D000 29701
DOE 29701

~~CONFIDENTIAL~~

~~SECRET~~

~~TOP SECRET~~

This document consists of 71 pages
Copy No. 3 of ~~7~~ Series A

REDACTED COPY

BOOK VIII, VOLUME 3

CHAPTER 2

MANHATTAN DISTRICT HISTORY

PROJECT CAMEL

CLASSIFICATION CANCELLED
OR CHANGED TO w deletions
BY AUTHORITY OF Michael Kolbay
BY Memo DATE 5/21/13

Department of Energy Declassification Review

1st Review Date: 3/28/13 Determination: [Circle Number(s)]
Authority: ☐ DC ☒ DD 1. Classification Retained
Name: [illegible] 2. Classification Changed To: C
2nd Review Date: 4/18/13 3. Contains No DOE Classified Info
Authority: DD 4. Coordinate With:
Name: [illegible] 5. Classification Cancelled
6. Classified Info Bracketed
7. Other (Specify)

REVIEWED AND NOT DECLASSIFIED
BY U. S. DEPARTMENT OF ENERGY
OFFICE OF CLASSIFICATION
JOHN A. HARTSOCK
REVIEWED BY
9/4/74
DATE

~~CONFIDENTIAL~~

~~SECRET~~

~~TOP SECRET~~

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Its dissemination or disclosure to any unauthorized person is prohibited.

~~RESTRICTED DATA~~
Atomic Energy Act 1946
Specific Restricted Data
Clearance Required

~~CONFIDENTIAL~~

2013000684

FOREWORD

Project Camel was a subsidiary project of the Manhattan Engineer District. It was financed through an OSRD contract with the California Institute of Technology. The California Institute was already engaged in similar war emergency development work in cooperation with the Navy.

This Chapter presents a general description of the scope of Project Camel. The work, carried out under great pressure, was subject to general coordination between Dr. Oppenheimer of Los Alamos Laboratories and Dr. Lauritsen of CIT. This close personal relation assured security, unity of research effort and integration with the Los Alamos objective. A great deal of the effort expended under Project Camel was insurance against accident, or failure, of similar work highly centralized at Los Alamos. In addition, however, there were assigned to Project Camel several research, development and testing problems in support of the "main line" work at Los Alamos.

Not the least contribution of the Camel Project was in procurement, where the engineering ability of its staff, together with contacts in the industrial production field in the southern California area, were of tremendous importance to the success of the final product.

This chapter covers the history of Project Camel from its inception to the termination and transfer of its activities after the cessation of hostilities, as described in Section 8.

TABLE OF CONTENTS

SECTION 7 - DEVELOPMENT OF HIGH EXPLOSIVE PRODUCTION TECHNIQUES - SALT WELLS PLANT

SECTION 8 - TERMINATION AND TRANSFER OF CAMEL ACTIVITIES

SECTION 9 - CONSTRUCTION

SECTION I - INTRODUCTION

1-1. General. - Project Camel fills a unique position in the Manhattan Engineer District; while not showing any direct connection with the District, it was supported by MED funds allotted to the OSRD contract with CIT for the technical work and by MED funds allotted to the Navy Department for construction.

a. In the climactic period during which this project existed, the spring and summer of 1945, the urgency of the work was tremendous, and the measures taken to cope with the technical problems and the time factor were drastic. The work of an entire program might be abandoned, or its purpose so altered as to be almost unrecognizable, as the result of developments and decisions reached overnight at Los Alamos, or some other point in the District, on contemporary problems. The pressure and speed of work throughout the District made simultaneous and independent attacks in research and development problems a necessity.

b. A case in point is the series of decisions by the steering committee, formed at Los Alamos for the purpose of coordinating and directing efforts on final bomb development and production into the channels most likely to produce success in the shortest possible time. In any research program many "leads" must be followed up which turn out to be "blind alleys", and the activities of Project Camel were not exempt from this factor. In several instances efforts and facilities were expended on subsidiary research which later proved unnecessary.

1-2. Purpose of the History. - It is the purpose of this

history to show, insofar as possible, the factors leading up to the initiation of Project Camel, its organization and its broad programs of work, and their integration with the work of the MED project, as well as the demise, and transfer of the Project's responsibilities.

1-3. Events Leading Up to the Organization of Project Camel.

a. By the fall of 1944, the work of producing the atomic bomb was running into serious difficulty. Because of the limited resources it was possible to mobilize at Los Alamos, within the time available, the policy of decentralization of work to other locations had been established. The remoteness of the site from large centers of manufacture and considerations of security had led to the establishment, by the University of California, of a procurement office in Los Angeles. (See History of Los Angeles Chapter) In the early stages of the development of the Los Alamos laboratory (Site Y) the problem of procurement had been chiefly one of obtaining the countless items of equipment and supplies which were more or less standard with vendors. As the work of producing the atomic bomb progressed, however, the rapid procurement of specially fabricated items became a matter of increasing importance to the success of the project. This was particularly so in view of the fact that the schedules for the test and delivery of the bomb were constantly being advanced with the attainment of unexpected successes in the production of active materials.

b. Design and engineering staffs were centered at Los Alamos, as required for close collaboration with the scientists. Manpower shortages did not permit the assignment of any available personnel to other points. This lack of liaison with manufacturers

located in the Los Angeles area was one of the most discouraging factors in keeping abreast of the difficult schedules and was resulting in loss of irreplacable time.

c. In order not to place too much information in the hands of any one individual or firm, a practice had been instituted of distributing orders for the simplest possible components among as many manufacturers as were able to produce the items in the time required. The manufacture's problem was one then of adapting his personnel and equipment to the comparatively small scale production, to very exacting specifications, of items requiring unusual techniques and materials. Solutions of the problems which naturally arose were difficult to obtain in a short time, since they were relayed from the Los Angeles procurement office to Site Y, and back again. Further, a small change from the drawing or specification which was not apparent or appeared unimportant to the manufacturer could not be discovered until the order was received and tested at Los Alamos. To discover errors, advise the manufacturer of necessary changes and agree on methods by which corrections might be effected were time consuming operations which were eliminating all possibility of adherence to schedules.

d. It also was apparent that there were other phases of the work on which the Los Alamos laboratory would need assistance. These facts were recognized by the University of California and were made known to Dr. Vannevar Bush, Chairman, OSRD.

e. Previous to this time, the California Institute of Technology under Contract OEMsr 418 with the OSRD had independently carried the development of rockets to a point where the Navy had taken

an active interest in their use. Pending the construction of large production facilities by the Navy, CIT had been induced to undertake the experimental production of rockets as a part of its contract. For this purpose, the Navy had transferred large amounts of money to the OSRD, as a result of which CIT had developed extensive facilities for the procurement, production and inspection of metal and explosive rocket components. Since the peak of CIT's program had been reached by the fall of 1944, and the Navy's facilities were being put into operation, it was apparent that the CIT rocket organization and facilities could be of tremendous assistance to the University of California in the development and procurement of specialized equipment and fabricated parts required for the atomic bomb. It was also apparent that this organization, because of its experience with explosives and related fields in rocket development, was in a position to provide a great deal of "know how" in the solution of problems with which the Los Alamos laboratory was faced.

SECTION 2 - ORGANIZATION OF "PROJECT CAMEL"

2-1. General.

a. At the suggestion of Dr. Bush, Dr. C. C. Lauritsen, Director of Research for Contract OEMsr 418, was invited to visit Los Alamos in November 1944 to discuss the problems with which Site Y was confronted. As a result of this visit, Dr. Oppenheimer outlined in a letter to Dr. Bush, on November 21, 1944, the extent and manner in which the collaboration of CIT could be utilized and requested that necessary arrangements be effected toward that end (Appendix B-1).

b. To Admiral W. S. Parsons, USN, on special assignment by the Navy to the MED, and in charge of the Ordnance Division at Los Alamos, fell the task of obtaining the agreement of the parties concerned. The formation, by OSRD, of a special committee under NDRC composed of Dr. J. B. Conant, Chairman, Dr. F. L. Hovde and Mr. Hartley Rowe, had resulted in the transfer of $1,000,000 to contract OEMsr 418 for initiation of work on a "special War Department project" (Appendix B-2). There was an immediate reaction, however, by the Bureau of Ordnance of the Navy Department, upon receipt of information from CIT that it proposed to undertake work on another project of considerable magnitude. The Navy was greatly concerned over the potential effect of the special project on its program for rocket development and production. Whereas the OSRD and CIT had been committed to a reduction in the program of rocket production as Navy facilities became available, there remained problems connected with the improvement of rocket performance, and development of new types, which the Navy felt required the continued active participation of top CIT personnel. The matter was resolved in a series of

discussions by Admiral Parsons with Admiral Hussey, Chief of the Bureau of Ordnance, and others in the Navy Department, and, at a conference on 30 December 1944 in Pasadena, California, reported in a letter from Dr. F. L. Hovde, Chief of Division 3, NDRC, to Dr. Conant, Chairman, NDRC, the necessary agreements on how the new project could be carried on simultaneously were reached (Appendix B-3).

c. On 8 January 1945, Rear Admiral J. A. Furer, Coordinator of Research and Development for the Navy, formally requested by letter to Dr. Bush (Appendix B-4) the establishment of Project Camel at CIT and Inyokern, under the jurisdiction of the Navy Department. Funds were to be furnished by the OSRD and it was proposed "that a new contract be established with California Institute of Technology rather than conduct this work under contract OEMsr 418".

d. In accordance with the desires of CIT, and for security reasons, CIT was authorized by letter of F. L. Hovde, to Dr. Irvin Stewart, Executive Secretary, OSRD, on 25 January 1945, to carry on the work of Project Camel under Contract OEMsr 418 (Appendix B-5).

e. Formal arrangements for construction of Project Camel facilities at Inyokern by the Navy Department were confirmed on 27 January 1945 by letter of Major A. C. Johnson, CE, Washington Liaison Officer for the MED, to Capt. Hanson, Bureau of Yards and Docks (Appendix B-6). This agreement was later modified to provide for the transfer of MED funds to the Bureau of Docks through the Bureau of Ordnance rather than directly as previously agreed.

f. Thereafter contract policy and administrative and fiscal matters were handled directly between Professor E. C. Watson, Official

Investigator for the contract, representing CIT, and Drs. Hovde, Chairman of NDRC's Special Committee, and Irwin Stewart, Executive Secretary NDRC. Dr. E. M. Norton, Technical Aide to Section L, Division 3, NDRC, with offices at CIT for assistance to CIT in the administration of the contract, was designated Assistant Scientific Officer to Dr. Hovde, with responsibility for approval of expenditures in connection with Project Camel.

g. Mr. Hartley Rowe, a member of the NDRC Special Committee was also a member of the Los Alamos "Cowpuncher Committee" thus permitting liaison between the Los Alamos laboratory and the NDRC in regard to CIT's contract.

h. Dr. C. C. Lauritsen, in his capacity as Director of Research for CIT under the contract and as a member of the "Cowpuncher Committee", provided necessary liaison between CIT and Los Alamos on all technical matters.

i. Admiral Parsons, also a member of the Cowpuncher Committee, furnished necessary liaison with both the Army and Navy, particularly in matters requiring the assistance of either.

j. Responsibility for integration of the facilities and participation of Naval personnel of the Bureau of Ordnance of the Navy Department at the Naval Ordnance Test Station, Inyokern, California, with Project Camel was delegated to Captain S. E. Burrough, USN, Commanding Officer. Bureau of Yards and Docks activities at NOTS, Inyokern, were under the direction of Commodore L. N. Moeller, USN, Officer in Charge of Construction.

2-2. Initiation of the Work.

a. Thus, the collaboration of CIT was effected in the work connected with the development of the atomic bomb. In early December 1944 certain key personnel of the CIT organization were invited to Los Alamos for briefing and discussion of the problems which were faced. Out of these conferences grew the realization that there were, in some cases, problems for which responsibility could be assigned to CIT in their entirety and other cases in which parallel programs with Site Y and others could be undertaken by CIT. In addition it was obvious that CIT was in an excellent position to provide some data on the assembly, handling and ballistics of the bomb under field conditions.

b. In the consideration of the factors involved in the use of atomic bombs, it was necessary to carry out programs of tests and training with planes modified to carry them. Arrangements between CIT and NOTS proved valuable for this work assignment.

It was essential, that a training unit be developed which would approximate the weight, size and ballistic characteristics of the final implosion bomb as closely as preliminary estimates would permit. This problem was assigned to CIT in its entirety.

c. Meanwhile, work was to proceed with great urgency on development of certain components of the bomb. In this connection CIT was to render assistance in the design, production and test of the metal and explosive components. The work of CIT in the development of the explosive components was to include the design, construction and operation of a suitable plant for the casting of high explosives.

d. Upon return of the CIT personnel from Los Alamos,

work was begun immediately with great secrecy. On 19 December 1944, it was announced at a supervisors' meeting that a new project had been assigned to contract OEMsr 418. For security reasons it was explained as follows: "The U.S. has no bomb larger than 2000 pounds. It is desirable to develop something comparable in size to the British 'blockbuster', especially for use from B-29's. This new project --- will be done in collaboration with work already started in New Mexico in connection with a proximity fuze."

e. In the early stages of the work and before the name "Camel" had been applied to the project, it was identified by CIT as the "BB" program signifying "blockbuster" or "big boy". In order to eliminate the possibility of confusion with the name "Fat Man", used at Site Y to designate the implosion type atomic bomb, as differentiated from the "Thin Man" or gun and target bomb, the "BB" designation at CIT was dropped. The name "Pumpkin" was applied to the training bomb under development by CIT which approximated the design of the final bomb only in its external appearance and ballistic characteristics.

2-3. Scope of the Work. - By 8 January 1945, the program had crystallized to the point that responsibility had been designated, and work was under way on:

(a) Detonator development.

(b) High explosive development, including the design and construction of an explosives plant.

(c) Comparison and development of firing methods and circuits.

(d) Instrumentation, including electronic, mechanical

and photographic.

(e) Flight tests.

(f) Fusing

(g) Development and procurement of metal parts for the Camel and Los Alamos projects, together with the development of techniques and equipment for their inspection.

2-4. CIT Organization. - (Appendix B-12)

a. The organization of CIT had been developed in accordance with the requirements of its rocket development program and in January 1945 it included approximately 3000 persons. As a result of the agreements reached at Pasadena on 30 December 1944 and outlined in Dr. Hovde's letter of 16 January 1945 (Appendix B-3) the organization of the Institute's staff, employed on the contract, was not changed and work of Project Camel was accomplished by the delegation of responsibility to organization units set up for the rocket program.

b. In order to effect the assignment of responsibility for Project Camel an informal procedure was set up whereby requests, received from the Los Alamos Laboratory, were analyzed by the Director of Research, Dr. C. C. Lauritsen, or the Assistant Director of Research, Dr. W. A. Fowler, and their handling assigned to appropriate sections of the CIT organization (Appendix B-10). All problems related to explosive components were assigned to Section 1, headed by Dr. W. A. Fowler, and those related to the mechanical or electrical components of the bomb as a whole were assigned to Section 7, headed by Dr. F. C. Lindvall.

It was the responsibility of each of these sections to check or prepare designs and specifications in collaboration with the Los Alamos Laboratory, to prepare orders for fabrication or test, and to provide the necessary authority for changes by manufacturers, all toward the end of providing Los Alamos, and related sites, in the shortest possible time, with acceptable materials and equipment with which to carry on the work.

c. The work of Section 1 was further divided between Dr. T. Lauritsen and Dr. F. E. Roach. The former was responsible for the preparation of designs and specifications for test of explosive components. It included, with other miscellaneous items, responsibility for detonators, spherical pits, nose fuses and molds for the casting of explosives, the last in collaboration with Section 5 of CIT. Responsibility for all work connected with the experimental loading and test of detonators was assigned to Dr. F. E. Roach.

d. Actual production, in CIT and commercial facilities, was the responsibility of Section B, headed by Trevor Gardner, as were all activities connected with the final inspection of manufactured items for conformity with specifications. As a result of interference of Project Camel production with rocket production, because of the much higher priority carried by the former, a reorganization was later effected whereby responsibility for Project Camel production and inspection was assigned to Section 7, leaving Section B free to devote its energies to rocket production.

e. Section 5, under Dr. B. H. Sage, was responsible for the production loading of detonators in plants at Eaton Canyon, Pasadena,

and the Naval Ordnance Test Station, Inyokern, California, in addition to the development of facilities for production for high explosives.

f. Section 3, under Dr. I. S. Bowen, was responsible for the design and development of apparatus needed in connection with the photographic phases of the test work by other CIT sections, and for the development and production of special photographic equipment needed by the Los Alamos Laboratory.

g. The design, production and use of electronic, electrical and mechanical apparatus required for instrumentation in connection with the various tests was the responsibility of Section 2, under Dr. C. D. Anderson.

h. Flight and static firing tests were carried out by Section E, located at the Naval Ordnance Test Station, Inyokern. This section collaborated closely with all other sections engaged in Project Camel and with the Los Alamos Laboratory in the performance of whatever field tests were required.

i. Other sections engaged in activities associated with Project Camel were Section A, Personnel, under Verne E. Wilson, and Section R, Editorial, under Joseph Foladare.

j. In order to make available to CIT the assistance of the Manhattan Engineer District in matters pertaining to priorities, expediting, transportation, communication and draft deferments, Capt. H. D. Burton of the MED was assigned to the Institute on 19 January 1945. The history and activities of this office are covered separately. It is pertinent to note, however, that this office became responsible for items included in orders from the Los Alamos Laboratory which did not

require development and which could be procured on the open market. It also served as a relay point for contact between the Washington Liaison Office and the MED officer assigned to the Naval Ordnance Test Station, Inyokern, California, as well as a point of contact and control between CIT and the Los Alamos Laboratory in the issuance of orders or requests by the latter.

k. The development and research carried out under Project Camel were reviewed on behalf of the Government by the Patent Group at Los Alamos, New Mexico, for the purpose of determining whether patentable subject matter existed therein. The Group was under the direction of Major Ralph Carlisle Smith, who in turn reported on the findings to the Patent Advisor to the Office of Scientific Research and Development.

This review entailed the reading of all of the reports and such other documents as from time to time became available, as well as the preparation of the Disclosures, Applications and Records necessary to protect the rights of the Government in the work being done.

l. The activities and accomplishments of any one group are extremely difficult to delineate because of their numerous diverse and interrelated activities. It is proposed therefore to continue from this point with a description of the major parts of the work, and their relation to the development of the bomb, with mention in passing of the responsibilities of persons and sections of CIT and Los Alamos.

2-5. Statement of the Problem.

a. For the purpose of explaining the work described in the following chapters it is desirable to point out the the initiation of a chain reaction in the implosion bomb was based upon the compression

of a core of active material contained in a metallic tamper. To accomplish this end it was proposed that the tamper be surrounded by a sphere of high explosives which upon detonation at selected points on its periphery would produce the simultaneous convergence toward the tamper of shock waves of tremendous force. Any lack of simultaneity in the initiation, or propagation, of the shock waves in the implosive mass would obviously decrease the efficiency of the ensuing chain reaction.

b. Work had been begun at Los Alamos on development of the components of the implosive type bomb and by November 1944 had progressed to the point where considerable information had been accumulated on explosives, shock wave propagation, geometric division of the sphere and the techniques for casting of explosives. This information indicated a need for a tremendous amount of additional work for all of which the personnel and facilities required would be very difficult, if not impossible, to mobilize and construct at Los Alamos within the time available.

c. The necessity of dividing the implosive sphere for production and handling had resulted in its design in two contiguous layers, each of which was divided into geometric components capable of assembly to a tolerance of a few thousandths of an inch. The study of shock wave performance in the outer layer of blocks had resulted in the opinion that 72 was the minimum number of points required for acceptable results. The number of blocks required in the outer layer was therefore also 72.

d. Continued experimentation with casting techniques and materials was not, however, able to produce the simultaneity of

emergence of the shock waves required, but indicated a need for blocks prepared with a core of slow-burning explosive overcast with a fast-burning explosive. This method for production of castings was known as the "lens" method as differentiated from the "non-lens" method first developed. Upon study of the results obtained with "lens" type of casting it was determined that the number of detonation points required could be reduced to 32, thereby appreciably reducing the possibility of lag or misfire by one or more detonators from that of the system requiring 72 point detonation. Because of the uncertainty at that time that either of the methods could be developed to the point required to produce the desired results, it was necessary that further development of both methods be prosecuted.

e. The chief technical problem therefore, in so far as the Los Alamos Laboratory was concerned with collaboration under Project Camel, was the development of techniques, and the production of higher quality castings than had hitherto been made, for the lens and non-lens systems, and the simultaneous development for each of related bomb components such as detonators, firing circuits, fuses, and metal parts.

f. At the request of the Los Alamos Laboratory the further development of the non-lens system was undertaken by the California Institute of Technology together with programs for the parallel procurement and development of the related explosive and metal parts for both systems.

g. While the above is a statement of the technical problem of Project Camel in very general terms, the chief and most difficult problem of all was the tremendous urgency of the work required

to meet the ever approaching date for the test of the bomb.

SECTION 3 - DEVELOPMENT OF EXPLOSIVE COMPONENTS

3-1. General. - Previous to the time that the assistance of CIT was available to the Los Alamos Laboratory much preliminary work had been done on the development of explosive components of the "Fat Man". Included in this work was the development and/or production of detonators and molds for the casting of the high explosives components, as well as other miscellaneous parts and items of test equipment, for which responsibility was later assigned in whole or part to the California Institute of Technology. For the sake of clarity it is proposed to group the history of the design and development of these explosive components in this chapter.

3-2. Detonators.

a. Early work had been done at Los Alamos on the multi-point detonation of the implosive sphere by the use of one electrical detonator connected by leads of primacord, a cord detonant , to boosters located on the sphere. However, the simultaneity of firing required was not attainable by this means. Therefore, work had been begun on the development of multi-point electrical detonation.

b. The problem in this instance was based upon the principle of the detonation by shock developed by direct electrical means.

DOE b

DELETED DELETED DELETED

In addition the highest possible degree of reliability of performance was mandatory.

c. The development of detonators was one of the earliest programs of work assigned to CIT and began with the test of detonator parts then currently under production in the Los Angeles area. The detonators were of two types, identified as the spark gap and bridge wire types, both of which were the subject of intensive work by CIT under the technical guidance of the Los Alamos Laboratory. Before an acceptable detonator was developed, ten models were designed and produced in quantities of thousands for the statistical analysis of reliability and measurement of simultaneity at each of the several sites so engaged.

d. General supervision of the detonator program was assigned to Section 1 of the CIT organization under Dr. W. A. Fowler. Dr. T. Lauritsen was given responsibility by Dr. Fowler for the development of designs, preparation of test specifications and issuance of orders for procurement of component parts. Actual production of these components, in CIT facilities at the Foothill Plant or by commercial manufacturers, was the responsibility of Section B under Mr. Trevor Gardner. To Dr. F. B. Roach, Dr. Fowler gave responsibility for the development of explosive detonator components, techniques for their loading and tests for completed detonators. Involved were numerous problems in the preparation and molding at various pressures of several materials.

e. Experimental loading was done in facilities at the Eaton Canyon Pilot Plant provided by Section 5. This work was concerned principally with the investigation of methods for the preparation and pressing of PETN and lead oxide into pellets in close proximity to the

initiating parts of the detonator. Production loading and the problems connected with the adaptation of experimental loading techniques were under the direction of Dr. B. H. Sage of Section 5. Operations were begun in Section 5 facilities at the Eaton Canyon Pilot Plant, Pasadena, but were later expanded into facilities made available by the Bureau of Ordnance at the China Lake Pilot Plant, Inyokern.

f. These loading facilities were highly important since by their use it was possible to load manufactured parts, test their performance and obtain answers to production and design problems in a minimum amount of time, usually 24 hours.

g. The demand for detonators during their development stages was tremendous, for, in addition to the considerable requirements of the detonator test program, large numbers were required for other programs concerned with the development and test of firing circuits, explosive castings, metal components, final assemblies and the training of aircraft crews.

h. The program of detonator tests was also begun at the Eaton Canyon Plant in collaboration with Section 5. It was expanded in March 1945 into temporary facilities constructed in a "Camel" test area at NOTS, Inyokern. At this site tests were under the direction of Dr. E. L. Ellis, head of Section E of CIT, who worked in collaboration with Dr. Roach.

i. The most important item of equipment used in these tests was a high-speed rotating mirror camera developed by Dr. I. S. Bowen, head of Section 3. DELETED

DOE b(3)

DELETED DELETED DELETED

The camera was later developed and adapted for the photography of the emergence of shock waves from explosive castings and the measurement of their regularity in much smaller increments. Statistical analysis of results of the firing of the best detonators it was possible to produce, indicated that the failure or lag in detonation of one detonator was an ever present possibility. To eliminate this eventuality detonators with dual initiation points were developed and tested.

3-3. Molds.

a. By 1 December 1944 a number of contracts had been made by the Los Alamos Laboratory through its Los Angeles procurement office for the production of molds. At this stage of the development of the explosive components of the bomb the determination of the geometric division of the implosive sphere was in a state of flux. So also was the development of casting techniques and the design of molds. Consequently an extensive program for procurement of molds had been undertaken to permit experimentation with all of the various shapes of casting required for the interior and exterior layers of the lens and non-lens spheres, in a range of sizes including 1/6, 1/3, 1/2 and full scale.

b. Upon the entrance of CIT into active collaboration with the Los Alamos Laboratory a large number of contracts for molds and other items were either cancelled or transferred to the jurisdiction of CIT. Since they were related to the explosive components of the bomb, CIT's responsibility for their development and production was delegated

to Section 1 and the particular cognizance of Dr. T. Lauritsen.

c. The mold program involved intensive work, in collaboration with the Los Alamos Laboratory, in the evolution of designs required for the rather complicated cooling cycles necessary to obtain homogeneous castings which were free from shrinkage cracks and voids. To solve this problem molds with coils for the circulation of several systems of water were required. Because of the accuracy of dimensions and quality of surface required of the explosive casting, molds with surfaces of equal perfection in dimension and quality of finish were also required.

d. The composition and fabrication of the interior lining was therefore the most difficult technical aspect of the mold program. In order to obtain the necessary accuracy of dimension a lead alloy of low coefficient of thermal expansion was required, which in this instance proved to be, as was not unusual, one in which there was a very critical shortage. The problem was therefore complicated by the necessity for developing mold designs requiring as little of the material as possible, leading thereby to a series of problems concerned with the casting of water tubes in the rough jacket of the mold components rather than in the lining and a search for a substitute material.

e. The production of molds entailed a series of operations for which few, if any, manufacturers were equipped. As a result the production of components was sub-contracted to numerous concerns, to assure their production in the short time allowable and to provide the varied facilities required. Facilities for the casting and finishing of the

inner lining and their inspection, for compliance with the very exacting specifications, were provided and operated by Section B at the Foothill Plant.

f. The demand for molds was seemingly insatiable, for as advances were made in the technique of casting and more information became available on the performance of castings more specific requirements were possible for mold designs. The work on the production of non-quality castings at the Naval Mine Depot, Yorktown, Virginia, and at the Naval Ammunition Depot at McAlester, Oklahoma, required additional molds.

g. In connection with the responsibility of CIT for the design and operation of a casting plant at NOTS, Inyokern, a more or less independent approach to the development of suitable molds for the non-lens castings was initiated. Later, when it was clear that success could be attained by the Los Alamos Laboratory with lens castings, molds of other sizes and different mechanical design were required to permit lens castings in the Salt Wells Plant with molds incorporating improvements over those currently in use at Los Alamos.

h. The extremely critical nature of the work of development and production of molds is revealed by the fact that the first - the second - the third of July came and went and still castings had not been produced in sufficient number for the assembly of a single bomb; nevertheless the "Trinity" test at Alamogordo, N. M., was carried out on schedule, on 16 July 1945.

3-4. Contact Fuzes.

a. In event of failure of the bomb to explode, in spite

of all the precautions taken to prevent that possibility, it was desirable that some means be provided for its destruction to prevent its falling into enemy hands. The problem was simply one of detonating the high explosive sphere on contact of the bomb with a hard surface, but since this was to serve only as a last resort the solution required was one that was positive and reliable.

b. Responsibility for development and test of this component was assigned to the group headed by Dr. T. Lauritsen under Section 1. Collaboration of other sections, however, was necessary, particularly that of Section E, which was responsible for the assembly and drop tests at NOTS, Inyokern.

c. The solution was comparatively easy, since it entailed only the inclusion of four standard service fuzes in the nose of the outer casing of the bomb and their connection with primacord to the same number of boosters in the surface of the explosive sphere. The principal work was that of the providing for inclusion of the system in the manufacture of metal parts, the test of its performance under actual conditions and the modification of components of the fuze system in accordance with the results thereof.

SECTION 4 - DEVELOPMENT OF METAL COMPONENTS

4-1. General.

a. Metal components are herein roughly classed as all those not identified as explosive components of the "Fat Man". Included in this category, in addition to parts for "Pumpkins", are parts for "Fat Men" such as firing circuits and electronic fuzes, also handling devices and other miscellaneous items.

b. As indicated in par. 2-4d, overall responsibility for production of metal parts was given to Section 7 working in collaboration with Section B, which served as a procurement and production agency. The changes in organization which made Section 7 responsible for the activities of Section B are covered in par. 6-1e. This section deals only with the development and production of metal or non-explosive components by Section 7 as follows:

4-2. Pumpkins.

a. In the very earliest stages of Project Camel, CIT was given complete responsibility for the development and production of the "Pumpkin" or "practice" bomb. The program was assigned to Dr. F. C. Lindvall, head of Section 7. Designs for an exterior casing suitable for the "Fat Man" were provided by the Los Alamos Laboratory.

b. The problem was the design and production or procurement of all of the components required to make a blockbuster within the limitations set up by the Los Alamos Laboratory, namely that it approximate the ballistic characteristics of the "Fat Man" and also serve as a conventional bomb.

c. The bomb evolved had an inner "tank" of steel which was loaded with explosives at the Naval Mine Depot, McAlester, Oklahoma,

or with inert materials at CIT's Foothill plant at Pasadena. After experimentation with several methods, detonation of the bomb on contact with the ground was effected by means of sleeves, containing high explosives, extending from the inner tank to the nose of the bomb, where they terminated in standard service fuses.

d. All of the production of "Pumpkin" required for development and test programs at NOTS, Inyokern, and other sites was furnished by CIT. Other production, to cover needs of the Army Air Forces for programs of training and operation, were undertaken by the Bureau of Ordnance in the plants of CIT sub-contractors, chiefly Consolidated Steel Company and Western Pipe and Steel Company, from designs furnished by CIT. This arrangement was in accordance with agreements between OSRD and the Armed Service that no production for service use would be undertaken by OSRD research and development contractors. Units produced by the Bureau of Ordnance for service use were used in this country and overseas, several units being dropped on Japan with devastating effect in the course of the Army Air Forces operational training program.

4-3. Tails.

a. Difficulties observed in the flight test program of a lack of stability of the bomb in flight led to a program of modification of designs originally prepared elsewhere on the basis of theoretical calculations. The program was principally concerned with the determination of the optimum size and location of drag plates in the tail unit. The work was prosecuted in collaboration with Site Y and the Army Air Forces.

b. Theoretical advantages in a circular tail were

independently investigated by CIT, with the objective of giving additional rotation and stability to the bomb during descent. Several tails of this design were produced by CIT but not before the problems of the square tail were solved.

c. The original design for the tail was based upon the use of Dural, an aluminum alloy, for fabrication. A critical shortage of this material led to an investigation by CIT of the possibility of substituting steel. While the problem might seem simple on first thought it was not, because of the requirement that the weight of the steel tail should not exceed that of the aluminum tail.

d. Primary production of tail units was the responsibility of the Detroit branch of the Los Angeles procurement office. Recommendations by CIT for modification of the tail were transmitted to Los Alamos for further consideration and incorporation in the design.

4-4. Spheres.

a. Preliminary designs for the sphere, or metallic casing surrounding the implosive sphere, were prepared at Los Alamos and the problem of procurement and further development was assigned to CIT.

b. This work was delegated to the group in Section 7 under Dr. F. C. Lindvall who was responsible for the design modifications necessary for its integration with other ever changing components. The problem was particularly difficult because of the large diameter required and small tolerances permitted in its manufacture. Few firms in the west were able to undertake its manufacture because of these

requirements.

c. Essentially the problem was one of producing hollow aluminum and magnesium spheres in seven parts with numerous very accurately placed provisions for detonators, attachment of the outer casing or "ellipsoid", suspension in the plane and assembly of the parts.

d. A large number of spheres was required to resolve the problem of their assembly with inert or explosive charges and to satisfy the requirements of the extensive program of tests for integration and performance of other components.

e. The independent work by CIT on a further development model was stopped with the termination of Camel activities upon cessation of hostilities. This design was a normal progression from an experimental to a standard model, effecting improvements for handling, ease of assembly, reliability, etc.

4-5. Pits.

a. Project Camel was not concerned with the nuclear system of the bomb. For purposes of security the nuclear system was known at Los Alamos as the "Pit". At CIT the term "Pit" was used to identify the metal casing only, or its representation which served as a core for assembly and test of the explosive components.

b. Responsibility for production of the components and the development of methods for their assembly was assigned to Section 1. In the course of their manufacture a number of rejected parts were available for assembly and test of the assembly. In addition, numerous pits of various materials were supplied and, in some cases, used for

experiments to develop a technique for determination of the simultaneity of convergence of shock waves.

4-6. Ellipsoids.

a. The design of the outer casing of the bomb, called "the ellipsoid", was based on requirements evolved by the Los Alamos Laboratory. As previously mentioned, there were parallel programs for development and production at CIT of casings for the "Fat Man" and "Pumpkin". While at first glance they were identical in shape they were different in many details, chiefly because of differences in fuzing methods employed and the requirement that the casing for the "Fat Man" be demountable.

b. Design and production of "Fat Man" ellipsoids was carried out by Section 1 in collaboration with Sections B and 7. They were manufactured by the Consolidated Steel Company of Los Angeles.

c. In order to provide the inner components with a protection from missiles equal to that provided plane crews by armor plate, considerable effort was spent in the development of a heat treated ellipsoid. Tests, however, indicated that the results obtained were insufficient to warrant the continuation of this work.

4-7. Electronic Fuzes.

a. The requirement that the bomb be set off at a predetermined height above the target gave rise to another series of problems related to methods of arming and "triggering" the bomb. For obvious reasons the utmost in reliability was the end objective of the program.

b. Responsibility for the development and production of several types of radar-type fuses was delegated to Dr. H. R. Crane of the University of Michigan. Development of one type, known as PMR, was handicapped by need for production by the University of Michigan of other typical fuses particularly on the tail warning type of unit. Further work on the PMR was undertaken by CIT at the request of Dr. Crane with a view of putting it into production. The first University of Michigan models of the PMR were delivered to CIT in the latter part of February. Laboratory and field test of the units were begun immediately and modifications were proposed. These modifications were undertaken by CIT and led to a parallel program for development and production of an improved test model in close collaboration with the University of Michigan. Work on this program at CIT was under the direction of Dr. F. C. Lindvall who collaborated with Dr. H. R. Crane of the University of Michigan and Dr. R. B. Brode of Los Alamos. The first PMR's were used in flight tests in mid May.

Work on this program ended with the cessation of hostilities.

4-8. Firing Systems.

a. A necessary adjunct to the development of detonators was a program for the development and production of a circuit for firing them which would be comparable in reliability of performance with that required of the detonators.

b. The earliest efforts of Los Alamos had been spent in the investigation of the electrical detonation, at a single point, of

lengths of primacord connected to detonators. Primacord had been shown to hold little possibility of providing the simultaneity or reliability required, because of variations inherent in the materials of which it was made. But multi-point electrical detonation was likewise inadequate in simultaneity and reliability in its early stages. The shortcomings of the multi-point electrical system were due to deficiencies in the circuit components then available.

c. Experiments with detonators had indicated that voltages considerably higher than those previously used would be required for proper detonation. The final objective of the program therefore, was the development and production of firing circuits and their components similar to that proposed by Los Alamos, but capable of providing greater capacitance and higher voltage.

d. Actually the work entailed the gradual evolution and production of condensers and switches capable of operating at 7500 volts, together with the wiring, connections, etc. for the independent test of detonators, and later for the test of assembled bombs. In the latter instance the problem was particularly difficult because of limited space available in the bomb for installation and operation of a circuit of the above mentioned voltage.

e. In the course of the development, experience indicated the need for inclusion of dual systems of firing and elaborate precautions and safety devices to obviate the chance of misfire or detonation by failure of a part.

f. The decision by the Cowpuncher Committee that Project Camel would concentrate its activities on the non-lens type of implosive sphere required a parallel program for the development of firing systems for 72 and 144 point detonation. This was in addition to the work of the 32 point system, requiring detonation at 64 points in the case of the dual system for use with the lens type implosive sphere being developed by the Los Alamos Laboratory.

g. As was the case with detonators, the amount of production required was enormous. When it is realized, however, that the circuit components required for the firing of a given number of detonators are different from those required for any other number and that many tests were required at Pasadena, Los Alamos and Inyokern on a great number of groups of detonators varying in number from 2 to 144, the production needs are understandable.

h. At the suggestion of Dr. C. C. Lauritsen, work was undertaken on studies of wind-driven generators to supply electric power for detonation in place of internal batteries, as it was believed that greater reliability and safety might result. The study was still incomplete at termination of activities on this project.

i. Responsibility for the work of development of firing circuits was assigned by Dr. C. C. Lauritsen to Dr. Fred C. Lindvall, Head of Section 7 under the CIT contract and Professor of Electrical Engineering at the Institute. The experimental and development work was carried out by members of this section with the collaboration of the Los Alamos Laboratory and other members of the CIT staff.

4-9. Handling Equipment.

a. To provide for transportation of bombs from points of assembly to plane loading points, equipment of special design was needed. Adaptations of standard equipment had been used by the Section E at NOTS, Inyokern, in the early stages of the test program, but in order to transfer the bomb to hydraulic hoists, located in specially constructed pits, crane equipment was required. The loading process was much too cumbersome and offered many opportunities for damage to the bomb and possible detonation of it. In order to permit loading of planes at fields where special pits might not be available it was considered necessary that special transportation equipment be provided.

b. Designs were prepared by collaboration between the Los Alamos Laboratory and Section 7. The latter was requested to procure the equipment.

SECTION 5 - FLIGHT AND STATIC TESTS

5-1. General.

a. Integrated with the program for design and production of metal and other parts of the bomb was an extensive program for test of parts and assemblies of live and inert "Fat Men" and "Pumpkins". Since the expeditious development and production of bomb components was dependent to a large degree on the speed and accuracy with which test information could be obtained on the performance of theoretical designs, and since schedules for the Trinity test and subsequent delivery to the enemy were set and reset not from the point of view of providing time for the required work but because of the necessity for earliest possible use of the bomb, the work of this program was of the utmost urgency. This and other programs were further complicated by the requirements for a program of training and operations in the delivery of an atomic bomb to the enemy.

b. The purpose of the program was to obtain complete information on conditions within the bomb during flight from airplane to ground, and included, among other things, the determination of vibration, temperature, air pressure, moisture influx and precise barometric data. In addition, the program was to serve as the means for the check and assimilation of data on the assembly and performance of designs for the bomb under field conditions, in order that production models could be crystallized. It was also intended to furnish data required for the development of ballistic tables. The program was concerned with the

tests required for the development of detonators and boosters, which are covered in the paragraph on Detonators, but it was not intended that it be concerned with the training of Army Air Force personnel.

c. In order to provide aircraft and crews for the test program, Admiral W. S. Parsons, USN, had previously effected arrangements with the Army Air Forces whereby the 509th Bombardment Group had been designated to work in collaboration with the Los Alamos Laboratory in the performance of these tests. Toward that end, the bombardment group, known as W-47, under Col. Tibbetts, had been based at Wendover, Utah, and had been equipped with specially modified B-29's. Technical direction of the program was delegated to Drs. Brode and Ramsey of Los Alamos.

d. With the entrance of CIT into a program of collaboration with the Los Alamos project, and the availability of the CIT staff and Navy facilities at NOTS, Inyokern, a decision was reached to divide the work of the Army Air Forces into two parts, whereby the training program, using "Pumpkins", would be conducted at Wendover, and the test program, using both "Pumpkins" and "Fat Man", would be conducted at Inyokern. As a result a special test group of Army Air Force personnel under Major Shields, equipped with 9 B-29's, was designated as a test group.

e. The decision that a test program would be carried out by CIT and the Navy at NOTS was reached in January 1945. Responsibility for assembly of units, instrumentation of ranges and assembly of data was delegated to Section E of CIT, located at NOTS under the direction of Dr. E. L. Ellis. Responsibility for all other operations in connection with the scheduling of drops, loading of units into aircraft and operation

of the planes was delegated to the Experimental Operations Officer at NOTS, Captain J. T. Hayward, USN. The enthusiasm and technical knowledge of this officer were of inestimable benefit to the project in effecting the collaboration of the numerous parties involved in the test program at NOTS, Inyokern. Project Camel officer for the Navy was Lt. M. M. Walther, USNR.

f. All operations were originally centered at Wendover and the first test drops at NOTS, Inyokern, were made by planes flown to and loaded at Armitage Field for each drop. However, with the increase in tempo of the test program it became necessary to transfer planes and crews to Armitage Field. Thereafter three squadrons, of three planes each, with crews, were rotated at NOTS, Inyokern. After equipment and techniques for the measurement of ballistic data had been developed, drops were made by planes from Inyokern at a similarly instrumented range at the Naval Air Station, Sandy Beach, California, which, because of its location on the Salton Sea, more nearly approximated the conditions to be found in Japan. Later, in order to take advantage of training drops by planes based at Wendover, Utah, arrangements were made whereby a range was developed in a remote section of the reservation at the Naval Ordnance Test Station, Inyokern, known as Carrieart Valley. In the course of these operations a total of 121 "Pumpkins" and "Fat Men" and three "Thin Men" was dropped.

5-2. Types of Tests. - Test work conducted by Section E may be divided roughly into types as follows:

a. Drop tests intended for determination of the ballistic

characteristics of the bomb, test of tail designs for stability during fall, time of fall, fuze arming time, reliability of detonation by contact fuzes, determination of barometric pressures inside the unit, operation of telemetering equipment, and operation of the PMR.

b. Assembly tests for the determination of the suitability of component parts, the development of assembly techniques, the adequacy of handling equipment, and the development of plane loading techniques.

c. Static firing tests for the measurement of blast, study of flame propagation and development of apparatus and techniques for the determination of the convergence of shock waves in explosive castings.

d. Miscellaneous tests for determination of resistance of assembled units to machine gun fire, vibration and shock resulting from short drops.

5-3. A Typical Test. - The activities associated with a typical test are best indicated by the responsibilities delegated in connection with drop No. 1 as follows:

a. Operation of test programs: Experimental Officer NOTS, Inyokern, and E. L. Ellis.

b. Radar tracking: C. E. Kron

c. Telemetering and informers: C. D. Anderson

d. Recovery: NOTS range crew and E. L. Ellis

e. Delivery of bomb components to NOTS: T. Lauritsen

f. Exterior ballistics: I. C. Bowen

g. Examination of recovered parts: T. Lauritsen

h. Fuze functioning tests: T. Lauritsen.

The coordination of all operations was the responsibility of W. A. Fowler.

5-4. Delivery.

a. Delivery of materials for "Fat Man" assemblies at NOTS was from a number of points and required a great deal of coordination in order to assure the performance of tests in accordance with predetermined schedules. Inert castings were furnished by the CIT Foothill Plant. Explosive castings were supplied from the Los Alamos Laboratory and the Naval Mine Depot, Yorktown, Virginia.

b. "Pumpkins" were delivered assembled with inert charges by the Foothill Plant. Live "Pumpkins" were furnished assembled by the Naval Ammunition Depot at McAlister, Oklahoma.

5-5. Construction of Test Facilities.- Facilities constructed at NOTS, Inyokern, in connection with this program of tests are as follows:

a. Armitage Field

(1) 1,000 foot concrete extensions to each end of three asphalt surfaces runways to permit operation of B-29's.

(2) Loading pit and parking apron.

(3) One building including plane crews' ready room and part storage space.

b. Camel Test Area.

(1) Roads, telephone and electric lines.

(2) Underground observation and photographic facilities

at three static firing sites.

(3) Three small magazines.

The above facilities are in addition to the temporary facilities constructed in connection with the detonator test program also conducted in this area.

c. Assembly Area.

(1) Two buildings for assembly of live and inert bombs.

(2) One building for storage of bomb components and inert units.

(3) One building for the assembly and operation of telemetering equipment.

d. Ranges.

(1) Extension of electric circuits.

(2) Construction of miscellaneous experimental facilities.

5-6. Bomb Assembly Buildings. - At the request of the Los Alamos Laboratory, work required for the procurement, crating and shipment of materials needed for the construction overseas of three air-conditioned bomb assembly buildings, complete with handling equipment, was undertaken at NOTS by Capt. L. N. Moeller, Officer in Charge of Construction, representing the Bureau of Yards and Docks. The magnitude of this task is indicated by the fact that the shipment was composed of ten carloads of crated materials, some of which, in order to meet the sailing schedule, had to be flown on a special plane from the east coast. In order that the design of the building might be tested before its

erection overseas, a building similar in all respects to the design for the overseas building was erected in the assembly area at NOTS and used by Section E.

5-7. Change in Organization. - Section E, on initiation of Project Camel, was a part of the CIT organization; however, in accordance with an agreement previously effected with the Navy, this Section was transferred on 1 April 1945 to Civil Service and became an initial part of a research and development staff then being organized to carry on the Naval program at NOTS, Inyokern. Thereafter all work connected with Project Camel continued under the technical guidance of CIT.

5-8. Telemetering. - In the series of drop tests much information was required on the performance of various components of the bomb in the interval between its release from the plane and its contact with the ground. The responsibility for development and production of suitable radio equipment, together with mechanical devices necessary for operation of the radio equipment, was given to Dr. C. D. Anderson, head of Section 2. To furnish a permanent visual record of the information obtained by telemetering, considerable collaboration was required with Section 3 under I. S. Bowen.

5-9. Photography.

a. A great deal of photographic information was required of the operation of equipment within the plane, of the action of the bomb in flight and of its detonation and resulting blast on the ground. This work was accomplished with the aid of equipment developed or furnished by Section 3 or made available by the photographic laboratory at

NOTS, Inyokern.

b. The special camera developed for use in the test of detonators and explosive castings is described in Paragraph 8.10.

SECTION 6 - PRODUCTION AND PROCUREMENT

6-1. General.

a. As previously mentioned in paragraph 2-4, responsibility for production and procurement of fabricated items to designs prepared by CIT or Los Alamos rested with Section B. Under its OSRD contract no procurement of standard items or raw materials was to be undertaken by CIT for the Los Alamos Laboratory, these orders being routed through the Los Angeles procurement office of the University of California.

b. In the time between the initiation of Project Camel and the middle of February 1945, the orders received from Los Alamos and other sections of CIT had not been sufficient to cause Section B to extend itself, though the items required were of an entirely different type from those it had previously produced. In that time, however, much development work had been completed at both locations and the lens type castings were giving indications of the possibility of success at Los Alamos.

c. By the latter part of February, orders began to flow in from CIT and Los Alamos, particularly for the production of lens molds, and accessories for which the need was one of tremendous urgency. Also the program for production of metal components had to be stepped up. All of the items were required to tolerances not usually approached in commercial manufacture. Section B was swamped, as witnessed by the fact that by the last of March 90% of the Foothill plant and personnel of Section B had been converted to Camel production. Since the priority

of Project Camel greatly exceeded that of the rocket program the effect on the latter can well be imagined. Thus on the ninth of April steps were taken to reorganize Section B by setting up a separate group under Trevor Gardner with separate facilities for rocket production. That part of Section B concerned with Camel production was transferred to Section 7, under Dr. L. C. Lindvall, in view of the fact that Section 7 had been primarily concerned with the design and development of metal components for "Pumpkins".

d. Simultaneously an extensive modification and re-arrangement of the Foothill plant was undertaken to enable it to satisfy the requirements of Project Camel. By 1 May the plant was 95% engaged on Camel activities.

e. At approximately the same time and in accordance with the desire of CIT and OSRD to be relieved of responsibility for rocket production, negotiations were under way with the Navy Department with a view of transferring the CIT production facilities and operations to a commercial organization. Transfer of function to the General Tire and Rubber Company on 15 July required further extensive reorganizations of personnel and space, to provide necessary security by segregation of operations in the Foothill Plant and in offices located at 1020 Green Street, Pasadena.

f. The facilities and operation of the Foothill Plant are covered in a special report Number K. 32 entitled "Project Camel Production Facilities, CIT Foothill Plant" and dated 18 May 1945. The organization of Section B included over 1000 persons and handled all administration,

buying, inspection, and expediting shipping and production, except for procurement done by Section 5.

g. Most of the subcontracts let were to small concerns and necessitated in many cases the placing of duplicate orders with several firms to assure deliveries in the time allowed. Several large concerns, notably the Joshua Hendy Company of San Francisco, and the Consolidated Steel Company and Western Pipe and Steel Company of Los Angeles, were engaged in the production of parts for "Fat Man", "Pumpkins" and molds. Mold production was also undertaken by the Mare Island Navy Yard for CIT.

6-2. Cost. - The work of Project Camel was begun with the thought that it could be superimposed on the work being done for the rocket program. One million dollars had been estimated in the beginning as sufficient to cover procurement and CIT expenses for a considerable period of time. By the middle of December this amount had been increased to $3,000,000 to cover a period of six months. By 1 May 1945 this amount had been expended and commitments were approaching a peak of $1,500,000 per month. Within a period of nine months approximately $7,500,000 was expended.

SECTION 7 - DEVELOPMENT OF HIGH EXPLOSIVE PRODUCTION TECHNIQUES

7-1. General. - The discussions between Dr. Oppenheimer and Dr. C. C. Lauritsen in November 1944 led to an agreement that CIT would undertake the development of techniques for production of small scale non-lens castings as a program entirely independent of the work at the Los Alamos laboratory. In the latter part of December 1944 Dr. B. H. Sage was requested by Dr. Lauritsen to study the program requirements and to prepare a preliminary statement of the physical requirements for a suitable plant and an estimate of the cost of its construction. This report was to be prepared with the understanding that the initiation of work on the casting program was a matter of the utmost urgency.

7-2. Site. - In early January, after consideration of sites at the Naval Ammunition Depot, Hawthorne, Nevada, the Naval Ordnance Test Station, Inyokern, California, and others in the environs of Pasadena, a site was selected in the Salt Wells Valley on the reservation of the Naval Ordnance Test Station, Inyokern. This site was adjacent to the Navy's China Lake Pilot Plant then partially in operation under CIT in the experimental production of rocket propellants. The reasons for the selection of this site were: First, that the contiguity of the two sites would permit the general administration of the Salt Wells Pilot Plant with a minimum of additional administrative personnel, and second, that since CIT would be concerned with the operation of the plant only for the duration of the war, its operation could be taken over and continued thereafter by the Navy with little change in personnel or other interruption. Since the mission of the Naval Ordnance Test Station was the

performance of experimental work, the Salt Wells Pilot Plant could be operated and supervised by a class of personnel which would not usually be available at a production facility such as the Naval Ammunition Depot, Hawthorne. Consideration of the requirements for housing and related facilities at an independent site eliminated the possibility of locating the plant near Pasadena. The site at NOTS, Inyokern, had the additional advantages of being reasonably close to Pasadena and not requiring a further spread of CIT activities.

7-3. Type of Construction. - Preliminary consideration of the problem indicated that the program could be implemented by construction of temporary facilities, for the development of production techniques in connection with small scale castings. By this approach, the facilities would be smaller and simpler to procure and construct, the saving in time appreciable and the loss in the event of failure of the program smaller. However, in view of the following considerations the proposal for construction of minimum temporary facilities was rejected.

a. The only facilities for experimental work on the casting problem, which were located at Los Alamos, were temporary and inherently hazardous.

b. The Navy Department would not consent to the operation by others of an explosives plant on a Navy base which did not conform to the standards of safety adopted by the Bureau of Ordnance.

c. Development of casting techniques by preparation of small scale castings could be accomplished in facilities designed for preparation of full scale units.

d. It was desirable that facilities constructed be capable of conversion should an accident at Los Alamos necessitate the transfer of the casting operations being performed there to another site.

e. The urgent need for the facilities, for development of the non-lens castings or as insurance against the possibility of accident at Los Alamos, did not permit a delay in the construction of full scale facilities.

7-4. Construction Schedule. - Preliminary estimates of the time required for construction of the plant indicated that the major construction of the basic facilities could be completed in approximately 100 days, or on or about 1 May 1945. Installation of equipment would require 20 to 30 days longer. With that understanding, it was agreed that construction should begin immediately, with highest priority given to facilities for melting, casting, mold cleaning, machining and radiography, together with two magazines, a laboratory, boiler plant and a complete system of utilities and roads. These facilities were to be so arranged as to permit future expansion of the plant by the addition of buildings only. Other less urgent construction requirements were an administration building, machine shop, change house and laundry, which with the boiler house and laboratory were to comprise the service area.

7-5. Responsibility and Organization.

a. Since the plant was to be located on a Navy base, it was agreed that the Bureau of Ordnance should determine the features of construction required for safe operation of the plant. Toward that end, the preliminary designs were reviewed by a representative of the Bureau of Ordnance on 18 January 1945 and preliminary approval with minor

modifications was granted, subject to review of more detailed designs at a later date. Because of the fact that the exact nature of the work could not be divulged to the persons in the Bureau of Ordnance who were responsible for the approval of safety provisions, somewhat more refinements were included than were inherently necessary, in order to provide for the "unknowns".

b. Further consideration by CIT of the proposal that it assume responsibility for the design, construction and operation of the plant led to an agreement that the expenditure of funds for preparation of working drawings and construction of the plant should be the responsibility of the Navy Department. Therefore, the responsibility for awarding and administration of architect-engineer and construction contracts was transferred after agreement with the Bureau of Ordnance to the Bureau of Yards and Docks, which was then engaged in the construction of other station facilities. The firm of Holmes and Narver of Los Angeles was retained as architect-engineer by the Officer in Charge of Construction under a cost plus a fixed fee contract (Noy 11762) and attended the first meeting with CIT and the Navy on 19 January 1945. At this time it was agreed that the architect-engineer would develop plans in accordance with preliminary sketches to be provided by CIT and that all plans and construction were to be subject to the approval of CIT.

c. It was also agreed that CIT would retain responsibility for the design, procurement and supervision of the installation of all operating equipment, which would be installed by the construction contractor under his contract with the Navy.

d. In accordance with safety policies agreed upon with the Bureau of Ordnance, explosive operations were to be conducted in heavily barricaded structures and those of a particularly hazardous nature were to be controlled from points outside the barricades. This required the design and procurement of special hydraulic equipment, periscopes and remote control apparatus. This work was undertaken by engineering and procurement groups of Section 5, who collaborated on occasion with the engineering groups under Sections 1 and 7.

e. Construction operations were begun on 13 February 1945 by Haddock Engineers Limited, with the construction of a contractor's camp and grading of roads. It was soon apparent that if the proposed schedule were to be met, unusual measures would be required to assure the delivery of construction materials and to eliminate delays resulting from lack of authority in the field.

f. The problems were resolved in mid-March by establishment of a policy by Rear Admiral G. F. Hussey, Chief of the Bureau of Ordnance, that authority for Project Camel construction should rest with the parties most concerned. This policy was outlined by him to the Chief of the Bureau of Yards and Docks on 17 March 1945, (Appendix B-7). Specific authorizations and delegations of responsibility were made as follows:

(1) To Captain S. E. Burroughs, USN, Commanding Officer, NOTS, Inyokern, was delegated responsibility for determination of safety requirements, upon advice of the Bureau of Ordnance Safety Engineer, and authority for the approval of construction in connection

with its effect on station administration (Appendix B-8).

(2) To Captain L. N. Moeller, USN, Officer in Charge of Construction, was delegated authority for initiation of construction upon receipt of approvals from the Commanding Officer, and from representatives of CIT and the Manhattan Engineer District (Appendix B-9).

(3) Dr. C. C. Lauritsen, Director of Research for Contract OEMsr 418, or his designated representative, Dr. B. H. Sage, were recognized as responsible for the determination of the technical requirements of the plant. (Appendix B-8.)

(4) To Captain J. T. Ware, AUS, Representative of General Groves at NOTS, Inyokern, was delegated authority for certification that the construction was required in connection with Project Camel and that the use of War Department funds was authorized (Appendix B-10).

7-6. Priorities. - In order for the Navy to procure materials and equipment with the requisite speed, it was necessary to effect and facilitate the issuance of war Production Board upratings and directives which were available to the Manhattan Engineer District through its Washington Liaison Officer, Major A. C. Johnson, and his assistant, Captain P. Firmin. The Army representative at NOTS, Inyokern, was charged with the responsibility for obtaining all necessary information for processing requests for priority assistance and transmitting them by the quickest available means to the Washington Liaison Office. All operations in connection with the construction were centered at NOTS, Inyokern, except the procurement office of the construction contractor,

which was located in Los Angeles. Poor communications with this office soon indicated the need for quicker transmission of requests for priority assistance from the contractor's procurement office to Washington than could be attained via NCTS, Inyokern, so arrangements were effected for their processing through the Los Angeles Area Office of the Manhattan Engineer District. This was one of the minor difficulties experienced in attempting rapid construction at a location so remote.

7-7. Change to Lens Castings - Increment 3.

a. During the time intervening between the start of the project in January and the first of April, unexpected progress had been made at Los Alamos on the development of the lens method, which more or less obviated the need for further development of the non-lens method assigned to CIT. By action of the Compuncher Committee, tremendous effort was being exerted on the lens program at Los Alamos. As a result, the effort being expended on the design and production of molds for the Salt Wells Pilot Plant was transferred to molds for the Los Alamos laboratory. This together with a lag in the design and procurement of mechanical equipment for the plant, due to a shortage of qualified engineering personnel and the fact that the buildings were more complex than originally anticipated, was a combination of factors which delayed the completion of the first increment of construction and completion of the installation of equipment until August. However, from the time that procurement of materials and development of plans would permit, work on construction was carried on on a twenty hour, seven day week schedule.

b. By the latter part of March it was apparent that the

purpose for which the Salt Wells Pilot Plant was originally intended, the development of small scale non-lens casting techniques, no longer existed, and that if the plant were to serve any useful purpose it would be necessary to supplement its facilities to permit work on small and full scale lens castings.

c. On 12 April 1945 the construction of facilities for the preparation of lens explosives was therefore authorized. The facilities required were six buildings for the breaking, grinding, drying, sizing, weighing and inspection of explosives and one building for the preparation of inert metal powders. These buildings comprised Increment Three of the pilot plant construction program and were considered of sufficient importance to require their construction with the same urgency as had been designated for Increment One.

7-8. Increment 2. - On 8 May 1945, the Officer in Charge of Construction was authorized to proceed with the previously delayed construction of Increment Two of the plant facilities. This authorization covered the construction of an administration building, laboratory, shop, change house and laundry for completion of the service area. Because of the fact that the operation of the Salt Wells Plant could be begun by the use of service facilities available in the adjacent China Lake Pilot Plant, which would not be put into full operation until after September 1, less urgency was attached to the construction of these facilities than was required for the construction of the previously authorized Increments One and Three. However, three buildings were included in this increment to supplement the inadequate and temporary

facilities previously constructed in the Eaton Canyon Pilot Plant at Pasadena and in the Camel Test Area at Inyokern for the test firing of detonators and boosters. These buildings were a small magazine, a firing bay and a control building. Their completion was deemed as urgent as Increments One and Three.

7-9. Increment 4.

a. In a meeting on 6 April 1945 between Dr. C. C. Lauritsen, Admiral W. S. Parsons and Dr. H. M. Sage, the consideration of the machining facilities for high explosives then in existence, or authorized, led to agreement that in the event of loss of the machining facility at Los Alamos, the one facility under construction at Inyokern as part of Increment One would be inadequate to meet production requirements. It was therefore decided that additional machining capacity should be provided in the Salt Wells Pilot Plant. To comply with restrictions set up by the Bureau of Ordnance Safety Engineer for use of the machining building under construction in Increment One, it was deemed advisable to split the operations connected with the machining process into five phases. For this reason five buildings, one for each of the four machining operations and one for preparation of castings for machining were designed. On 24 May 1945, the construction of this group of buildings, known as Increment Four, was authorized. As was the case with Increments One and Three, this Increment was assigned a number one priority.

b. Except for eight advance-base type magazines, authorized on 10 April 1945, to provide raw material storage space in the

station magazine area for plant use, there were no other major authorizations directly attributable to the high explosives development program at Inyokern.

7-10. Trial Operation. - The installation of equipment in buildings of the first Increment was begun before completion of the structures in mid-July and sufficiently completed by mid-August to permit the initiation of melting and casting operations. In anticipation thereof, requests were made through Dr. Lauritsen on 31 July for the preparation of 20 spheres with lens type blocks at the rate of one sphere per week from 15 August and two spheres per week from 1 September. Trial operation of the plant with inert materials had barely begun when cancellations of the orders were received as a result of the cessation of hostilities.

7-11. Pressing Non-Lens Blocks. In the spring of 1945 independent work was begun by Section 5 on investigation of technique for pressing non-lens blocks. The work was chiefly concerned with the design and procurement of small scale dies for use in a 12 inch hydraulic press. Permission of the Bureau of Ordnance was obtained to use a press of this size in the China Lake Pilot Plant at NOTS, Inyokern, and work progressed to the point of pressing inert blocks before it was dropped in view of the change in emphasis from non-lens to lens blocks. The results obtained gave indication that the method was feasible but that considerably more development work and facilities would be required for its perfection.

SECTION 8 - TERMINATION AND TRANSFER OF CAMEL ACTIVITIES.

8-1. General.

a. The participation of CIT in war research and development had been independently begun for the development of rockets and had inadvertently grown to the extent of employing over 3000 persons for experimental production of rockets and the development and production of components of the atomic bomb. This work was entirely foreign to the peace-time pursuits of the Institute and to some extent could be said to be a misdirection of the efforts of the CIT research staffs insofar as it was concerned with actual production programs. Such endeavor had been undertaken only on persuasion of the Institute that its assistance was essential to the war effort and with the understanding that it would be relieved of responsibility for production as soon as other means could be developed to carry on the work. CIT also agreed to the organization of other groups such as the test section (Section E) at NOTS, Inyokern, with the clear understanding that they would in time be transferred to the Navy.

b. The initiation of Project Camel by CIT was a complication to the otherwise clear cut program for the transfer of facilities and personnel to Navy jurisdiction and required many compromises with the policies of both CIT and the Navy.

c. This transfer of jurisdiction began with the transfer of Section E to Navy civil service on 1 April 1945 and, as previously stated, necessitated that CIT continue with the close technical supervision of the Camel work of this section in order that it could be in-

tegrated with other work not transferred.

d. The second compromise came with the transfer on 15 July 1945 of CIT's rocket procurement and production work to the General Tire and Rubber Company under contract with the Bureau of Ordnance. Here again CIT retained that part of its organization required to carry on Camel procurement and production.

e. With the cessation of hostilities the situation became more complex. On the one hand was the Navy's desire to continue with work in collaboration with CIT on the atomic bomb with a view toward modifying its design for use from aircraft carriers. There was also an apparent desire by CIT to continue with the research phase which would have meant that production and development work would have been carried on in the facilities transferred to the Navy and under Navy jurisdiction. In addition there was the desire of General Groves that no work be undertaken which would in anyway commit the agency to be set up by Congress to a course of future action, together with a desire that all information and work connected with the development of the atomic bomb be kept under the jurisdiction of the MED insofar as was possible.

8-2. Decision to Terminate. - By agreement of all concerned the decision was reached by 1 October 1945 that all work at NOTS, Inyokern, and at Pasadena by CIT would be terminated at the earliest practicable date and that operation of the Salt Wells Pilot Plant would be continued by the Bureau of Ordnance. In the meantime, termination of CIT subcontracts as recommended by the Los Alamos Laboratory was begun. Work of other subcontracts was continued to satisfy needs of Los Alamos and

until other arrangements could be made. Work on parallel development programs by CIT was stopped almost immediately.

8-3. Transfer of Personnel. - The transfer of personnel of Section 5, engaged in the operation of the China Lake and Salt Wells Pilot Plant at NOTS, Inyokern, was effected on 1 November 1945, to the Research and Development Division of NOTS, headed by Dr. L. T. E. Thompson under Captain J. E. Sykes, Commanding Officer. Technical direction of the Salt Wells Pilot Plant continued under Dr. E. H. Sage by arrangement of the Bureau of Ordnance with CIT for his part time services.

8-4. Completion of Construction.

a. Construction work in the plant continued until 21 January 1946 by the construction contractor as did the installation of equipment. Because, however, of the fact that subcontracts for and work by CIT on development of equipment designs and procurement had ceased in the early fall, installation of equipment had progressed very slowly until January 1946, by which time a program of work for the plant had been agreed upon and funds had been provided by the MED for its operation.

b. In January 1946 construction of the plant was completed and intensive work by the Navy was undertaken to complete the procurement and installation of equipment. This phase was completed in May 1946.

8-5. Transfer of Techniques.

a. Beginning 1 February 1946 the plant was to begin the scheduled production of two explosive spheres per month. The time intervening between 1 September 1945 and 1 February 1946 was spent chiefly in the development of techniques and equipment suitable for production

of lens and inner castings in the Salt Wells Plant. Difficulties experienced in the period immediately prior to and following V-J-Day had shown that the technique developed at Los Alamos could not be transferred to other facilities without modifications to adapt it to fundamental differences in plant design. Of interest in this connection is the point that two adjacent lines for production of these castings were constructed at Los Alamos whereon development of casting techniques was carried out. On development of a process of suitable castings by one of the lines it was desired to increase production by putting both lines in operation on that particular technique. Great difficulty was encountered in transferring the technique to the adjacent line even after the second line was manned by operating personnel from the first line. The difficulties in transferring the technique to a plant of fundamentally different size were, mildly speaking, tremendous.

b. This process of transfer of "know how" and modifications of techniques was begun in December by assignment of key personnel from Los Alamos to observe and comment on the work of operators in the Salt Wells Plant and has continued on a decreasing scale until this writing, with the result that the number of rejections has become almost negligible. At this time the plant is producing castings by quantity production methods while working on methods to simplify the processes.

8-6. Disposition of Records and Materials.

a. Termination of the activities of CIT and the Test Section in connection with Project Camel involved the problem of collecting or disposing of all classified records and materials. This work was

supervised by the Pasadena Branch Office of the Military Intelligence and Security Section of the Manhattan Engineer District. All classified records in the possession of CIT were collected and forwarded to the Los Alamos Laboratory except those required in connection with operation of the Salt Wells Pilot Plant. These records were transferred by Section 5 to NOTS, Inyokern, for storage with other Camel Files in the Salt Wells Pilot Plant. One complete set of reports of Section K was left with the Experimental Officer of the station.

b. All materials which because of fabrication would in any way reveal the shape, size or design of the atomic bomb were collected from the plants of the various CIT subcontractors, were collected at the Foothill Plant and were destroyed or mutilated, together with the classified materials from the plant. The only classified materials excepted were complete or useable units which were shipped to Los Alamos or other sites at the direction of MED office at Los Alamos.

c. Classified materials at NOTS, Inyokern, were disposed of in the same manner except that numerous non-quality castings were transferred to the jurisdiction of the Salt Wells Pilot Plant for use in development of techniques and equipment for quality control of plant production.

d. No summary technical reports or histories were prepared by members of the OSRD or CIT staffs, in accordance with the request of the Manhattan Engineer District, in order that the possibility of collection and dispersal of vital information would be reduced. This is the only history of this work heretofore prepared.

SECTION 9 - CONSTRUCTION

9-1. General. - The construction required for each of the programs of work is listed, with the discussion thereof, and summarized, in Appendix B-11.

9-2. Housing. - The addition of a plant to the facilities originally planned for the NOTS, Inyokern, and the necessity of housing the additional workers required for its operation necessitated an agreement between the Bureau of Ordnance and the Manhattan Engineer District for the assistance of the latter in providing necessary quarters. Since the Naval Ordnance Test Station was to be a permanent station and since the policy of the MED was not to use its funds for the construction of permanent family housing, the agreement reached provided that funds from the MED would be used for the construction of eight 25-man dormitories which would be consistent with other construction on the station. Later, the personnel at the station, together with overhead personnel required by their employment, exceeded the number of accommodations provided by Project Camel, and a large number of persons were yet to be employed for the plant operation. On request of the Commanding Officer, use of Project Camel funds was authorized for the erection of two 200-man prefabricated overseas type barracks. No other authorizations other than those directly connected with the work of Project Camel were made.

9-3. Contracts.

a. Construction work at NOTS, Inyokern, was performed in accordance with the procedure outlined for construction of the Salt

Wells Pilot Plant. All construction was performed under contract to the Bureau of Yards and Docks, represented at NOTS by Capt. L. N. Moeller, USN, until September 1945, when the drop in urgency of the work permitted his replacement by Commander E. H. Thouren, USNR.

b. Because of the importance of the work a separate contractor was engaged and work was initiated and carried on under a cost plus a fixed fee contract (Noy 11847) with Haddock Engineers, Limited, of Los Angeles, until 15 July 1945 when the work was placed on a lump sum basis (Contract Noy 12,909) with the same contractor. During this period all other construction for the station by the original contractor was terminated and transferred to this contractor.

9-4. Cost.

a. To cover the cost of construction connected with Project Camel at NOTS, Inyokern, a total of $15,500,000 was transferred by the Manhattan Engineer District to the Bureau of Yards and Docks. Included in this amount was a fund of $100,000 for expenditures for materials, equipment and labor required in connection with recovery of detonated or buried bomb parts, and other miscellaneous work performed by station personnel or contractors for Project Camel.

b. The costs of construction at NOTS, Inyokern, were high because primarily of the urgency of the work, requiring abnormal amounts of overtime. Efficiency of labor in the construction operation, which was at its peak in July and August, was low because of the tremendous heat of the Mojave Desert at that time.

9-5. Construction at Pasadena. - Construction at Pasadena was

of a comparatively minor nature and was accomplished by sub-contract to the California Institute of Technology. Its cost was charged against funds transferred by the MED to the OSRD.

SECTION 10 - SECURITY

10-1. General. - In order to comply with a Presidential directive requiring the highest possible security in work connected with the atomic bomb, the Los Alamos Laboratory had been set up as a project apart from other work of the Manhattan Engineer District, and for all practical purposes almost entirely isolated from contact with other parts of the work. When Project Camel started, the same conditions influenced the work there.

10-2. Joint Responsibility. - With the decision to bring CIT, the Bureau of Ordnance and the Bureau of Yards and Docks into the work as independent agencies not under the direct control of the Intelligence and Security organizations of the MED, it was necessary that carefully promulgated policies for protection of information be agreed upon with, and become the responsibility of, these agencies.

10-3. Compartmentalization. - Since the policy of compartmentalization was the basis for all security within the MED it was agreed that this policy should apply to each of the sites and agencies concerned, that information would be transferred only at high levels, and that contact between personnel by communication or visit would be kept to the minimum consistent with the requirements of the work.

10-4. Personnel Investigations. - Backgrounds of personnel to be engaged in work on Project Camel were to be investigated in a manner comparable to that of the MED. Physical security was to be maintained by the issuance of appropriate passes and establishment of guard forces by

appropriate agencies. Further, the fact that Project Camel was connected with the MED was to be kept from all possible personnel including civilians and members of the armed services, within the MED as well as outside. The connection of work at Pasadena and Inyokern with other sites - such as: Los Alamos, New Mexico; Wendover, Utah; the Naval Mine Depot, Yorktown, Virginia; the Naval Ordnance Plant, McAlester, Oklahoma; and the Naval Air Facility located on the Salton Sea, California were to be kept secret.

10-5. Pasadena Branch Office. - In order to assist the Navy Department and CIT in the maintenance of security on Project Camel, a Pasadena Branch office of the Military Intelligence and Security sections was opened at Pasadena, under Lt. R. W. Kirkman, in April 1945. The duties of this office were to check the security measures instituted by CIT and the Navy Department, to make recommendations for their improvement and to furnish security clearances for personnel from information in the files of the Army Service Commands, the Federal Bureau of Investigation, the Office of Naval Intelligence, and the MED upon request. In addition this office served as a headquarters for intelligence work of the MED in Southern California and for the protection of shipments between all of the activities connected with Project Camel and the Calexico Engineer Works.

10-6. Agents at NOTS, Inyokern. - For collaboration with the Navy and CIT at the Naval Ordnance Testing Station, Inyokern, California, two special agents were assigned to that base under the general control of the MED Officer stationed there.

10-7. Assignment of Personnel. - The assignment of personnel from the MED was made by the Washington Liaison Office, where three officers in addition to the Commanding General were informed of the work of Project Camel. MED military personnel visiting CIT were required to wear civilian clothing. The officer stationed at NOTS, Inyokern, was disguised as an Ordnance Officer. All special agents wore civilian clothing.

10-8. Limitation of Naval Responsibility. - At NOTS, Inyokern, security was, in accordance with Naval procedure, the responsibility of the Commanding Officer, which in this instance had to be limited to actual physical security, for with one or two exceptions, the naval security officer not included, no information could be divulged as to the purpose or connections of the project. Nor could assistance be obtained through naval channels in the maintenance of security, for by agreement with the Chief of Naval Operations, Naval Intelligence and Security officer had been directed not to undertake investigation of activities connected with the MED. This was done in order that these officers would not unwittingly discover or disclose information about activities of the MED.

10-9. Concealment of Information.

a. All possible emphasis was placed on the discouragement of unnecessary discussion by personnel of their work, and on the use of symbols and code names when such discussion was necessary. Somewhat complicated means of communication and shipment were evolved whereunder contact directly between related activities was the exception

rather than the rule.

b. In the decision to obtain the collaboration of CIT and of the Bureau of Ordnance, there were several advantages from the standpoint of security. The large procurement and production facilities of CIT could furnish the great number of special and revealing items without establishment of their connection with the MED. If attempts were made to establish the connection of the work with the war effort, such attempts would result in its identification with the Navy's rocket program. Research, development and test work on particularly revealing components of the atomic bomb could be broken down into unrelated parts and accomplished without revelation to the individuals concerned of the connection or the implications of their work. Further, the large amount of construction required for a casting plant and related test facilities could be carried on by the Navy at an isolated location and "lost" in the construction then in progress in connection with the naval base and related facilities.

APPENDICES

A. Photographs and Drawing

1. Additions to Armitage Field, NOTS, Inyokern
2. Assembly Area, NOTS, Inyokern
3. Salt Wells Pilot Plant, NOTS, Inyokern
4. Map of Salt Wells Pilot Plant.

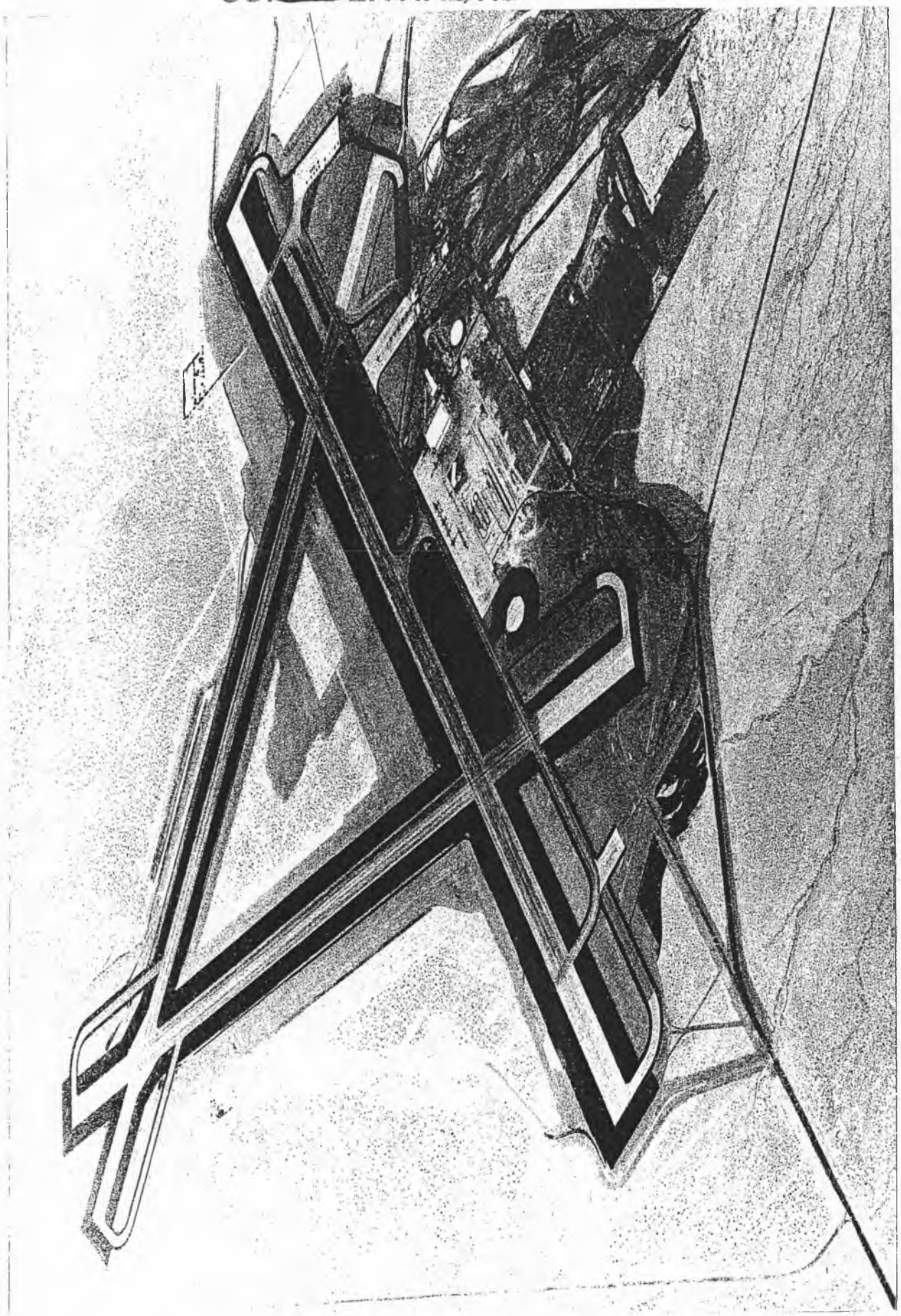
B. Documents

1. Letter, Dr. J. R. Oppenheimer to Dr. Vannevar Bush, 21 November 1944.
2. Letter, Dr. F. L. Hovde to Prof. E. C. Watson and Dr. E. M. Norton, 22 December 1944.
3. Letter, Dr. F. L. Hovde to Dr. J. B. Conant, 16 January 1945.
4. Letter, Admiral J. A. Furer to Dr. Bush, 8 January 1945.
5. Letter, Dr. F. L. Hovde to Dr. Irvin Stewart, 25 January 1945.
6. Letter, Major A. C. Johnson to Captain E. L. Hanson, 27 January 1945.
7. Letter, Chief of the Bureau of Ordnance to Chief of the Bureau of Yards and Docks, 17 March 1945.
8. Letter, Chief of the Bureau of Ordnance to C.O., NOTS, Inyokern, Calif., 28 March 1945.
9. Letter, Kirby Smith, Bu. Docks, to Officer in Charge of Construction, NOTS, Inyokern, Calif., 30 March 1945.
10. Memorandum, Captain P. Firmin to Chief of Bureau of Yards and Docks, 20 March 1945.
11. List of Construction Required for Project Camel - NOTS, Inyokern, California.
12. CIT Organization Chart

APPENDIX A

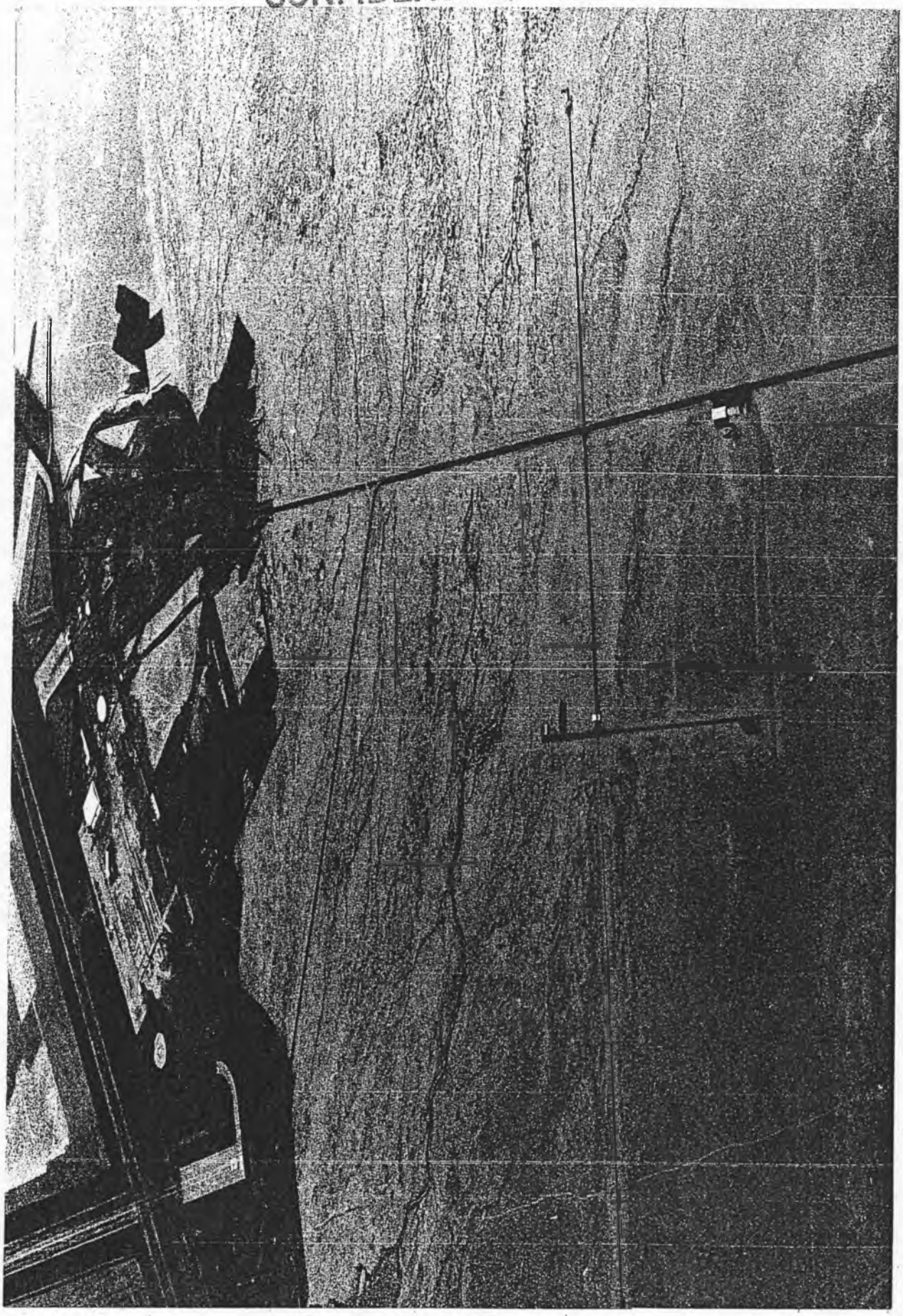
PHOTOGRAPHS & DRAWINGS

ARMAMENT FOR PROJECT CANEX, TO
ARMITAGE FIELD
NAVAL AIR FACILITY
U.S. NAVAL ORDNANCE TEST STATION
INYOKERN, CALIFORNIA
LEGEND
1600' Runway Extension
Taxi Strip Extension
Loading Pits and Apron
Storage Bldg and Ready Room



ASSEMBLY AREA
PROJECT CASH.
U.S. NAVAL ORDNANCE TEST STATION
INYOKERN, CALIFORNIA

KEY
A Storage Pits
B Assembly Buildings
C Assembly Bldgs. (Overseas type)
D Warehouse
E Electronics Building



TEST
AREA

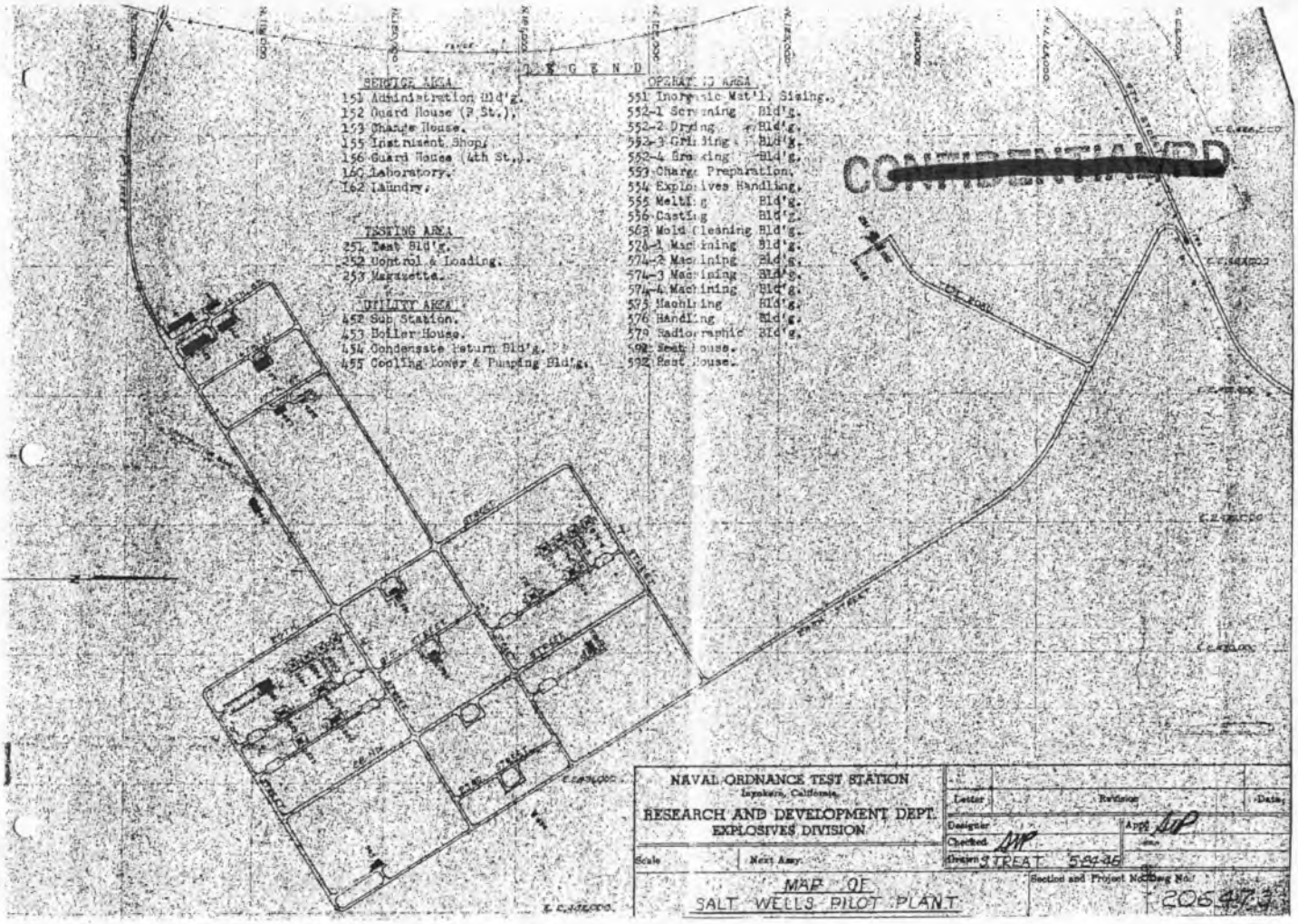
SAIT MAIS PILOT PLANT
U.S. NAVAL ORDNANCE TEST STATION
INYOKERN, CALIFORNIA

PROTECTION AREA

SERVICE AREA

CONFIDENTIAL

CONFIDENTIAL



CONFIDENTIAL

APPENDIX B

DOCUMENTS

~~CONFIDENTIAL/RD~~

~~SECRET~~

C
O
P
Y

November 21, 1944

Dr. Vannevar Bush
1530 P Street, N. W.
Washington, D. C.

Dear Dr. Bush:

After my last discussion with you I persuaded Lauritsen to pay us a visit at Site Y. He has been here some days now and has had an opportunity to discuss our problems briefly with General Groves and at somewhat greater length with Parsons, Kistiakowsky, and other members of the project. The outcome of these discussions seems most satisfactory to me and tends to conform to Dr. Lauritsen's ideas about the desirable form of collaboration between us. I will try to sketch below what we propose to do, submitting this for your approval and for your support as occasion may arise.

1. Dr. Lauritsen himself will spend the greater part of his time at Site Y, without specific assignment. He will undertake to assist with the direction of the project, both in a technical and in an administrative way, and will in particular try to see in what ways the project with which he has until now been exclusively associated can help to solve our problems.

2. We will endeavor to make good use of the facilities of the California Institute project for the support of the work at Project Y. This will most certainly include the design and expediting facilities for shop work. It will almost certainly involve the assignment of certain specific problems to personnel in the Institute project, often in parallel with developments being undertaken here or at other sites. It may involve the use of field facilities which are available to the Institute project. It is my desire not to predetermine the extent of these services since I am convinced that Dr. Lauritsen and a few of his key men will best be able to determine the nature and extent of this collaboration.

3. It seems to us desirable that Dr. William Fowler, who is Associate Director of the Institute project, and Dr. T. Lauritsen, and perhaps later a few other men, be brought to Site Y in order to familiarize themselves with our problems. We should not at this time wish to make a commitment as to whether the greater part of their time will be spent here or in Pasadena.

~~CONFIDENTIAL/RD~~

~~SECRET~~

~~CONFIDENTIAL/RD~~

~~SECRET~~

4. The above arrangements have been discussed with General Groves, both from the point of view of general administration and of security, and have his approval in principle. In fact, he is most anxious for us to carry out away from this site all parts of our work which do not need to be centralized here, and you will well appreciate the growing necessity for this.

5. It is understood by me that appropriate arrangements for the continuation of the work on which Dr. Lauritsen was formerly engaged will have to be made, and certain steps to expedite this have already been undertaken by Captain Parsons, who is of course vitally interested both in the continuance of that work and in solving the problems of Site Y. In the meantime, we shall so proceed as to be sure that the Institute project is not completely deprived of competent supervision.

6. We appreciate that the arrangements outlined above must meet with your approval in order to be put into effect. We hope that you will approve them, and believe that they will contribute enormously to the solution of our problems. I believe that if you do approve it will be necessary for you to communicate your assent through the NDRC and Division 3 to the California Institute of Technology.

7. Because of the indefiniteness of the present status of the arrangements, it is impossible to fix the dollar value of the services which will be carried out by the Institute project for Site Y. We understand that the Institute budget has an item for three million dollars contributed by the OSRD. It is improbable that work performed at the request of Site Y will involve spending more than this amount within the next six months. We should like to know what arrangements need to be made to reimburse either the OSRD or the Navy Department for Institute expenditures committed for the Site Y project.

Sincerely yours,

J. R. Oppenheimer

CC: General Groves
Dr. Lauritsen

~~SECRET~~

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL/RD~~

~~SECRET~~

December 22, 1944

COPY

MEMORANDUM

AIR MAIL

TO: Prof. E. C. Watson, Official Investigator, OEMsr-418
Dr. B. M. Norton, Technical Aide, Sec. L, Div. 3

FROM: F. L. Hovde, Chief, Division 3, NDRC

SUBJECT: Authorization to Proceed with Work on Special War Department Project under Contract OEMsr-418 as Assigned by Dr. C. C. Lauritsen under the Control of Dr. J. B. Conant's Special NDRC Committee

As you well realize, the many difficult questions of policy and administration relating to the nature and extent of the new project work coming from the War Department for assignment to CIT are now being discussed here in great detail by all concerned. All matters, of course, are not yet settled but I intend to come out to Pasadena shortly after Christmas to arrange all details with you, Dr. C. C. Lauritsen, Dr. Millikan, the Trustees if necessary, and others concerned.

Dr. Tolman has acquainted me with the contents of Prof. Watson's letters of December 11 and 13. The problems raised in those letters are of direct concern to me as Chief of Division 3. However, I believe that when more of the picture is presented, a satisfactory method of procedure can be worked out which will satisfy the needs of all whom we asked to serve.

Inasmuch as work is already under way on this new project under an authorization provided by Dr. J. B. Conant, Chairman, NDRC, and the NDRC itself voted the allocation of $1,000,000 to Contract OEMsr-418 to carry out the new project, CIT is authorized to proceed with the work and make commitments up to the above amount in order to carry out tasks presented through Dr. C. C. Lauritsen. My instructions to CIT are that this authorization should remain in effect until all administrative details are settled in the near future, provided that the acceptance of new tasks does not interfere with the Institute's present commitments on the rocket program.

~~SECRET~~

~~CONFIDENTIAL/RD~~

For your information, the following paragraphs give the present position and thinking of those of us in Washington:

1. Messrs. Bush, Conant, Tolman, the NDRC, and the cognizant officials of the War Department have reached complete agreement as to the necessity, priority, importance, and wiseness of asking that a portion of the unique facilities and manpower at CIT under Contract OEMsr-418 be devoted to an extremely important development problem.

2. Assuming the CIT authorities and Trustees are willing to undertake this additional work, the total effort to be devoted by the CIT organization must be kept at such a level as not to interfere seriously with the NDRC-CIT commitments to its rocket program. Both Dr. Conant and Dr. Tolman have definitely agreed to this principle and will support it. Inasmuch as no other person has a greater interest in nor knowledge of the rocket program than Dr. C. C. Lauritsen, I am sure, therefore, that satisfactory administrative arrangements can be reached which will effectively prevent any serious conflict for manpower and facilities from developing.

3. The expenditure of special War Department funds transferred to OSRD for allocation to Contract OEMsr-418 for this new project is to be under the control of a special NDRC committee consisting of Dr. J. B. Conant, Mr. Hartley Rowe, and myself. I intend to ask this committee to have Dr. B. M. Norton designated as a technical aide to the committee, in order that he may supervise the operations and report from time to time to the committee on the various aspects of the work on the new project.

4. Inasmuch as special funds are to be used for the new War Department work, I believe it will be necessary for CIT to set up a new section and keep all accounting records and vouchers separate from the remainder of the CIT-Division 3 project organization.

5. With respect to security, I have already consulted Dr. Tolman and Colonel Lansdale, chief security officer of the cognizant War Department organization. Both agree that the classification of all operations, subcontracting, purchases, etc., is to be determined by Dr. C. C. Lauritsen and/or his deputies. Much of the procurement work can and should be unclassified. In fact, placing this work within the rocket project, which carries a comparatively low order of classification, gives us one of the best guarantees of security insofar as the War Department is concerned.

To expedite the rapid clearance of subcontractors, Col. Lansdale indicated that CIT could call upon Mr. Killough and that Mr. Killough would be able to help on short notice. However, since much of the procurement work will undoubtedly be unclassified, I do not think CIT should have much difficulty on this score.

6. When this new project was first discussed with me by Messrs. Conant and Tolman, I insisted that the Navy Department be informed at once, because it was depending upon our organization for many phases of its rocket program. It was indicated that this would most certainly be done, and I understand from Dr. Tolman that Admiral Purnell, Assistant Chief of Staff, has instructed the Bureau of Ordnance regarding this matter, and decisions, therefore, have been cleared at high level in the Navy Department. The nature of Admiral Purnell's instructions to BuOrd is not known to me but I presume Purnell's clearance of this matter was based on my assurance that arrangements could be made such that the rocket research and development program would not unduly suffer, and that CIT could undertake a reasonable additional load of special work without serious interference with our present commitments to the Navy.

7. Both Dr. Bush and Dr. Conant recognize that a decision to undertake this new project will serve to give a new lease on life to Contract OEMsr-418. I do not believe this contradicts present OSRD policy, since that policy now suprorts (a) continuation of our work at full speed until Germany is defeated, and (b) our participation in experimental production activities under the CIT contract has the full backing of NDRC. The issue of whether or not OSRD should continue experimental production has been decided affirmatively for as long as a case for its value can be made.

F. L. H.

cc: Dr. J. B. Conant
Dr. R. C. Tolman
Dr. C. C. Lauritsen

FLH:ms

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

COPY

January 16, 1945

Dr. J. B. Conant
Chairman, NDRC
1530 P Street, N. W.
Washington 26, D. C.

My dear Dr. Conant:

The decision to assign a special War Department project of some magnitude to Contract OEMsr-418, California Institute of Technology, immediately raised the question of possible interference with the rocket research and development program being carried forward under that contract. It is recognized that the priority and importance of the rocket program is so great at this time that undue interference with this work would not be acceptable to either the NDRC or the Navy Department.

I wish now to report to you, and for the information of others to whom you may wish to forward this letter, my report on the meeting held Saturday, December 30, 1944, in Pasadena, at which representatives of the Navy Department, Division 3, NDRC, and the California Institute of Technology were present. This meeting had been called together at your suggestion to discuss the issues involved in the assignment of the special War Department project to CIT, and to reach mutually acceptable understandings with regard to the policy and conditions under which the new project work is to be carried out. Representatives attending this meeting were: for the Navy Department, Rear Admiral R. S. Holmes, Comdr. C. E. Haugen; for the Bureau of Ordnance, Captain F. I. Entwistle, Commander J. A. E. Hindman; for NOTS, Inyokern, Captain S. E. Burroughs, Commander J. T. Hayward; for CIT, Messrs. E. C. Watson, C. C. Lauritsen, W. A. Fowler, B. H. Sage, W. N. Lacey, I. S. Bowen, C. D. Anderson; for Division 3, NDRC, Messrs. B. M. Norton, F. L. Hovde.

Whether or not the new project would interfere seriously with the rocket program during the next twelve months depends on the nature and magnitude of the over-all research and development demands placed on CIT. The rocket program for the coming year was, therefore, discussed in great detail, and general agreement on the part of the majority of representatives present was reached on the following statements, although certain individuals could not agree in full with these statements.

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

1. The rapid growth and construction of the Bureau of Ordnance facilities at the Naval Ordnance Test Station, Inyokern, California, will provide additional rocket development facilities to supplement those at CIT during the coming twelve months, and the Bureau of Ordnance will expedite in every possible way the building, staffing, and equipping of NOTS, Inyokern, and the orderly transfer of suitable rocket projects to that station as the best means of insuring a continuance of the Navy's rocket research and development program, not only during the present war but during the coming peacetime.

2. Many of the most urgent and important aspects of the rocket development program which must be prosecuted during the coming twelve months are those aspects concerned with increasing the effective operational use of the rockets already developed and now in production; i.e., improvements in sights and fire control methods, improvements in fuzes, electrical systems, and miscellaneous equipment. It is believed that such work, being directly related to operations, can be handled more effectively by the staff and facilities at NOTS, Inyokern, as it grows into full development than by CIT.

3. Although at the present time CIT has no new major rocket development projects in view, it is more than likely that new and urgent projects will arise during the coming months. Any such new projects can be undertaken by CIT, however, since its project organization, its knowledge of and experience with rocket development and the training of its staff have constantly improved.

4. It is recognized that up to the present time much of the time and effort of the CIT organization have been devoted to meet "crash" production requirements of the Navy for rockets, launchers, and other equipment. Although present CIT production commitments will soon be completed, new demands will certainly arise. However, it is likely that the magnitude of these future demands upon CIT may lessen as the Bureau of Ordnance industrial suppliers begin to meet their schedules during the coming months and obtain manufacturing experience and competence.

   For instance, during the next six months the production schedule for rocket propellant grains to be produced at both the Eaton Canyon station and the China Lake Pilot Plant will be based on a supply of 320,000 lbs. per month of sheet propellant stock. Production operations at these two facilities will, therefore, be on a reduced basis compared with the past six months when the entire load was carried by the Eaton Canyon facility alone. The amount

of sheet stock supplied to the propellant processing facilities under the control of CIT was determined by agreement between CIT and the Bureau of Ordnance. It provides sufficient stock only to keep the facilities operating at an efficient level.

With respect to demands upon CIT for the procurement and manufacture of metal parts of HVAR, SSR, and other rockets, CIT's present commitments will be substantially completed in February, 1945. Additional Navy production orders will be required if the production organization is to be kept in operation. The Developmental Engineering Section of the CIT organization uses in the main, the subcontracting method for procurement and manufacture. This method can be expanded to handle any foreseeable demands placed upon CIT for the production and procurement of special equipment and devices as needed for the new War Department project work in addition to any new rocket production now in view.

The above statements describing the future of the rocket program at CIT received general approval. The meeting then considered the problems presented by the acceptance of the new War Department project, and the following policy statements were arrived at for the guidance of all concerned.

a. The acceptance of the new project will not require any significant change in the organization, direction, and scope of the rocket research and development program at CIT.

b. Both NDRC and CIT intend to continue, with undiminished vigor, all important and urgent rocket projects now in the program.

c. Sufficient manpower and facilities will continue to be devoted to rocket research and development so that should any new and urgent rocket projects arise which the Navy Department cannot undertake itself or handle elsewhere, sufficient development capacity will be available to meet Navy Department needs.

d. In order not to spread the effort of the CIT supervisory personnel engaged in working on both rocket projects and the War Department project, it was strongly urged and recommended by all present that the field testing facilities at the pilot plant and field testing facilities required for the new work be handled at NOTS, Inyokern. Approval and action on this matter has already been taken by the Bureau of Ordnance through the establishment of Project NO-281, "Camel".

As matters stand now, I believe the policy statements reached at this meeting will prove acceptable to both the NDRC and the Bureau of Ordnance. I am sure that the CIT authorities, and Division 3, NDRC, will make every effort to carry out their full responsibilities with respect to the Navy's rocket program.

I am sending copies of this letter to those indicated below. You may wish to inform others who are concerned.

Yours very sincerely,

Frederick L. Hovde
Chief, Division 3, NDRC

cc: Dr. V. Bush
Dr. E. C. Tolman
Rear Admiral R. S. Holmes
Chief, BuOrd, Att.: Capt. C. L. Tyler
Captain S. E. Burroughs, NCTS
Professor E. C. Watson
Dr. C. C. Lauritsen
Mr. Hartley Rowe
Dr. B. M. Norton

FLH:ns

~~CONFIDENTIAL/RD~~

CONFIDENTIAL

C O P Y

NAVY DEPARTMENT
WASHINGTON 25, D.C.

(SC)All
JHW:ejb

January 8, 1945

Dr. Vannevar Bush, Director
Office of Scientific Research & Development
1530 P Street, N. W.
Washington, D. C.

Dear Dr. Bush:

The Navy Department requests that the Office of Scientific Research and Development establish a project with California Institute of Technology for experimental work at that Institute and at the Naval Ordnance Test Station, Inyokern. This project will be entitled CAMEL and will include the design, construction, equipping, staffing, and operation of certain facilities at NOTS, Inyokern under the jurisdiction of the Navy Department.

It is understood that the funds for this project will be supplied by the Office of Scientific Research and Development. In the administration of these funds it is considered preferable that a new contract be established with California Institute of Technology rather than to conduct this work under Contract OEMsr-418.

Project CAMEL will be designated as NO-281 and will be classified Confidential. The Bureau of Ordnance liaison officers on this project will be Captain C. L. Tyler, Section (Re) and Captain S. E. Burroughs, Commanding Officer, NOTS, Inyokern.

The Bureau of Ordnance considers this project to be of sufficient importance to warrant the draft deferment of personnel employed on this project for the time necessary to complete the work.

Project control sheets in quadruplicate are herewith forwarded.

Sincerely yours,

J. A. FURER, Rear Admiral, USN(Ret)
Coordinator of Research & Develop.

Encl.
1. 4 Proj. Con. Shts.
CC:
BuOrd (Re)
Capt. S. E. Burroughs

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

25 January 1945

COPY

Dr. Irvin Stewart
Executive Secretary, OSRD
1530 P Street, N. W.
Washington 25, D. C.

ATTENTION: PROJECT CONTROL

RE: NO-281 "CAMEL"

REF: a Conf Proj. Cont. Sheets (2) 1-4-45
b Conf Ltr 1-8-45 Coordinator to Director, OSRD
c Conf Ltr 1-13-45 Exec Sec to Chief, Div. 3

Dear Dr. Stewart:

The referenced letters indicate the acceptance of Project NO-281, entitled "Camel", by the NDRC and the assignment of this project to Division 3, NDRC.

Division 3 accepts this project. Through the medium of a copy of this letter, forwarded to Professor E. C. Watson, Official Investigator, Contract OEMsr-418, California Institute of Technology, the Institute is requested and authorized to undertake the subject project and to carry out the necessary work by the use of facilities and personnel currently provided by CIT under Contract OEMsr-418.

Essentially, through the establishment of this project, certain of the Bureau of Ordnance facilities are made available to CIT for the purpose of prosecuting special new experimental work and of undertaking to construct, equip, staff and operate certain new facilities for experimentation at the Bureau of Ordnance station, namely, the Naval Ordnance Test Station, Inyokern. Since the research and developmental work being initiated relates to a special project of the War Department which has been assigned to the California Institute of Technology, the use of transferred Navy funds to cover any expenses created by this work is not contemplated nor authorized at this time.

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

The feasibility of writing a separate OSRD contract to provide funds for the new project work, as was requested by the Coordinator, has been discussed with the parties concerned. Captain C. L. Tyler, Chief, Research and Development Division, Bureau of Ordnance, was in strong agreement with this policy of arranging such a new contract. However, the cognizant officers of the War Department agency involved were of the conviction that the work should be handled under Contract OEMsr-418, chiefly for security reasons. Moreover, the CIT authorities definitely prefer to carry on their work under a single contract and, consequently, opposed the institution of a new OSRD contract in connection with the project under consideration. Finally, through conversations with you and with Mr. Cruikshank of the Fiscal Section, OSRD, it was made clear that difficult financial and fiscal problems would be imposed upon the contractor through the writing of a new contract. After a consideration of the various points brought forth by these discussions, Division 3 has concluded that it would be preferable to handle the matter as planned originally and hopes that its recommendation for the adoption of such a policy will prove to be acceptable to the Coordinator.

A copy of this letter will serve to authorize and direct the CIT project authorities to make the arrangements directly with Captain S. E. Burroughs, Commanding Officer, designated as one of the Bureau of Ordnance liaison officers on this project, for carrying out all of the operations under Project NO-281 which involve NOTS, Inyokern.

The direction of this work will be the responsibility of the Chief, Division 3, and of Dr. B. M. Norton, Technical Aide, Section L of this division.

Sincerely yours,

Frederick L. Hovde
Chief, Division 3

FLH:GLH:epo

CC: Coordinator of Research and Development, Navy Department
Admiral R. S. Holmes w/cc ref. b
Dr. C. C. Lauritsen " " b
Prof. E. C. Watson " " a & b
Dr. B. M. Norton " " b
Capt. S. E. Burroughs, NOTS, Inyokern

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

Army Services Forces

UNITED STATES ENGINEER OFFICE
Manhattan District

COPY

Washington Liaison Office
P. O. Box 2610
Washington, D. C.

In Reply
Refer To

BIDM WL-1

27 January 1945.

Subject: Construction of Facilities for Project Camel at USNOTS Inyokern.

To: Captain E. L. Hanson,
Bureau of Yards and Docks,
Navy Department,
Washington, D. C.

1. In accordance with instructions contained in letter dated 11 January 1945 from the Chief, Bureau of Ordnance to the Chief, Bureau of Yards and Docks, File Ad 3, Subject: "USNOTS Inyokern - Construction on Site of Facilities for NDRC", it is our understanding that the BuDocks will arrange for such construction at Inyokern as will be required by California Institute of Technology for the prosecution of their work in connection with Project Camel.

2. The construction of the proposed plant and miscellaneous facilities will be performed in accordance with plans and specifications prepared by Cal. Tech. It is proposed that operating equipment for the plant will be procured by Cal. Tech. and installed by BuDocks under Cal. Tech. supervision.

3. Funds to cover the cost of this construction will be transferred to the BuDocks by this office rather than by Cal. Tech. as specified in paragraph 4 of the above-mentioned letter to the Chief, BuDocks. Upon receipt of validated Standard Form 1080 prepared by the Navy Department, an initial transfer of $5,000,000 will be effected by this office. If required, additional funds will be transferred upon receipt of Standard Form 1080 and a copy of the current cost estimate.

4. In accordance with our discussion with you the Corps of Engineers will issue job priority ratings covering the construction required. At such time as construction contracts or supplements thereto are awarded for the prosecution of the work, this office should be furnished information regarding the value of the work specified, the name and address of the contractor, the contract number, completion date specified and a very brief description of the work to be performed. Upon receipt of the above information

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

Lt. to Captain K. L. Hanson 27 January 1945

preference rating certificates assigning an AA-1 rating to cover the work to be performed will be issued by this office to the contracting firm concerned and forwarded to them through BuDocks. This office will also obtain special priority ratings, directives, and allocations when required by Navy contractors to eliminate any possible delay to the progress of the construction. Every effort is being made to conceal the War Department's interest and connection with this work and it is therefore requested that all details relating thereto be handled accordingly.

5. It is our understanding that BuOrd has advised BuDocks that this construction carries the highest priority, as its completion by the earliest possible date is of utmost importance to the war effort.

A. C. Johnson
Major, Corps of Engineers.

cc: Dr. Hovde.

COPY

NAVY DEPARTMENT

~~CONFIDENTIAL~~

BUREAU OF ORDNANCE

NP36
(Ad3)

Washington 25, D. C.

17 March 1945

From: The Chief of the Bureau of Ordnance.
To: The Chief of the Bureau of Yards and Docks.

Subj: Naval Ordnance Test Station, Inyokern, California - Construction of facilities for Project CAMEL.

Ref: (a) BuOrd ltr NP36(Ad3) of 13 Jan. 1945 to BuDocks.

Encl: (A) CO, NOTS, Inyokern Conf ltr NP45/LA Ser 144 of 15 Jan. 1945.
(B) War Dept Memo to Chief, BuOrd 14 Feb. 1945 (conf).
(C) War Dept Memo EIEM WL-12 to Chief, BuOrd of 2 Mar. 1945 (conf).
(D) War Dept Memo to Chief, BuOrd of 3 Mar. 1945 (conf).
(E) Copy of procedure proposed by War Dept for construction of Project CAMEL.

1. In reference (a) the Chief of the Bureau of Ordnance requested the expeditious construction of an explosive casting plant for the Office of Scientific Research and Development and authorized the construction and operation of this plant on land available at the Naval Ordnance Test Station, Inyokern, California. Reference (a) also made certain recommendations regarding the preparation of construction plans and the procedures to be followed in approval of plans and other construction matters

2. The construction of the explosive casting plant and certain temporary facilities for testing the products of this plant has been started and some items are completed. Representatives of this Bureau, War Department, Commanding Officer, and the Bureau of Yards and Docks have discussed procedures to be followed in future construction.

3. The following is the desire of the Chief of the Bureau of Ordnance in the matter:

(a) The development of the plans for the facilities should be worked out directly between the War Department and the Bureau of Yards and Docks with reference to this Bureau only as indicated in (b) and (d) below.

(b) The schematic plans and layouts of structures involving explosives not already cleared

NAVY DEPARTMENT

BUREAU OF ORDNANCE

~~CONFIDENTIAL/RD~~

NP36
(Ad3)

Washington, 25, D. C.

17 March 1945

Subj: Naval Ordnance Test Station, Inyokern, California - Construction of facilities for Project CAMEL.

- -

shall be submitted to the Chief of the Bureau of Ordnance for review of their safety features and with relation to their effect on the safety of other facilities at the Naval Ordnance Test Station, Inyokern, California.

(c) Approval of construction using funds furnished by the War Department shall be given direct by the War Department or their designated field representative to the Chief of the Bureau of Yards and Docks or their designated field representative.

(d) Construction of facilities other than the explosive casting plant proper and located close to or in the general area of the Naval Ordnance Test Station shall be referred to the Bureau of Ordnance through the Commanding Officer for consideration as to their effect on the construction and operations of the station.

4. Enclosure (A) is a list of facilities requested by the Commanding Officer as being required for the Project CAMEL. Enclosures (B), (C), and (D) are the War Department's approval of the construction of certain of these facilities chargeable against funds furnished the Bureau of Yards and Docks for financing the construction referred to in reference (a). It will be noted that all facilities requested by the Commanding Officer except the Yukatat Hangar and two storehouses which have been sponsored by the Bureau of Ordnance are covered in the approvals by the War Department. Action on the Hangar will be taken in future correspondence.

G. F. HUSSEY, JR.

bs
CC: NOTS, Inyokern
Capt. Firmin, War Dept
P.O. Box 2610
Washington, D. C.

012345 40119

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Address Reply To
BUREAU OF ORDNANCE, NAVY DEPARTMENT
and Refer to

COPY

NAVY DEPARTMENT
BUREAU OF ORDNANCE
Washington 25, D. C.

(Ad3b)

28 March 1945

From: The Chief of the Bureau of Ordnance.
To: The Commanding Officer, Naval Ordnance Test Station, Inyokern, California

Subj: Naval Ordnance Test Station, Inyokern - Salt Wells Valley Project - Procedure for.

Ref: (a) Conversation between Capt. J. C. Byrnes, BuOrd, Capt. Burroughs, CO, NOTS, Inyokern, and Capt. Moeller, OICC, Inyokern, of 21 Mar 1945.

1. This is to confirm the information furnished in reference (a) to clarify the administrative structure for control of the "CAMEL" Project as it pertains to the procedures to be followed in the construction of facilities. This was done to expedite the review of the facilities to be constructed; the development of plans for these facilities with regard to safety; and the final completion of construction.

2. Detailed procedures to be followed in the construction of the production, research and maintenance facilities for the "CAMEL" Project at the Naval Ordnance Test Station, Inyokern, are:

(a) Dr. C. C. Lauritsen or his accredited representative will stipulate the facilities that will be constructed.

(b) They will be undertaken should the approval of the expenditure of the necessary funds be given by the representative of General Groves in the area.

(c) The technical details of the facilities will be as required by Dr. C. C. Lauritsen or his accredited representative except that the safety features must be satisfactory to the Bureau of Ordnance as represented by the Commanding Officer at Inyokern.

(d) Common use of existing Naval Ordnance Test Station, Inyokern, maintenance and overhead facilities will be made in the development of the facilities for Project "CAMEL". Any maintenance or overhead facilities constructed specifically for Project "CAMEL" may later be subject to amalgamation with similar station facilities when such amalgamation can be accomplished without materially hampering the progress of Project "CAMEL".

3. The information given in (a), (b), (c), and (d) above is further amplified as follows:

(1) Approval of the representative of General Groves in the

area is interpreted as meaning that he is the financial representative of General Groves for the sole purpose of indicating whether or not the expenditure of funds is, in the opinion of General Groves, justified as applicable to the "CAMEL" Project and within the legal stipulations placed on these funds, such as type of construction, etc.

(2) With regard to the technical details required by Dr. C. C. Lauritsen, the decision on technical matters entering into the construction of facilities must rest with Dr. C. C. Lauritsen or his representative, since he is the technical director of Project "CAMEL".

(3) With regard to the safety features entering into the construction of facilities, the Commanding Officer is informed that the services of the Bureau's Safety Engineer will be available to him and shall be used by him in determining the safety features of the construction of items included in the project. The determination of whether safety is involved is left to the judgment of the Commanding Officer but when it has been determined to be a factor, he shall act on the advice of the Bureau's Safety Engineer.

(4) With regards to the maximum common use of maintenance and overhead facilities, it is desired that service and maintenance overhead facilities be combined with existing similar facilities in so far as will not definitely hamper the progress of Project "CAMEL". This is necessary to the proper administration of these facilities by the Commanding Officer who must exercise the strictest economy in the distribution of personnel, provision of housing, and use of transportation services. The Commanding Officer is further advised that expedience or convenience are not to be considered as adequate reason for duplicating service, maintenance or overhead facilities and such duplication can only be warranted should it definitely affect the prosecution of Project "CAMEL".

/s/ G. F. HUSSEY, JR.

bc
CC: Gen. Groves
Adm. Holmes
Dr. C. C. Lauritsen
Cal Tech
CICC, Inyokern
BuDocks

copied verbatim: ead

Address Reply to
The Bureau of Yards
and Docks

~~CONFIDENTIAL~~

NAVY DEPARTMENT

Washington 25, D. C.

C
C
P
Y

~~CONFIDENTIAL/RD~~

30 March 1945

NOy-11847
C-9

SERIAL - YD 8523

To: Officer in Charge of Construction
Naval Ordnance Test Station
Inyokern, California

Subject: N.O.T.S., Inyokern, Cal. - Construction of Facilities for Project Camel.

Reference:
(a) War Department Conf. memo to BuDocks dated 20 Mar.
(b) BuOrd conf. ltr NP36(ad3) to BuDocks dated 17 Mar. 1945.
(c) BuOrd ltr to CO NOTS Inyokern Cal.

1. Copies of references (a) and (b), clarifying procedure and responsibility for the subject project are enclosed for your information and guidance.

2. Responsibilities and authority of the Army Liaison Officer as described in reference (a) have been accepted by this Bureau. Inasmuch as the War Dept. is financing the project and since the Bureau of Ordnance has, by reference (b), no interest other than safety requirements in that portion of the project to be built at Salt Wells Valley, it is desired that type of construction conform to the recommendations of the Army Liaison Officer. However, since the Officer in Charge of Construction is charged with final responsibility for both design and construction to meet time schedules, the exact degree of permanency of construction will be determined by the Officer in Charge of Construction.

3. Reference (c), copy of which was sent to the Officer in Charge of Construction, outlines the relationship of the Commanding Officer to the other interested parties and stresses that the various interests are as follows:

(a) Cal. Tech. -- technical requirements
(b) Army -- financial considerations and speed
(c) BuOrd -- safety and station administration

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

NOy-11847
C-9

Subj: N.O.T.S., Inyokern, Cal. - Construction of Facilities for Project Camel

---

4. It is considered that all of the enclosures are consistent with one another and that the procedure to be followed will be something like this:

> CalTech (Dr. Lauritsen or his accredited representative) will ask the CinCC to prepare plans and to construct such facilities as will be required for Project Camel. This request will bear evidence of financial approval by the Army representative and site and safety consideration approval by the Bureau of Ordnance as represented by the Commanding Officer.
>
> It is suggested that appropriate approval stamps be designed and used on initiating correspondence and layout drawings.

5. Authority already given by telephone for the Officer in Charge of Construction to approve plans, specifications and locations for this Bureau is hereby confirmed. New construction may be undertaken by the Officer in Charge of Construction in accordance with procedure outlined above, without further authority from this Bureau, within the limit of funds allotted for Project Camel. It is however, assumed and requested that the Officer in Charge of Construction keep the Bureau fully informed of all work undertaken under this project and its progress from time to time. It is also pointed out that this project carries a higher priority than any straight Navy construction project and that everything possible should be done to insure its early completion.

6. The Army has advised that additional funds for the Camel Project will be made available as needed. It is requested that the Bureau be kept informed regarding the status of funds at all times, to the end that the necessary transfer of funds may be arranged by the Bureau, if and when necessary.

/s/ Kirby Smith
Kirby Smith
By direction of Chief of Bureau

Incl.
"HW" 1. Copies of Refs. (a) & (b)

2. Copies of encls. (C&D) of ref. (b).

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

~~CONFIDENTIAL/RD~~

COPY

WAR DEPARTMENT
P.O. Box 2610
Washington, D. C.

20 March 1945

MEMORANDUM FOR The Chief of Bureau of Yards and Docks,
The Navy Department.

SUBJECT: Assignments of Army Liaison Officer to NOTS - Inyokern.

1. This office has assigned Capt Joseph T. Ware to NOTS, Inyokern, to act as Army Liaison officer on all matters relating to Project Camel. He will assist in expediting materials, equipment, transportation, personnel and the like. As our representative at the site, Captain Ware will arrange for prompt issuance of all high priority ratings required to complete the work as scheduled.

2. Captain Ware will have authority to issue approvals, on behalf of the Army, for all items of construction which Cal Tech or the Commanding Officer, NOTS, Inyokern, indicate is necessary in connection with Project Camel. If it should become necessary to revise construction schedules because of changes in design or because of any other unavoidable cause, Captain Ware will have authority to approve such changes in completion dates.

3. It is intended that Captain Ware, in collaboration with Cal Tech, will determine and approve the scope and characteristics and indicate the desired completion dates of the structures and services required for Project Camel and that the Officer in Charge of Construction will accomplish their design and construction. Where supplements to existing facilities on the station proper are required, which will be financed by War Department funds, Captain Ware will approve the requirements and the Officer in Charge of Construction will accomplish their design and construction in accordance with Navy standards.

4. In accordance with arrangements made with BuOrd, it is agreed that structures and services will be designed and constructed to meet BuOrd safety requirements.

P. FIRMIN,
Captain, Corps of Engineers.

cc: Captain J. Ware

App. B-10

~~CONFIDENTIAL/RD~~

~~CONFIDENTIAL~~

APPENDIX

CONSTRUCTION REQUIRED FOR PROJECT CAMEL

NAVAL ORDNANCE TEST STATION, INYOKERN, CALIFORNIA

Development of High Explosive Production Facilities

See map of Salt Wells Pilot Plant and legend thereon.

Flight and Static Tests

Armitage Field

Extensions of Armitage Field runways, taxi strips & lighting.

Loading apron and pits.

Building for plane part storage and crews' ready room.

Assembly Area

Two assembly buildings.

One storage building and addition for parts.

One electronics building and radio tower.

One overseas type assembly building.

One temporary loading dock.

Two storage pits for live units.

Fencing

Static Test Area

One detonator firing bay with water storage and supply system for photographic development.

Two Quonsett huts.

Three storage magazines for detonators and castings

Two stations with underground camera and observation bays for test of implosive spheres with inner and outer casings.

Telephone, electric and test circuits, and roads.

Magazine Area

8 advanced base type magazines.

Housing Area

Eight 25-man dormitories

Two 200-man prefabricated barracks (erection and utilities only)

Administration Area

Eight Butler type huts 20' x 48' for offices and laboratories.

Two stran-steel buildings 40' x 100' to replace facilities used by Project Camel.

PASADENA, CALIFORNIA

Production and Inspection

Foothill Plant

Modifications for Project Camel work.

Re-arrangements required by transfer of C.I.T. rocket program by General Tire and Rubber Company.

Development of Metal & Explosive Components

1020 Green Street

Minor modifications on 2 occasions to provide office and drafting space.

1276 Colorado Street

Minor modifications to provide office space for accounting staff of Section 7.

Culbertson Hall, C.I.T.

Minor modifications to provide office space on removal of Project Camel offices from 1020 Green Street.

CIT ORGANIZATION CHART

MANHATTAN DISTRICT HISTORY

BOOK VIII, VOLUME 3, CHAPTER 2

CAMEL PROJECT

INDEX