Commission in its drop test program in the field, it has been giving assistance in data reduction and preparation of bombing tables.

b. Ballistics

(1) The Army Ordnance is currently assisting the Atomic Energy Commission in ballistics studies of bomb and projectile shapes using wind tunnels, free flight range, and spark range facilities. Guided missile shapes are also studied in these facilities under basic ordnance responsibility.

c. Environmental

(1) Army Ordnance is currently participating in environmental testing of the TX-9. In addition, every technical service has environmental test programs, in many cases involving cold chambers, humidity and tropic test chambers and other environmental test facilities. Personnel competent to run such tests and evaluate the results are available. Any assistance from such facilities will of necessity interfere to some extent with tests of other equipment.

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d. Structural

(1) Competence to assist in various structural testing appropriate to equipment of interest exists in various technical service laboratories. Additional participation in the Atomic Energy Commission program will undoubtedly cause some interference with existing Army programs.

e. Hydrodynamic (earth and water)

(1) The Army has conducted an extensive study of earth penetration by bombs. Competence to expand this effort is in the Ordnance Corps and the Corps of Engineers.

f. Compatibility

(1) It is anticipated that the vehicle designer or developing agency for guns, rockets, and missiles will have the responsibility and the competence to carry out compatibility tests that involve particular vehicles of interest to that agency. This sort of task can only be managed with the full cooperation of the vehicle developing agency, and in most cases, can best be done by that agency.

12. ASSOCIATED FUNCTIONS

a. Logistics

(1) Storage

(a) The Atomic Energy Commission has in the past used Army facilities for storage when necessary, and it is anticipated that the same thing will happen again. Aside from somewhat stringent environmental requirements and special security needs, there is no essential difference between the Atomic Energy Commission and military storage problems. In the field, it is expected that the Army will store its own nuclear and non-nuclear components, using Army personnel for assembly, test, and surveillance..

(2) Custody

(a) The Army is not now assisting the Atomic Energy Commission in

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its custody problems except as Army individuals are being used by the Armed Forces Special Weapons Project. The Army anticipates no very difficult problems connected with custody of atomic weapons when they are turned over to the Army in the theater.

(3) Surveillance

(a) Army assistance to the Atomic Energy Commission in surveillance is being furnished through the Armed Forces Special Weapons Project. Experience and competence is available whenever this task falls to the Army in the theater or elsewhere.

(4) Maintenance and Modification

(a) Army assistance in the maintenance and modifications of Army designed atomic weapons will be furnished through the Armed Forces Special Weapons Project in the continental United States and will be assumed by the Army in the theater. All of this activity will be much more expeditiously handled administratively if the full responsibility for maintenance, modification, surveillance, and custody is made the responsibility of the Armed Forces Special Weapons Project acting for the Joint Chiefs of Staff.

b. Weapons Tests

(1) Performance

(a) Specialists in the Army technical services have frequently been called on in the past to assist the Atomic Energy Commission in performance tests of atomic weapons, and similar help will always be available to the Atomic Energy Commission.

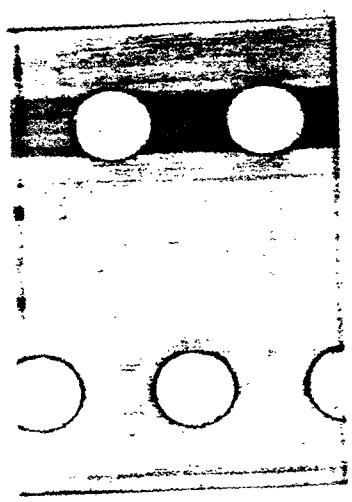
(2) Effects

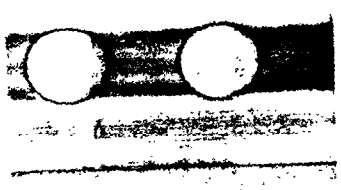
(a) Every Army technical service has participated to some extent in the study of the effects of atomic weapons, sometimes at the request of the Atomic Energy Commission, sometimes over the objections of the contractors to the Atomic Energy Commission. Inasmuch as the effects of atomic weapons are of primary interest to the military, it is anticipated that the

Army will participate to an ever increasing extent in effects tests. The Army has proved competence in blast studies, biomedical studies, radiological studies, long range detection studies, thermal studies, and related end-item studies such as the effects on equipment, personnel, and structures.

(3) Operational Suitability (or Service Test)

(a) The Army is presently carrying out the service test of the TX-9 under the supervision of the Army Field Forces Board Number 1. Guided missiles and rockets will be given service test by Board Number 4 at Fort Bliss. These Boards possess full competence to carry out the tests expected of them.





TAB A * - PART II

UNITED STATES NAVY PARTICIPATION AND COMPETENCE IN THE ATOMIC WEAPONS PROGRAM

1. Enclosed herein is a list of tasks and areas which give a fairly comprehensive coverage of the atomic weapons field. Aligned with these tasks and areas are statements as to Naval participation and descriptions of certain pertinent capabilities which taken together give a strong indication that a competence exists within the Navy for providing greater and more responsible assistance to the atomic weapons program. Naval assistance to the atomic weapons program has been so extensive and there are so many areas where additional competence exists that it is impracticable to furnish a complete list. It is believed, however, that the listings below show the nature and potentials of Naval support to the program and indicate sufficient competence to undertake any task likely in the future with a strong probability of successful accomplishment.

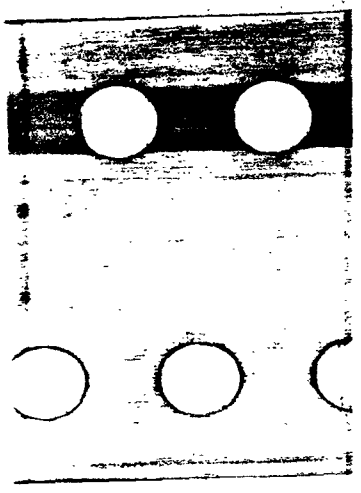
2. Although the atomic weapon field is broken down into component tasks and areas, some of the working agencies expressed a strong opinion that tasks should not be assigned to them in such a piecemeal fashion. It was felt that a better weapon and one which would be closer integrated into its weapon system would result if the weapon were developed in toto by the Navy with its packaging and handling and test equipment included.

3. Suggestions are presented as to the assignment within the Navy of those tasks which the AEC contemplates using military assistance. In general, however, it is recommended that the development of complete weapons which are assigned to th Navy be assigned to the cognizance of the Bureau of Ordnance. An exception is made in the case of guided missiles having the characteristics of an aircraft, which should be assigned to the Bureau of Aeronatics. This opinion is based on the fact that the Bureau of Ordnance is unique in having integral facilities and a wide rang of talents in sufficient strength to accomplish practically all phases of the research and development of a weapon for any weapon system.

CUTER CASE - Implosion Bombs

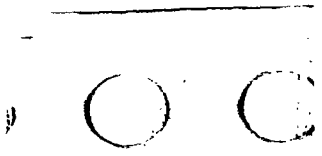
The Bureau of Ordnance (BuOrd) and the Naval Proving Ground, Dahlgren (NPG) provided considerable assistance in the development of the FM 1561 shape. BuOrd handled manufacture and procurement of the shape and other mechanical parts with the Naval Ordnance Plant (NOP), Centerline, doing most of the work assisted by

by other BuOrd plants. The quantity desired and the nature of future shapes would be a factor in deciding whether they should be manufactured for the AEC in BuOrd facilities. For the development of any implosion case, BuOrd has the facilities for complete prototype fabrication, ballistic studies and testing. The Bureau of Aeronautics (BuAer) can supplement BuOrd effort on all phases to do with air work and continue to supply as in the past, all necessary design, structural loading, vibration and environmental criteria.



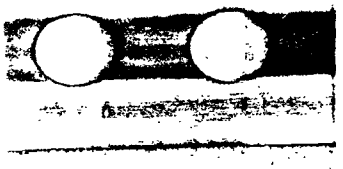
OUTER CASE - Gun-Type Bombs

BuOrd designed the gun for the LB during the war with the Naval Gun Factor (NGF) and the NOP, Louisville, doing most of the manufacturing. After the war BuOr production designed the mechanical parts for the LB and produced them at the Naval Ordnance Plants, Louisville and Pocatello. The Mark 8 non-nuclears were developed, designed, and are now being produced by BuOrd. The major development tasks were done by BuOrd, Naval Ordnance Laboratory (NOL), Naval Ordnance Test Station, Inyokern (NOTS), Naval Powder Factory (NPF), Indian Head, and the Naval Ammunition Depot (NAD), Crane. Production is being accomplished at NGF, NOP, Pocatello, NAD, Crane, NPF, and the NOP, Macon. Similar tasks are under way for the TX-11, XW-8 and XW-11. BuAer can continue to provide pertinent design and load criteria and work on the aerodynamic problems of the weapon and the airplane plus weapon. BuAer using the facilities of the Douglas Aircraft Company, initiated and developed the approved saddle and fuze actuator for the externally-carried Mark 8-X2.



OUTER CASE - Projectiles

BuOrd has not done any work on atomic projectiles except to consult with Army Ordnance; however, all the non-nuclear parts of such projectiles are problems with which the BuOrd has had extensive experience. Its experience in impact type projectiles is outstanding.



OUTER CASE - Guided Missiles and Rockets

BuOrd pioneered in the field of guided missiles and has atomic guided missiles scheduled for the future. BuOrd is currently studying the feasibility of an atomic warhead on its ground to air missile using for the most part the facilities of its subsidiary, the Johns Hopkins Applied Physics Laboratory (APL). It conducted the highly successful feasibility tests of Big Stoop and the feasibility study and

related tests of Little Stoop. BuOrd has extensive experience in rocketry, particularly at NOTS, Inyokern. BuAer has worked on the marriage of atomic warheads to missiles and is currently prosecuting the submarine launched atomic guided missiles, Regulus and Rigel.

OUTER CASE - Depth Charges, Mines and Torpedoes

The Alias Study was made by the NOL and was aided by this laboratory's experience in effects and conventional ordnance. NOL is the prime technical agency in the field of depth charges and underwater mines. BuOrd has four major activities undertaking work in the torpedo field using assistance and design criteria of BuAer, as necessary. However, the current torpedo program is using nine BuOrd facilities, two other DOD activities, five universities and twenty-two contractors. BuOrd has the water and wind tunnels, ballistic ranges, laboratorie fabrication plants and test facilities to prosecute any of the above developments from inception to completion and sufficient facilities to accomplish limited production, if desired.

NUCLEAR SAFING AND ARMING - Implosion

The Navy has not participated in developing nuclear safing for implosio weapons; however, NOTS has evolved highly promising ideas on the use of decellerating forces to arm a rocket warhead. The problems of gun and mount mechanism are not unlike the techniques of implosion nuclear safing and arming, and experience in this field may be adopted to development of atomic weapons.

NUCLEAR SAFING AND ARMING - Gun-Type

BuOrd is currently undertaking this work in connection with the TX-11.

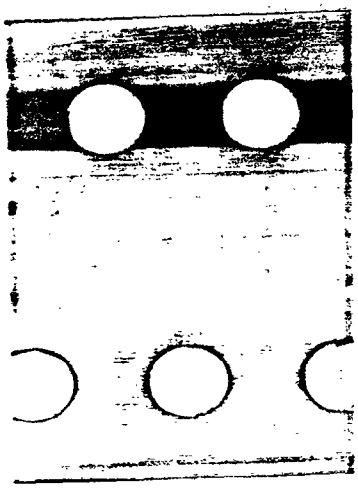
HIGH EXPLOSIVES

During the war the Naval Mine Depot, Yorktown, did development work and produced "quality" and "non-quality "HE castings. The Naval Ammunition Depot (N McAlester, produced "non-quality" castings and loaded the pumpkins. The Salt Pilot Plant was at one time the sole plant outside of Los Alamos for this type of high explosive. Its work is now emphasizing development. NOL now has an explosi development task for the AEC. A number of other BuOrd agencies have supplied special materials and explosives to the AEC. The precision work on this material requires special facilities so that any existing HE plant not specially equipped

would need to be altered in order to make and machine castings. Experienced personnel of BuOrd could facilitate any such work.

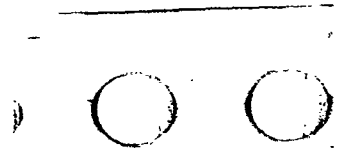
DETONATORS

BuOrd has furnished detonators and detonator parts. NOTS loaded detonators for Los Alamos during the war. BuOrd has production facilities suitable for this work with capabilities for suitable testing. In NOL there is special competence in the detonator development field.



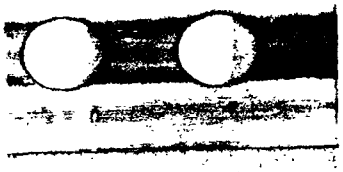
FUZING SYSTEMS - Radiating

BuOrd contributed in the research and development associated with the possible use of VT fuzes for atomic bombs and rendered considerable assistanc to the Michigan group. Although BuOrd did some radar work, its greater effort was in VT fuzes and in utilizing the APL to develop the PMR which was considered by Los Alamos during the war as a possible fuze. APL retains talent to work on PMR. The Naval Research Laboratory, which is exceptionally competent and pioneer radar in the United States, demonstrated a phase of its capabilities while workin on Project Rebecca. This laboratory has often acted as consultants to the AEC. BuAer has contributed pertinent technical data to the Sandia Corporation, including reports of its developments in the field of FM/CW transmissions. Of further interest in the field of radiating fuzes: NOP, Indianapolis, does fire control work, has experience in radiating devices and acts as a BuOrd test agency for all airborne electronic equipment: the Navy Electronics Laboratory under BuShi has capabilities in electromagnetic propagation, underwater acoustics, and radar development. BeShips holds the broad Navy responsibility for electronic reliabili and, in addition, has special competence in miniaturization, unitization, assembly techniques, counter-jamming features, and active and passive countermeasures.



FUZING SYSTEMS - Baro

The NOL uses baro switches for mine parachute releases. BuOrd assisted the AEC in getting the basic components in this field. The BuAer has considerable experience in baros and various methods of pressure-sensing.



FUZING SYSTEMS - Time Powder

The NOL under BuOrd developed the explosive delay train fuze for the Ma 8 and is currently developing the fuze for the TX-11. Although not timed by

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explosive, NOL has recently developed what is believed to be the most significant electric time fuze in the country. Experimental models of the high accurate RUEHLMAN time circuit have been furnished the Sandia Corporation. BuAer has co-operated with BuOrd on the fuzing for the Mark 8 and TX-11 and developed the MC-215.

FUZING SYSTEMS - Mechanical

BuOrd and its principal fuzing laboratory, NOL, have considerable experience in this field. Capabilities exist for developing fuzes actuated by clockwork, mechanical extrusion, inertia decoy, soluble plug, capillarity, resist condensor, magnetic decoy, and thermo-conduction. It is of special importance that BuOrd works on complete systems, including detection, acquisition, designati fire control, and computing equipment, weapons, ammunition, handling fuzing, and recording, and evaluation devices.

FUZING SYSTEMS - Inertial

Inertial or integrating fuzes are a possibility for which competence should exist at NOL, NRL, and other Naval Laboratories.

FUZING SYSTEMS - Impact

BuOrd has vast experience in this field, one manifestation being the Mark 8 fuze. NOTS has done some work in connection with shape charged fuzes for rockets, but most fuzing has been done by NOL which pioneered in the fast as well as the slower impact fuzes, including the crystal type which requires no battery.

FUZING SYSTEMS - Hydrostatic

Hydrostatic fuzes are a standard problem of NOL and BuOrd. These activities have also developed actuating devices for mines which utilize a wide variety of physical phenomena.

POWER SUPPLY - Batteries

BuOrd and its stations are experienced in battery development, particularly for mines and other underwater ordnance, VT fuzes and guided missiles. Two representative developments are the silver cell battery for METEOR and the NOL Thermo-cell for fuzes which is activated by a pyrotechnic. NRL has collaborated with the AEC in battery work.

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POWER SUPPLY - Wind-Driven

The Navy, through BuOrd, developed a wind-driven power supply for the guided missile DOVE (bomb).

POWER SU PLY - Turbine

BuOrd developments in this field include the powder-driven "integrated power supply" of the TERRIOR missile and the NOTS propellant-driven turbo-generator for OMAR and SIDEWINDER.

TEST EQUIPMENT

BuAer has manufactured test equipment to Sandia Corporation specifications and has designed aircraft equipment of this nature. The NRL was brought into the field of atomic weapon test equipment through work on the ABEE fuze. Although BuOrd did not develop the test equipment for the Mark 8, such was recommended. BuOrd is prepared in the future to develop test equipment along with the weapon with which it is associated. Many activities in the Navy have experience and competence in developing equipment to test any specific piece of ordnance developed by themselves.

HANDLING EQUIPMENT AND PACKAGING

The Navy is currently designing universal handling equipment that will be adaptable to conventional as well as atomic stores. The activities of BuOrd, BuAer and BuShips have extensive experience in developing handling equipment to meet rigorous requirements, such as use on unstable platform, and are equally familiar with packaging techniques. In fact, BuOrd considers handling and packaging equipment as a single area of development and conducts research therein at the Materials Handling Laboratory, Earle, N.J. Much of the loading, transportation and packaging equipment developed by BuAer and BuOrd is applicable to atomic weapons. An example is the strippable film equipment used on the wartime bombs. BuOrd alone has six facilities and a laboratory doing major work on packaging.

INSTRUMENTATION - Laboratory

Cases in which laboratory instrumentation has been provided for the AEC are too numerous to record. Some examples are environmental testing by NOL, instrumentation for structural loading by the NAS, Patuxent, and very extensive

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instrumentation for structural loading by the NAS, Patuxent, and very extensive instrumentation by NRL for a great variety of purposes.

INSTRUMENTATION - Field

BuAer, Bushipe, BuOrd, and Naval Research have contributed extensively to instrumenting full scale tests in the field by supplying or developing instruments and techniques. Some examples of Naval assistance in this field are: equipment for collecting air samples, long-range detection, measuring blast, earth movement, alpha, transit time, neutrons time release, heat, ionizing radiation, the effects of radiation and blast, structural loading and scaling criteria. Many other special sensing devices, indicators, recorders, analyzers, and computers have been specifically developed for the AEC with NOL and NRL contributing most of the effort.

INSTRUMENTATION - Range

A large percentage of range instrumentation used in atomic weapon work has been provided by the Navy. BuOrd and NPG have supplied high-speed cameras, Askanias, chronographs, pressure guages, etc. NRL has, in addition to other work developed new telemetering techniques and equipment which are extensively used.

ASSOCIATED DEVELOPMENT FUNCTIONS

AERODYNAMICS - BuOrd supplied assistance and facilities for aerodynamic testing during the war and subsequently has done much work on the Mark 8 and the TX-11. It has personnel on the Sandia Aerodynamics Board. BuOrd has many wind tunnels among its facilities, such as the six at NOL. BuAer has special competence to conduct subsonic and supersonic wind tunnel tests of weapons and airplane-weapon combinations, and to conduct flight and laboratory tests either statically or dynamically at the Naval Air Test Center, Patuxent. Through the BuAer, aircraft and pilots have been made available to the Sandia Corporation for conducting aerodynamic as well as ballistic and compatibility tests.

BALLISTICS - In connection with ballistics the Navy has performed drops and has done much instrumentation for the AEC at Dahlgren, Inyokern, and Salton Sea. In addition to conducting these tests the Navy has the competency and appropriate computers, such as those at Dahlgren, to reduce the data.

ENVIRONMENTAL TESTING - All branches of the Navy possess a great variety

of facilities for environmental testing. Some of these have been utilized for th atomic weapon program. The non-nuclears of the Mark 8 and the TX-11 were tested at NOL and NOTS. NOL has unique facilities in this field which include not only means to determine the effects of temperature, shock, pressure, vibration, but al the effects of transient mechanical, electrical, acoustical and magnetic shock.

STRUCTURAL TESTING - All BuOrd laboratories and facilities have equipment fc structural testing with particularly good equipment for some types of testing at NGF and NOL. BuAer and BuShips also have structural test equipment. NATC, Patuxent, is equipped for structural tests in flight and during catapulting and arrested landings, and is currently under contract to the Sandia Corporation to conduct such tests.

HYDRODYNAMIC TESTING - BuOrd has many facilities for such testing and has conducted hydrodynamic tests of the Mark 8 and TX-11 for water and "solids" at the Pasadena Annex of NOTS and NPG, Dahlgren. BuOrd probably has the most extensive and comprehensive experience in regard to "hard targets" such as steel plate, concrete and granite.

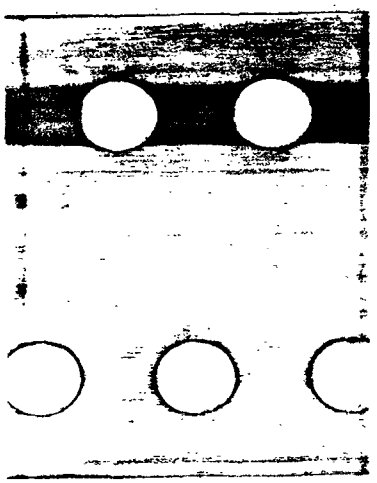
COMPATIBILITY TESTING - Compatibility studies and testing are a normal and continuing function of various Naval material bureaus, with BuAer, BuShips, and BuOrd mostly involved. BuAer and BuOrd are experienced and effective in collaborating to achieve compatibility of weapons with vehicles, and both of these bureaus work successful with the BuShips to insure that aircraft, guns, bombs, guided missiles, and other stores are mutually acceptable.

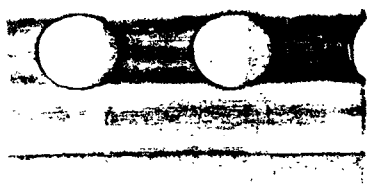
LOGISTICS - Naval participation in the logistics of atomic weapons is in general confined to its work as part of AFSWP in training, surveillance, modification, maintenance, and handling. The Navy has planned and is competent, however, to extend its logistic effort in case of necessity, or if additional assistance is requested.

WEAPONS TESTS FOR EFFECTS AND PERFORMANCE

The Navy in conjunction with the other Services has accomplished a large part of the work involved in weapon performance and weapon effects tests. Naval Operations has contributed by supplying operational ships and aircraft, logistical support, radsafe personnel, and operational staff personnel. Various

material agencies throughout the Navy have contributed equipment and personnel to measure and evaluate as appropriate practically all types of phenomena. Some specific assistance by the Navy in conducting full scale tests include the measurement of transit time, optical, thermal and alpha radiation, time dependent neutron release, shock and blast, soil displacement, and the effects of many of these on personnel and materials. NRL is conducting research in long range detection. BuAer is studying the response of aircraft to blast, heat and other radiation, is exposing aircraft components to blast to develop deisgn criteria, and is instrumenting aircraft and drones with a view to future tests. The BuShips and the BuYards and Docks are each contributing in their specific fields with accent on certain of their broad responsibilities, such as radiological safety (NROL) and structural design.





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TAB A

PART III

UNITED STATES AIR FORCE PARTICIPATION AND COMPETENCE IN THE ATOMIC WEAPONS PROGRAM

1. Air Force participation and competence in the atomic weapons field are discussed in considerable detail and by major weapon subdivisions in the following text. Past and current participation by the Air Force has been and still is modest compared to existing competence. This competence stems from years of experience in developing and procuring aircraft, guided missiles and associated equipment, items which bear a marked similarity to atomic weapons in many respects.

2. While Air Force participation to date has not included responsibility for development of a complete weapon exclusive of the nuclear portion, it is considered highly desirable that Air Force assistance to the AEC be extended to include development of a complete atomic weapon system including packaging and handling, and test equipment. Such a development project could well be undertaken by the laboratories of Wright Air Development Center which have carried to successful completion many projects of equal or greater magnitude and complexity.

3. Outer Case

a. Implosion Bombs

The Aircraft and Armament Laboratories of Wright Air Development Center have made design studies and conducted flight tests of aerodynamic shapes in connection with the development of externally carried bombs such as the TX-7 and TX-12 weapons. The Aircraft Laboratory performed static testing of the Mark 4 and 6 bomb cases. Development competence has been clearly demonstrated and while the Air Materiel Command to date has not made any procurement of outer cases, a definite competence to accomplish this is evident from procurements made of similar items such as externally carried aircraft fuel tanks.

b. Gun-type Bombs

While the Air Force has not participated in the development or procurement of outer cases for gun-type weapons, a definite competence

exists for accomplishing such work through the medium of the Air Research and Development Command and the Air Materiel Command and their contractors.

c. Projectiles

Air Force experience and competence both as to development and procurement is slight.

d. Guided Missiles and Rockets

The Air Research and Development Command is actively engaged in the development of guided missiles and rockets which will carry atomic warheads. WADC laboratories monitor and project these developments and Long Range Proving Ground Command presently is conducting flight tests of certain guided missiles at Holloman and Patrick Air Force Bases. An AMC-WADC liaison officer is stationed at Sandia Base to follow the progress of the marriage program of guided missiles and rockets and their respective atomic warheads. The Air Materiel Command is procuring quantities of guided missiles in much the same manner as quantity procurement of aircraft is made.

e. Depth Charges, Mines, Torpedoes

The ARDC currently is engaged in a design study of a mine to be delivered by aircraft. Competence in this field extends to any ensuing procurement by AMC. Relatively little experience exists in the Air Force with regard to depth charges and torpedoes.

4. Nuclear Safing and Arming

a. Implosion

The Special Weapons Command along with the ARDC contributed considerably to the development of the H-1 insertion gear and AMC has procured numbers of the H-1 gear. The similarity of in flight insertion gear to Air Force items being developed and procured indicates a high competence in this area.

b. Gun-Type

The USAF has not participated in this particular development but is competent to develop and procure such items by virtue of the

similarity of these mechanisms to actuators and other items found in aircraft and guided missiles.

5. High Explosives

The USAF has no experience in development or procurement in this field.

6. Detonators

The USAF lacks experience in this area both as to development and procurement.

7. Fuzing Systems

a. Radiating

WADC has extensive experience in the field of radar and electronics and AMC is equally experienced in the procurement of radar and other electronic equipment such as communications systems and fire control equipment. Archie stemmed from the APS-13 radar, many of which were procured by the AMC for the AEC. WADC participated in work on the MC-1 namely, Project "Rebecca."

b. Barometric

The USAF has not participated in either development or procurement of these fuzes for the AEC but enjoys a high competence to perform those functions. Barometric altimeters, air speed indicators and other smiliar instruments are developed and procured by the Air Force in quantity. One multiple baro switch was developed by the WADC to provide a system for improved baro arming.

c. Time Powder

The Air Force has no experience in either development or procurement of this item.

d. Mechanical

The Air Force has not contributed appreciably to AEC programs either in development or procurement on these systems. A true competence exists by virtue of development work and procurements of bomb sights, computers, guidance systems and control systems. The WADC presently is working on vertical velocity indicators, accelerometers and time of fall computers which contain mechanical features.

e. Inertia

Work undertaken on such items in connection with guided missiles and rockets indicates a high degree of competence in the development and subsequent procurement of these items. There has been no Air Force participation as yet in AEC programs of this nature.

f. Impact

Experience has been acquired by WADC in this area through guided missiles and rockets developments, but no development or procurement work has been performed for the AEC. Competence in development and procurement is high on the part of the Air Force.

g. Hydrostatic

The Air Force has no development or procurement experience in this field.

8. Power Supplies

a. Batteries

The Air Force has a fine background of experience and competency in both development and procurement but has not assisted the AEC materially in this area.

b. Wind Generator

No assistance has been provided the AEC by the USAF in this area but the latter possesses an inherent competence for development and procurement since these generators resemble closely other items of Air Force equipment.

c. Turbines

Work on turbines of all types has been extensive in the Air Force and competence is high for development and procurement of these items. To date, no work or procurement in this area has been performed for the AEC.

9. Test Equipment

Some work has been performed in this field for the AEC such as provision of the range checker for the Archie by the WADC. A great capability exists in the Air Force for both development and procurement since many types of test equipment using similar components are developed and procured for Air Force use.

a. Field Testers

Competence in development and procurement of testers has been demonstrated continuously by the Air Force and some work has been done for the AEC in this field.

b. Monitors and Control Equipment

Commencing with the IFM-T-4, the ARDC has developed control and monitoring equipment as required for each combination of weapon and aircraft. AMC has procured all such equipment for implosion bombs since the Mark 4. Competence in both development and procurement is positive.

10. Handling Equipment

Since the advent of the first atomic bomb, the USAF has been actively engaged in developing and procuring assembly and handling equipment such as the N-1 dolly for 60" bombs and the P-3 dolly. Competency in development and procurement of handling equipment is high due to the variety of heavy items which Air Force units must handle.

11. Packaging

The Air Force has a continuous program to develop and procure better packaging. Special packaging test facilities are in constant use at WADC. Competency is high and improvements are being eagerly pursued. Standards and specifications are studied constantly with a view to betterment.

12. Instrumentation

a. Laboratory

Development and procurement of laboratory instruments has and is being accomplished by the USAF on a continuing basis and backed up by extensive experience in this type of activity.

b. Field

Much of the field instrumentation used by the AEC has been developed by the Air Force. This includes survey equipment, theodolites, photographic equipment and so forth. The USAF has a wealth of experience in developing and procuring this type of equipment.

c. Range

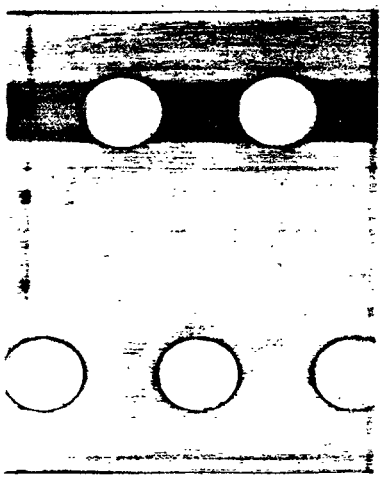
Through experience in equipping and operating bombing ranges, guided missiles test ranges, aircraft speed courses and flight test

facilities, the Air Force has a strong capability in this area. This includes development and procurement of telemetering equipment, computing equipment such as analogue computers and tracking radars.

13. Development Testing of Weapons Components and Associated Equipment

a. Aerodynamic

Much of the aerodynamic testing of bomb shapes has been accomplished for the AEC in WADC wind tunnels. Design work on optimum shapes of atomic weapons and of aircraft, guided missiles and rockets is performed at WADC. Arnold Air Development Center will augment USAF wind tunnel facilities considerably when completed. Wind tunnel facilities of the NACA and of contractors also are available and in use by the Air Force. The WADC and the AF Flight Test Center do a great deal of aerodynamic flight test work.

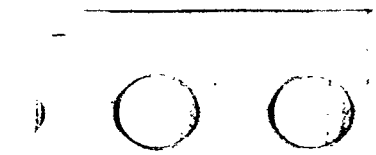


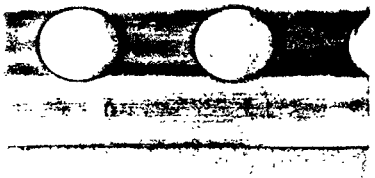
b. Ballistics

Special Weapons Command carries out bomb dropping programs to develop ballistics tables. The WADC budgets and contracts for the development of ballistic data which is obtained by the Aberdeen Bombing Mission. The competence of the USAF in this area is clear.

c. Environmental

The Air Force has extensive facilities at WADC and at Air Proving Proving Ground Command for conducting environmental testing in connection with aircraft, guided missiles and associated equipment. These facilities include capabilities for tropical, cold, altitude, humidity, fungus, vibratiion, and endurance types of testing. Cold weather testing of aircraft and major components is conducted annually in Alaska, Canada and at Mt. Washington, New Hampshire. During periodic maneuvers by SAC and operational suitability testing by SAC, additional environmental data under actual operating conditions are obtained. Considerable environmental testing of components has been performed for the AEC by the USAF and a competence exists to do a great deal more.





d. Structural

The Aircraft Laboratory at WADC has facilities for static testing of structures up to items as large or larger than the B-36 which are

unexcelled by any other facility in the country. Static testing of ballistic and sphere cases for the AEC has been performed.

e. Hydrodynamic

The Air Force has a competence in this field but has no facilities relying upon NACA and contractor facilities.

f. Compatibility

The Special Weapons Command in conjunction with the WADC conducts compatibility testing of Air Force aircraft. A high competence exists and much more extensive participation in this area could be provided.

14. Associated Functions

a. Logistics

In the field of logistics, the Air Force obviously has extensive experience. The AMC currently operates one site at Limestone, Maine and soon will operate four more sites. SAC has experience in this area due to maneuvers both in the United States and overseas. The Air Force possesses a definite competence as to logistics including storage, custody, surveillance, maintenance and modification as applied to atomic weapons.

b. Weapons Tests

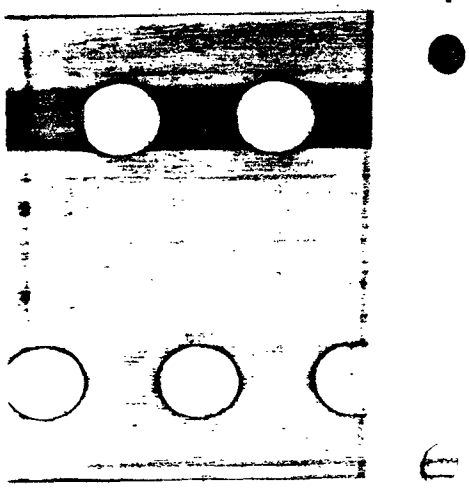
At Sandstone and Greenhouse, the USAF provided airlift, communications, weather service, cloud sampling and cloud tracking facilities in addition to providing personnel and materiel to the AEC to assist in the tests. Drone aircraft were developed by the WADC for certain tests. At Ranger and Buster, the USAF also participated extensively as in Sandstone and Greenhouse. The competence of the Air Force in carrying out work concerning atomic field tests has been amply demonstrated.

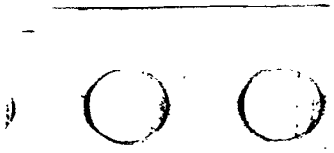
In the field of weapons effects, the USAF through WADC has designed and provided test panels and structures to be used in atomic field tests. Air Force sponsored studies on the effects of blast on aircraft in flight are proceeding.

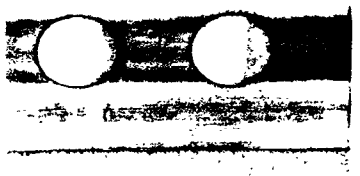
c. Operational suitability

Commencing with the 4N weapon, the Special Weapons Command has conducted full scale operational suitability tests on atomic weapons.

These tests enable the check out under actual operating conditions of all assembly, preflight, post loading and in flight procedures and equipment involved. Information obtained during tests is provided the AEC for use in modifying and improving the equipment and the weapons. The competence of the USAF to carry out operational suitability testing is exceptionally high by virtue of facilities, personnel and organization.







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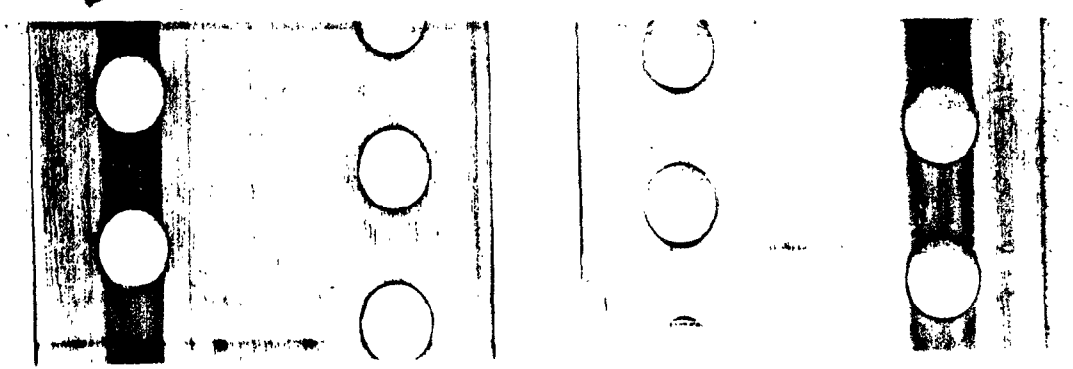
TAB B

DEPARTMENT OF ARMY INSTALLATIONS COMPETENT TO PARTICIPATE IN DEVELOPMENT AND PRODUCTION OF ATOMIC WEAPONS

Installation	Command	Function
Engineer R&D Laboratories Ft. Belvoir, Va.	Chief of Engineers	R&D in stream crossing equipment, mapping and geodesy, electrical material, water supply, construction equipment, industrial engines, soil stabilization, liquid fuels storage and distribution equipment, fire fighting, industrial gas equipment, road and airfield surfacing, prefabricated buildings, infrared devices, mine detection, mine and obstacle clearing, and equipment packaging.
White Sands Proving Ground Las Cruces, New Mexico	Chief of Ordnance	Testing unguided and guided missiles and gathering upper atmosphere data.
AFF Board No. 1 Fort Bragg, N. C.	Chief of Army Field Forces	Conducts user tests on all airborne equipment, or aircraft, on communications and electronic equipment, and on field artillery weapons, fire control, ammunition and associated component equipment used in the field army.
AFF Board No. 4 Fort Bliss, Texas	Army Field Forces	Prepares military characteristics and conducts user test on all anti-aircraft artillery equipment, including fire control, ammunition and accessory equipment; on guided missiles, including launching, guidance and control equipment, on target drones; and on maintenance equipment for above equipment.
Signal Corps Engineering Laboratories Fort Monmouth, New Jersey	Signal Corps	R&D on communications type equipment, such as voice, teletype, facsimile, television, teletypewriter, telegraph, etc., early warning, fire control, radiological, batteries, photography, etc. The Signal Corps Engineering Laboratories, although composed of four separate sub-laboratories, is a single Signal Corps Class II activity and should be considered as a single integrated organization.



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TAB B

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Installation	Command	Function
Aberdeen Proving Ground Aberdeen, Maryland	Ordnance Corps	Conduct ballistic research, development engineering and tests on all ordnance items; evaluate foreign ordnance, exercise technical supervision over R&D projects as assigned, furnish ballistic instrumentation and data reduction for guided missiles.
Detroit Arsenal Centerline, Michigan	Ordnance Corps	Research, development, and production engineering on combat and transport vehicles and components thereof except the weapons and recoil mechanisms peculiar to them.
Frankford Arsenal Philadelphia, Penna.	Ordnance Corps	R&D in the fields of small arms ammunition, artillery ammunition components, including VT fuzes, fire control systems, and nonferrous metallurgy and aircraft personnel catapults and canopy removers.
Jet Propulsion Laboratory (Contract) California Institute of Technology Pasadena, California	Ordnance Corps	Research, development, and testing of jet propulsion systems, guided missiles, test vehicles, and related subjects.
Malta Test Station Malta, New York	Ordnance Corps	Development testing of liquid fuel rocket motors and rocket propulsion systems.
Picatinny Arsenal Dover, New Jersey	Ordnance Corps	R&D on all elements of rounds of ammunition greater than caliber 60, including artillery and aircraft ammunition, and bombs of various types and packaging for same and applied research on nonmetallic materials peculiar to ammunition.
Redstone Arsenal Huntsville, Alabama	Ordnance Corps	R&D of guided missiles, rockets, and JATO units, and their components.
Rock Island Arsenal Rock Island, Illinois	Ordnance Corps	R&D of ordnance materials and materiel, such as gun mounts, recoil mechanisms, rocket launchers, etc.

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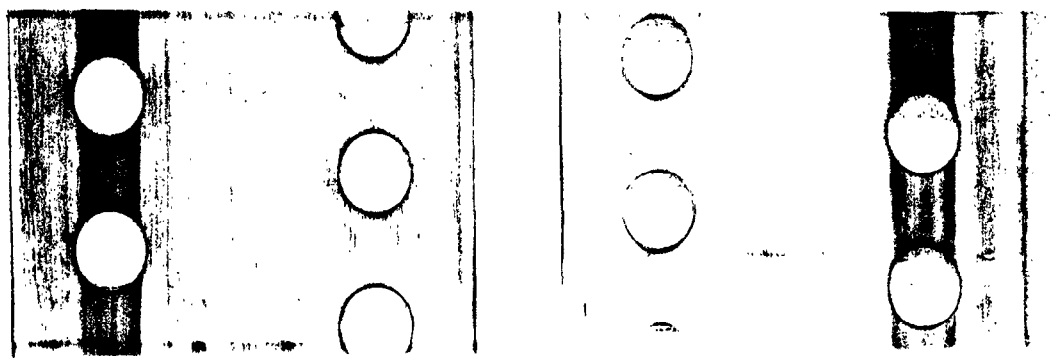
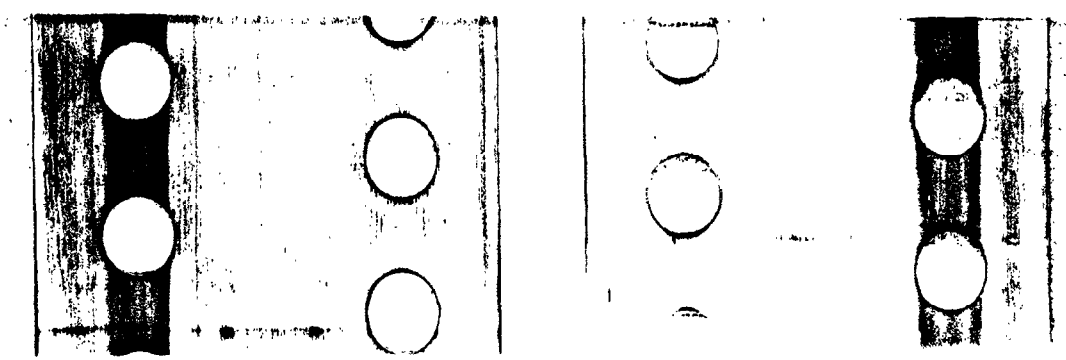


TAB B

Installation	Command	Function
Springfield Armory Springfield, Mass.	Ordnance Corps	Applied research on heat and erosion resistant materials for small arms weapons, deterioration, preservation, and treatment of leather, wood, and other non-metallic materials used in small arms, and research and development on ground type weapons up to and including 30mm in caliber including automatic aircraft guns.
Watertown Arsenal Watertown, Mass.	Ordnance Corps	R&D on metals and metallic materials, principally ferrous, titanium, and other transition metals and their alloys, and on armor, projectiles, guns, and gun carriages.
Watervliet Arsenal Watervliet, New York	Ordnance Corps	R&D of artillery cannon above 20mm, mortars and component mechanisms.
Arctic Test Branch Big Delta, Alaska	Army Field Forces	Composed of test groups I through IV, each group conducts service tests under arctic and sub-arctic environmental and terrain conditions for equipment service tested by the respective numbered Army Field Forces Board.
Yuma Testing Station Yuma, Arizona	Army	For use of the Army to conduct research, development, and testing of all equipment, materiel, and personnel under extreme hot-desert conditions. This is a Class I installation under the command of Hqs. 6th Army, with all test teams operating as Class II activities under the direction of the Chief of the Service or Army Field Forces concerned.



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PRINCIPAL U. S. NAVY FACILITIES
COMPETENT TO PARTICIPATE
IN THE ATOMIC WEAPONS FIELD

BUREAU OF AERONAUTICS, WASHINGTON, D. C.

The Bureau of Aeronautics is the Navy material bureau which has been assigned the responsibility for the design, development, procurement, production, test, fitting out, maintenance, alteration, repair and material effectiveness of all Navy and Marine Corps aircraft including components and equipment thereof. It exercises management control of those commands and organizations established as separate activities of the naval shore establishment for the above functions.

A large part of BuAir responsibilities is satisfied by contractual relations with universities, research and development groups and industry. Many of these are unique and would be of value to the atomic weapon program. It is pointed out, however, that these agencies are committed to BuAir and reorientation of their work load to atomic work would, in many cases, have to be effected by BuAir.

Those specific research and development activities under the technical and management control of BuAir which are best fitted and most appropriate for development work in the atomic weapon program are:

NAVAL AIR MATERIAL CENTER (U.S. Naval Base, Philadelphia)

The NAMC includes the Naval Aircraft Factory and the Naval Air Experimental Station. The NAF has a large engineering department capable of research and development in airframes, instruments, armament, etc., with shops equipped for all kinds of manufacture and test. The Naval Air Experimental Station consists of a flight test service and six aeronautical laboratories. The work of these laboratories is purely research and development and includes such tasks as evaluation and testing of aircraft and components, preservation and packing, aircraft materials, structures, radio control equipment, ejectable seats, strain gage telemetering, flight test instrumentation for high Mach flight, engines and accessories, remote controlled auto pilots, photography and medical [redacted].

NAVAL AIR TEST CENTER (Patuxent River, Md.) [redacted]

The NATC serves as a flight test center for BuAir and has six divisions to handle armament, electronics, flight test, service test,

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tactical test and test pilot training. In addition to testing, the duties of this agency include evaluating and recommending in regard to aircraft and equipment.

NAVAL AIR DEVELOPMENT CENTER (Johnsville, Pa.)

The NADC performs development functions in the fields of aircraft electronics, pilotless aircraft, aviation armament and some medical research and development. Its mission is to conceive and develop new armament and aircraft electronics systems. Some of the projects of the pilotless aircraft development laboratory include heat homing equipment, test of Shoran guidance for missiles, V-2 launching from submersibles, electronic parallox computers as terminal guidance for missiles, instrumentation and testing techniques, etc.

NAVAL AIR MISSILE TEST CENTER (Point Mugu, Cal.)

NAMTC conducts tests and evaluation of guided missiles and their components and is equipped and experienced for all phases of such work.

NAVAL AERONAUTICAL ROCKET LABORATORY (Lake Denmark, Dover, N.J.)

NARL acts as an eastern facility for the test and evaluation of rocket power plants, components and propellants; conducts appropriate research and development and makes available rocket engine test facilities to government contractors.

NAVAL PARACHUTE EXPERIMENTAL UNIT (El Centro, Calif.)

The major programs of NPEU are to develop, test and evaluate various applications of parachutes.

OFFICE OF NAVAL RESEARCH (Washington, D. C.)

The Office of Naval Research applies scientific research and primary, or laboratory, experimentation to Navy problems. In doing this, applied research, development and evaluation work is performed to meet immediate naval requirements and basic reaearch is conducted in anticipation of future naval needs. Its principal laboratory under naval administration is the Naval Research Laboratory which has been utilized to a great extent in the atomic weapons program. ONR is in an especially fine position to establish and coordinate extensive research programs in all fields related to military requirements for in addition to its own

research laboratories it [redacted] through which contact is established and maintained with the leading research authorities of the country.

NAVAL RESEARCH LABORATORY. (Bellevue, D. C.)

The NRL has a staff of about 3400 men and includes approximately 300 physicists, 500 electrical engineers, 100 chemists and 100 mechanical engineers. There are ten scientific divisions in NRL of which three are for radio and comprise about 50 per cent of the laboratory. Other divisions conduct research into Sound, Chemistry, Electricity, Physics, Nucleonics, Metallurgy and Optics. A few of the more pertinent tasks of these divisions include high polymers, protective coatings, high capacity primary cells, cryogenics emphasizing electrical and magnetic properties, meteorological instruments, anti-precipitation static antennas, free flight aerodynamics, instantaneous pressure time observations, shock and vibration improvement of material properties, crystals, nucleonics including cosmic rays as well as light particles, electron optics, radiometry, telemetering, radio propagation and absorption, countermeasures, radar, human reactions and acoustics.

RESEARCH GROUP

By its support of basic and applied research at universities and in industry, the ONR is in a very advantageous position in its contractual relationships with outstanding scientists. It is possible for ONR to undertake almost any research and development activity. Typical of such research programs are: Electronics involving fuzing, sensing elements and countermeasures; Detonation phenomena involving propagation of waves, etc.; cryogenics which include the problems encountered at the temperature of liquid helium and liquid hydrogen; Effects of atomic weapons; Applied mathematics involving atomic weapon design, design of shaped charges on expected weapons effects; Ballistics, Hydrodynamics and Aerodynamics. The ONR is experienced in organizing the task force type of attack on research problems. Typical examples of this type are the Project Michael Group resolving undersea warfare problems, Project Charles on air warfare, and study groups such as Project Vista and the Hartwell group.

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The Bureau of Ordnance is organized, staffed and extensively equipped with integral facilities to carry out its responsibility for research in, and the design, development, procurement, manufacture, distribution, maintenance, repair, alteration, and material effectiveness of Naval ordnance, and all pertinent functions relating thereto. BuOrd has technical control, in addition to that implicit in the above responsibilities, for the operating standards and procedures for all offensive and defensive ordnance. To assist it in carrying out its functions, BuOrd has management control of over 70 commands and organizations of the Naval Shore Establishment and employs over 1000 contractors. BuOrd is considered unique in being an organization which encompasses sufficient facilities and talents within its own ranks, exclusive of contractual relations, to conduct studies and accomplish research, development, incidental fabrication and limited production of nearly every phase of any weapon or weapon system. In addition, BuOrd possesses valuable contractual contacts with universities and industry. BuOrd is especially apt at extending research and development to include a reproducible production process.

Some of the major research and development activities of the BuOrd which are applicable to the atomic weapons program are listed below.

DESIGN AND RESEARCH DEPARTMENT, NAVAL TORPEDO STATION, Newport, R.I.

NAVAL UNIT, WHITE SANDS PROVING GROUND, Las Cruces, N.M.

Supports the Navy rocket missile program and cooperates and coordinates with the Army to insure effective and economical use of the White Sands Proving Ground.

ALLEGHENY BALLISTICS LABORATORY, Cumberland, Maryland

Research and development of cast double base powder and guided missile jatos.

NAVAL ORDNANCE TEST STATION, INYOKERN, China Lake, Calif.

The mission of NOTS is the research, development and testing of weapons. The technical work of the station is accomplished through six technical departments, namely Aviation Ordnance, Design and Production, Research, Rockets and Explosives, Test, and Underwater Ordnance. The station has an air facility. The primary work of NOTS as a development

center may be divided into the following broad fields, (a) Rocket development including solid and liquid fuels; (b) Explosives including atomic weapon work as well as warheads for rockets and missiles; (c) Fire control systems to control the projection of weapons from aircraft; (d) Underwater ordnance including high speed water entry, underwater ballistics, propulsion, controls, and development of complete missiles; (e) Guided missiles including components, field tests, instrumentation and data assessment; (f) Research. The principal lines of research conducted at NOTS are, (1) Microtime physics including shock waves, blast, electrical discharges and exploding wires; (2) Propellant and explosive chemistry; (3) Underwater and in air ballistics accenting high speed projection; (4) Internal ballistics of rockets including gas flow through nozzles and heat transfer; (5) Properties of propellants; (6) Atmosphere physics; (7) Analysis of air combat problems to provide development guide lines; (8) Analysis of general fire control problems; (9) Metallurgy of special components; (10) Radiation phenomena applicable to control and communication problems; (11) Control mechanisms, and (12) Instrumentation for special research problems.

ORDNANCE AEROPHYSICS LABORATORY, Daingerfield, Texas

This laboratory is primarily for research into supersonic aerodynamics and jet propulsion. Its main facilities are a wind tunnel and a burner laboratory. It is owned by the Navy and operated by Convair under the technical direction of the Applied Physics Laboratory of Johns Hopkins University.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Mass.

MIT is the primary contractor to BuOrd for research and development work in connection with the air to air guided missile METEOR. Major government furnished facilities are the Supersonic Laboratory and wind tunnel and the MIT Flight Simulator. The Flight Simulator is an analogue computing device which solves automatically and continuously the equations for the motion of an aircraft in flight and also subjects the unit being tested to motions identical to those it would experience in an airframe of specified characteristics. There is other government equipment, largely electronic.

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NAVAL AVIATION ORDNANCE TEST STATION, Chincoteague, Va.

NAOTS performs tests, modifications, and developments of aviation ordnance and guided missiles with accent on intelligence systems, guidance components, propulsion systems, fire control systems, toss bomb directors, and aircraft rocket launchers.

NAVAL ORDNANCE LABORATORY, White Oak, Md.

NOL carries out investigations in both pure and applied science particularly in the research, development, design, and developmental test of guided missiles, rockets, mines, depth charges, fuzes, torpedo mechanisms, pyrotechnics, demolition outfits and many other related items of naval ordnance. In addition the Laboratory is engaged on fundamental research to determine underlying principles and basic information on which new and improved weapons can be designed. Another duty is the supervision of the production of such weapons for service use. The four technical departments, Research, Engineering, Development and Evaluation, are completely implemented to carry out their appropriate functions. The laboratory's facilities are exceptionally complete and include 6 wind tunnels, some of which obtain speeds greater than Mach 5, a pressurized ballistic range, a pressurized Yaw Card range, an aeroballistic range, water entry tanks, an analysis facility staffed with IBM technicians and mathematicians, and many special laboratories for optics, acoustics, electronics, magnetic materials, chemistry, etc. There are external laboratories and test facilities such as:

NAVAL ORDNANCE LABORATORY TEST FACILITY, Barcroft, Va.

Primarily interested in accurate underwater acoustics.

NAVAL ORDNANCE LABORATORY TEST FACILITY, Solomons, Md.

For development and design evaluation and field testing underwater ordnance.

NAVAL ORDNANCE UNIT, Fort Monroe, Va.

For design and design evaluation of mines by ship actuation.

NAVAL ORDNANCE UNIT, Fort Story, Va.

For design and design evaluation of mines by ship actuation.

NAVAL ORDNANCE LABORATORY EXPERIMENTAL FACILITY, Hiwassee Dam, N.C.

A facility for deep, still water development and testing of underwater ordnance.

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NAVAL ORDNANCE PLANT, Indianapolis, Ind.

This plant conducts some research and development in aircraft fire control equipment. Utilizing the facilities originally set up to manufacture Norden bomb sights, it produces, overhauls and maintains aviation fire control equipment, spare parts, tools and accessories. This installation is a center for fire control components which might be used in development.

NAVAL ORDNANCE UNIT, Key West, Fla.

Maintained primarily for the use of contractors involved in the research and development of electronic and acoustic underwater weapons.

NAVAL POWDER FACTORY RESEARCH AND DEVELOPMENT LABORATORY, Indian Head, Md.

Involved in the research and development of solid propellants, including propellants for guns, catapults, rockets and jato units. Project are carried from initial research to a reproducible production process that may be used by service or contract manufacture.

NAVAL PROVING GROUND, Dahlgren, Va.

Although essentially a proving ground and divorced by philosophies from all development and production considerations, this station by virtue of its experience and facilities for handling and evaluating heavy ordnance expends 70 percent of its effort in applied research and developmental testing. It is experienced in mechanical and electrical devices, interior, exterior and terminal ballistics, statistical studies, special instrumentation, and large scale computations utilizing the digitel calculators.

BUREAU OF SHIPS

In addition to its material and technical responsibility for vessels, boats, craft, etc., BuShips has the navy-wide responsibility for radiological defense and for general usage electronic tubes. BuShips interest in atomic propulsion is well known. BuShips has technical and management control of eight laboratories and eleven shipyards. Considerable work is done by contract. The facilities which are most applicable to various tasks in the atomic weapons programs are:

NAVAL ENGINEERING EXPERIMENT STATION, Annapolis, Md.

Conducts research and development in most areas with emphasis on ships, ship equipment, fuels and associated problems. It has six basic laboratories, i.e., Chemical, Mechanical, Metallurgical, Welding, Wave Mechanics, and Internal Combustion Engine, and a few special projects such as Gas Turbines, Bearings and the Walther cycle.

DAVID W. TAYLOR MODEL BASIN, Carderock, Md.

The scientific organization of the D. W. Taylor Model Basin comprises four divisions for Hydromechanics, Aerodynamics, Structural Mechanics and Applied Physics. It conducts investigations to ascertain the most suitable and desirable shapes and forms for vessels and aircraft and parts thereof. Experienced in correlating model and full scale performance. Special facilities include deep water, shallow water and small model basins, pressure water tunnels and wind tunnels.

MATERIAL LABORATORY, Brooklyn, N.Y.

Involved in the investigation, evaluation, development with incidental research, analytical testing and standardization of a wide range of materials and naval equipment.

MINE COUNTERMEASURES STATION, Panama City, Fla.

To investigate influences that may be used to actuate mines, develop counter measures, etc.

NAVAL RADIOLOGICAL DEFENSE LABORATORY, San Francisco, Calif.

Prosecutes and implements the radiological safety program of the Navy by research and evaluation in the fields of radiation hazards, decontamination, minimization of personnel risks, biological studies including safety procedures, establishment of dosage criteria, determination of toxicities, etc.

NAVY ELECTRONICS LABORATORY, San Diego, Calif.

NEL undertakes applied research, development, investigation and tests to solve problems in the field of electronics and related physical effects including radio, radar, electromagnetic radiation, geophysics, infra-red, underwater sound and underwater television.

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TAB D

DEPARTMENT OF AIR FORCE INSTALLATIONS COMPETENT TO PARTICIPATE IN DEVELOPMENT AND PRODUCTION OF ATOMIC WEAPONS

Organization	Location	Functions
Air Research & Development Command	Baltimore, Maryland	Command Headquarters.
Wright Air Development Center	Wright-Patterson AFB Dayton, Ohio	Performs research, development, testing and in-service engineering on aircraft, guided missiles and associated equipment including power plants, propellors, airborne armament and electronic equipment.
Arnold Engineering Development Center	Tullahoma, Tennessee	Provides facilities and support for testing ramjet and turbojet power plants under simulated flight conditions and for wind tunnel testing of aircraft, missiles and component models at transonic and hypersonic speeds, full scale ramjet and turbojet power plants at transonic and supersonic speeds.
Cambridge Air Development Center	Cambridge, Massachusetts	Conducts fundamental studies and investigations in radio physics and geophysics including development of new techniques for communicating information.
Rome Air Development Center	Griffiss AFB, Rome, N. Y.	Develops ground radio and radar, detection, tracking and control equipment and ground equipment for air navigation including field test equipment.
Air Force Flight Test Center	Edwards AFB, Muroc, Calif.	Provides facilities and support for, and conducts flight testing of experimental and first production aircraft, flight testing in connection with development of power plants, armament and bombing systems and other components. Operates research tracks and rocket engine test facility.
Air Force Missile Test Center	Patrick AFB, Cocoa, Fla. Holloman AFB, Alamogordo, N. M.	Provides facilities and support including instrumented ranges for carrying out missile flight test activities at both bases. Holloman also supports upper atmosphere research including testing of certain long range radar equipment

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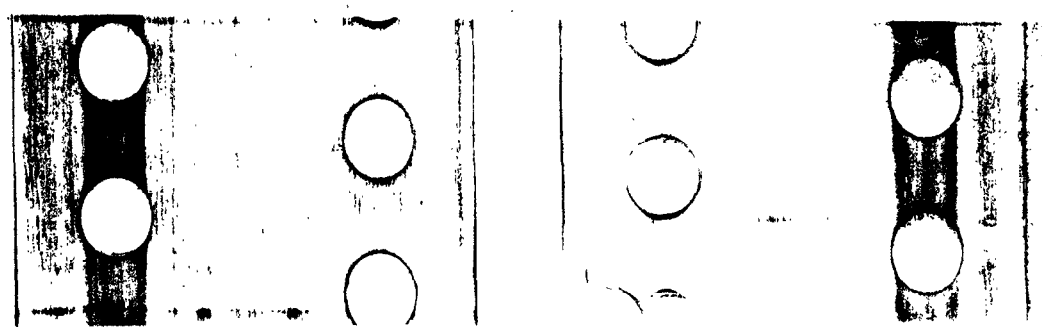
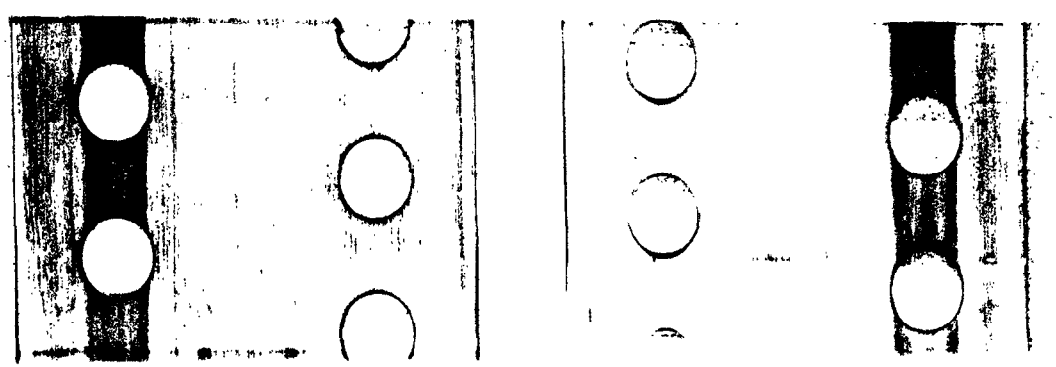


Organization	Location	Functions
Air Material Command	Wright-Patterson AFB Dayton, Ohio	Command headquarters, handles procurement, maintenance, storage and issue of all Air Force materiel. Provides contract administration including inspection. Maintains procurement field offices throughout continental United States.
Air Proving Ground Command	Eglin AFB, Valparaiso, Fla.	Performs proof testing and evaluation of aircraft and associated equipment including power plants, vehicles, personal equipment, aircraft armament and bombing systems. Operates bombing and armament test ranges and a large climatic test facility. Conducts Alaskan cold weather testing.
Special Weapons Command	Kirtland AFB, Albuquerque, N. M. Indian Springs AFB, Indian Springs, Nev.	Maintains facilities and provides supporting test aircraft for the testing of atomic weapons and associated equipment. This includes drop testing, compatibility flying and operational suitability testing. Supports AEC weapons tests at Nevada Test Site and maintains Indian Springs AFB facilities.



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UNITED STATES
ATOMIC ENERGY COMMISSION
Washington, D.C.

December 19, 1951

MEMORANDUM

TO : Captain J. T. Hayward, USN
Colonel M. F. Cooper, USAF

FROM : Colonel K. E. Fields, Director, Division of Military Application

SUBJECT: JOINT STUDY GROUP AEC AND DEPARTMENT OF DEFENSE

REF: (a) Letter of December 4, 1951,* from Colonel C. Ball to Mr. Dean
(b) Letter of July 18, 1951** from Exec. Secy., MLC, to Chairman, AEC, Subject: Military Guidance in the Atomic Weapon Field

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1. The following is furnished you for guidance in connection with reference (a) and the activities of the Joint Study Group.

2. It is clear that the organizations, facilities, and personnel working on problems of atomic weapons systems should be augmented. Our immediate problems are pressing, and those that will arise in the space of a few years will substantially increase our load. Increased amounts of fissionable materials then available will make practicable many additional applications of atomic weapons. It would appear that in a large measure many of these applications should be conceived and brought forward by various agencies of the Department of Defense. It should be emphasized that these applications must be integrated into a weapons system. Division of responsibilities now developing for doing this is believed to be the proper one, namely, the responsibility for the development and production of atomic warheads and adaptation of warheads to any system should rest with the AEC, and the larger responsibilities for the weapons system should rest with the Department of Defense.

3. It is necessary, in order to utilize most effectively our combined capabilities in the atomic weapons field, that active steps be taken by the various services to encourage thinking and studies on new applications for atomic weapons. An excellent example of this was the Project Alias study by the Navy.

4. The paragraphs below discuss the nature and scope of programs with specific tasks in which military assistance is contemplated by the AEC. It is recognized these are general in nature but it is believed your group will be able to go into details concerning them and suggest methods of handling these problems satisfactory to both agencies.

a. In reference (b) (MLC letter of July 18 to the AEC) there are various special applications that obviously fall into areas of Department of Defense competence. These include: (1) Atomic depth charges for air, surface, and sub-

*Secretariat Note - Circulated previously as AEC 485/6.
**Circulated previously as AEC 453.

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surface launching against submarines; (2) atomic warheads for torpedoes for anti-submarine and anti-shipping use; (3) 16-inch atomic projectile for precision shore bombardment; and (4) Air to ground and ground to ground rocket with atomic warhead;

b. Compatibility of weapon with vehicles such as aircraft and missiles with particular emphasis on the marriage of atomic weapons to supersonic aircraft. Here it seems logical that where the characteristics of the vehicle are predominant in the problem, the responsibility for compatibility should rest with the builder of the vehicle. The present missile arrangement is a good example and could be carried over to the aircraft compatibility problem;

c. Environmental testing of completed weapons. The Department of Defense possesses the background, facilities and personnel to accomplish this task. It could very well be done prior to or with the Operational Suitability tests.

5. It is believed that each specific task that evolves from the above areas under consideration will have to be the subject of separate negotiations with the responsible agencies for a division of tasks and responsibilities so that a clear understanding by both parties is attained.

/s/
K. E. Fields

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