Greenhouse # 46
Vol I

Greenhouse # 46

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SHN-1497

COMPLETION REPORT

U. S. ATOMIC ENERGY COMMISSION
CONTRACT NO. AT-(29-1)-507

ENIWETOK
PROVING GROUND FACILITIES

VOL. I

GENERAL

Classification Cancelled ~~or Changed~~
TO
By Authority of DOE
HTC 7-17-72
Name Title Date

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Date
[redacted]

HOLMES & NARVER, INC.
LOS ANGELES, CALIFORNIA

1 September 1951

[redacted]

HOLMES & NARVER
INCORPORATED
ENGINEERS
824 SOUTH FIGUEROA STREET
LOS ANGELES 17
TRINITY 8201

PLANS
SPECIFICATIONS
SUPERVISION
JAMES T. HOLMES

REPORTS
EVALUATIONS
CONSULTATION
D. LEE NARVER

U. S. ATOMIC ENERGY COMMISSION
CONTRACT NO. AT-(29-1) - 507

September 1, 1951

Manager
U. S. Atomic Energy Commission
Santa Fe Operations Office
Los Alamos, New Mexico

Dear Sir:

Presented herewith is the Completion Report covering all phases of engineering, construction, and operation of the Proving Ground facilities, Eniwetok Atoll, M. I. This report has been prepared in accordance with requirements of Contract No. AT-(29-1)-507 as set forth in Paragraph 7, Title III, Job No. 2, Article III thereof.

The object of this report is to provide a complete and detailed account of the stewardship of Holmes & Narver, Inc., as Architect-Engineer-Construction-Management Contractor for the Eniwetok Proving Ground; to make a careful evaluation of the work performance; and to present conclusions and recommendations which may be of value to the Atomic Energy Commission, to Holmes & Narver, Inc., or to any other participants in future projects of a similar experimental nature.

The main body of the report is divided into four separate and complete volumes, covering the several major aspects of the Project. Volume I is intended to present, within one set of covers, a general over-all picture of the Project from an administrative and contractual point of view, and to summarize, in the form of recommendations, the lessons learned in the course of the work. Volume II covers in detail the many engineering and design activities. Volume III is a comprehensive report on the construction of base facilities, scientific structures, and military structures. Finally, Volume IV discusses the manifold collateral services - personnel, fiscal, procurement, logistics, etc. - required in support of the construction work, the test operations, and the "roll-up" immediately following.

In addition to the four volumes comprising the main body of the report, seven additional volumes containing Appendices

A through G are included in the over-all Completion Report. These seven appendices contain detailed data, such as drawing lists, specifications, basic reports, etc., supplementing the main text. Taken together, the text and appendices constitute a complete, comprehensive, documented Completion Report on all activities of the A-E-C-M Contractor in connection with AEC Contract No. AT-(29-1)-507 through June 30, 1951.

Respectfully Submitted,

HOLMES & NARVER, INC.

James T. Holmes

James T. Holmes
President

this information; writing and editing the manuscript draft of the report; preparing the illustrations; and, finally, producing the completed printed publication was a sizeable project in itself. This task, under the guidance of the Report Committee, ultimately reached into every organizational unit of Holmes & Narver, involving every key man both at the Home Office and at the Jobsite. No stone was left unturned in the effort to make this report not only a complete factual record of all activities under the Contract but also a guidebook for use in avoiding pitfalls in future experimental projects of this kind.

A detailed outline of the Completion Report, prepared after compilation and thorough study of all available data, was completed on May 11, 1951; the outline was approved by AEC representatives on May 26, 1951; and the first rough draft of the body of the report was ready on August 1, 1951, in time to be of use to the Examination Committee of the Atomic Energy Commission, Washington, D. C., who arrived at Holmes & Narver's Home Office on that date.

FOREWORD

This Completion Report on the engineering design, construction, and operation of the Eniwetok Proving Ground cannot be said to have had its beginnings on any particular date. Throughout the course of the Project, the top-level management personnel of Holmes & Narver, Inc., were acutely aware that Paragraph 7, Title III, Job No. 2, Article III, of the Contract stated: "Prepare a Completion Report for the Project within 90 days after completion of test operations." Because of the continually expanding scope of the work, the ever-present pressure of time, and the difficulties of communication between the Jobsite and the Home Office, it was not practicable to attempt a comprehensive chronicle of activities during the period of construction and operations. However, at every opportunity, basic data in the form of notes, diaries, logbooks, conference summaries, letter reports, memorandums, etc., were prepared, so that the final job of compiling the Completion Report would be principally one of collating and integrating these written informational units.

The final compilation of the over-all Completion Report began on March 8, 1951. On that date, James T. Holmes, President of Holmes & Narver, Inc., issued two directives: (1) a memorandum addressed to all Department Heads, establishing a Report Committee to be responsible for the final compilation and drafting of the Completion Report and directing all Departments to cooperate fully with this Committee; and (2) a memorandum to the Report Committee outlining the general policies and procedures to be followed in compiling the Completion Report.

The task of bringing together the enormous store of data accumulated during the two-and-one-half-year Project; reviewing, sorting, and digesting

VOLUME VII - SURVEYS AND LOCATIONS

Appendix B - Drawing Lists
Appendix C - Locations of Scientific Stations, Military Structures, and Buildings
Appendix D - Horizontal Control Survey

VOLUME VIII - FACILITIES AND STATIONS

Appendix E - Facilities and Stations

VOLUME IX - SPECIFICATIONS (1)

Appendix F(1) - Specifications

VOLUME X - SPECIFICATIONS (2)

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COMPLETION REPORT

ENIWETOK PROVING GROUND FACILITIES

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VOLUME I

GENERAL

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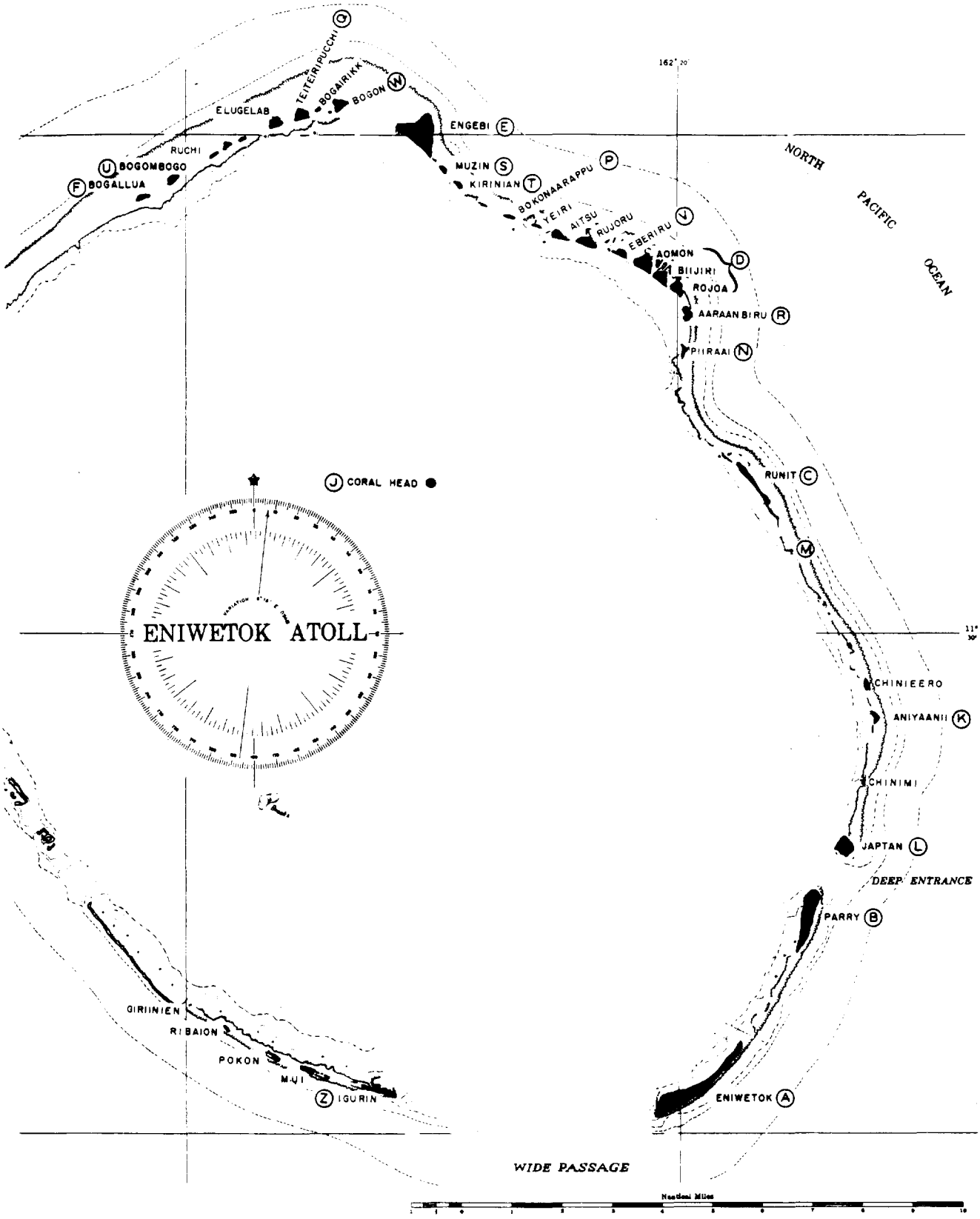
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WIDE PASSAGE
Nautical Miles

ABSTRACT

and

RECOMMENDATIONS

ABSTRACT

The record of performance of Holmes & Narver under Contract AT-(29-1)-507, from the inception of work in September of 1948 to July 1, 1951, covers the planning of a semi-permanent Proving Ground for the Atomic Energy Commission, the construction of base facilities, scientific stations, and special military test structures at the Proving Ground, and the maintenance and operation of the facilities provided during the construction phases of the Project, during the Operational Test Phase in the spring of 1951, and during the roll-up program initiated to place the Proving Ground in standby condition. It is a record of activities covering the entire gamut of services, from menial labor through those requiring highly technical competence.

In the fall of 1948, based upon the Los Alamos Scientific Laboratory's requirements for Proving Ground facilities to support the laboratory research program, authorized by a Letter of Intent issued on September 16, 1948, Holmes & Narver was requested to undertake a reconnaissance of Eniwetok Atoll, which had been used as the site of experimental detonations in the spring of that year, and to make recommendations on base facilities to be installed, the most economical construction program, and a program for operation of the Proving Ground during test periods. This reconnaissance was immediately undertaken and, on January 7, 1949, a comprehensive report was submitted by Holmes & Narver to the Manager, Santa Fe Office, Atomic Energy Commission.

A master plan concept consistent with the criteria established by the Atomic Energy Commission representatives was proposed. The estimate of cost of construction of the proposed facilities was slightly over $14,000,000. The report pointed out in detail the factors connected with overseas construction, and particularly construction at Eniwetok Atoll, which would have a material impact on the cost of the programs proposed. These factors included, among others, the cost of logistic support, transportation of personnel, materials, and equipment from the West Coast to the Atoll, intra-Atoll water and air transportation in support of activities at the many separate locations within the Atoll, housing and feeding of Jobsite personnel, climatic conditions affecting both personnel and equipment, and the flexibility required by the scientific nature of the installation.

After due consideration, authority to proceed with planning and construction in accordance with the recommendations of the report was issued and, in February 1949, the first group of Holmes & Narver personnel started for Eniwetok Atoll to establish a beachhead from which the construction program could expand. The work to be performed by the beachhead group included the rehabilitation of war-weary existing structures for occupancy by the construction forces to follow, in order to avoid the costly step of building a series of construction camps throughout the Atoll. It was planned that, by utilizing such space as could be made available at a minimum rehabilitation cost, these structures would be occupied during the initial phases of the construction and that as the

semi-permanent facilities planned for the Atoll were constructed they would be occupied by the Holmes & Narver construction and operation forces. This plan was followed through the life of the Project.

Engineering design activities were initiated immediately upon receipt of the authorization to proceed and thus created a second objective for the beachhead forces, the collection of data required by design forces in Los Angeles.

The third of the significant objectives of the beachhead group involved the determination of methods for reducing the radiological hazard which existed at the three sites of earlier atomic weapon detonations on the Atoll.

From this beginning, the Project expanded; new scientific programs were added to those originally contemplated, involving the activiation of new sites, radical increases in population estimates, and the two-fold increase in the estimated cost of construction to be accomplished. A new operational philosophy was established which increased the population of Eniwetok Island, which had been reserved for military purposes, from 600, as originally planned, to an ultimate total well in excess of 2100. The first of the major increases in scope occurred in July 1949 and concerned the preparation of facilities for an animal breeding colony, laboratories, and living quarters on Japtan Island.

By August of 1949, the need for radical changes in the capacities provided on Eniwetok Island was apparent from early discussions with the Joint Technical Planning Committee, the forerunner of Joint Task Force -3. At this same time, the Military Structures Program was being discussed in a tentative way; design engineering for this program was being performed under the direction of Department of Defense Agencies by groups other than Holmes & Narver. The complete requirements of the program were not firm, but in view of the presence of its construction and operating organization at the Atoll, the desirability of having Holmes & Narver perform the construction work was clear. During the fall and winter of 1949, much was done to make firm these increases in work.

In order to minimize the cost to the government, the decision was made to utilize the services of a Construction Battalion for the construction of a substantial portion of the facilities required on Eniwetok Island. All design work was to be performed by Holmes & Narver, and procurement of specified materials and equipment required for the program was also a Holmes & Narver responsibility.

By January 1, 1950, increases in scope of the scientific stations program were apparent. Experiments which had originally been planned were being frozen and the facilities which would be required were already beyond the tentative estimates made in the spring of 1949. In addition, changes in the world situation, reflected in changes in the program of the Los Alamos Scientific Laboratory, established the need for additional scientific programs and technical facilities to be constructed at the Proving Ground.

The impact of all of the above changes is illustrated in the accompanying chart, in which it is shown that the scope of construction at the Atoll was essentially doubled and that this doubling took place at a time which left only six to nine months for completion of all of the construction required. In any event, this impact was absorbed, the rescheduling required was accomplished, and the required construction completed in time to accommodate the scientific personnel and task force personnel arriving early in 1951 for operations during April, May, and June.

Design engineering went forward steadily from the inception of work and reached a peak in January of 1950 when almost 10,000 manhours were expended on master planning, design of base facilities, utilities, towers, and scientific stations. Approximately 1350 active drawings were issued to the Construction Department. More than 300 drawings were completed but were voided or held in abeyance due to changes in requirements. More than 1800 revisions were required on active drawings during the course of the Project, and although no records were kept of the number of preliminary drawings and sketches received by the Engineering Division, it is estimated that the total involved ran into many thousands. It was in engineering design that the first impact of all changes was felt, inasmuch as it was the responsibility of this division to make provision for programmatic changes in all of the elements affected. Thus, when scientific stations for newly conceived experiments were added to the design engineering work load, care had to be taken that power requirements could be met by design capacity, that population increases could be taken care of by the housing, mess, and fresh water facilities provided, and similar considerations.

Many special problems of design were dealt with. Rapid corrosion and deterioration of substantially all materials occurred in the tropical atmosphere prevalent at the Atoll. Materials to be employed in construction required careful selection to minimize corrosive effects and the electrolytic action encountered in the salt water laden atmosphere. Capacities of power and water distillation plants were of prime significance and required considerable study, rearrangement, and increase, as the Project grew. In fact, it might be said that the keynote of much of the master planning and detail design engineering reflected a flexibility factor which made possible at a minimum capital investment a considerable portion of the expansion ultimately encountered.

Soil investigations were carried out by Holmes & Narver to the extent necessary for the design of the various facilities and stations required. Thus, for example, special investigations were needed in connection with the foundation designs of the massive tower complex at Eberiru. Large paved areas were required as stabilization around the zero towers and many of the structures and stations on the experiment islands. Original plans called for hot mix asphalt paving, but in order to ascertain the most economical paving method, extensive tests were conducted which ultimately led to the choice of Bitumuls as the binding medium. Other special problems were resolved in the designs of the scientific stations, water and sewer systems, power generation and distribution systems, telephone communication systems, piers and causeways for the various islands, dehumidification, air conditioning and refrigeration, and the many other features of construction involved in the Proving Ground establishment.

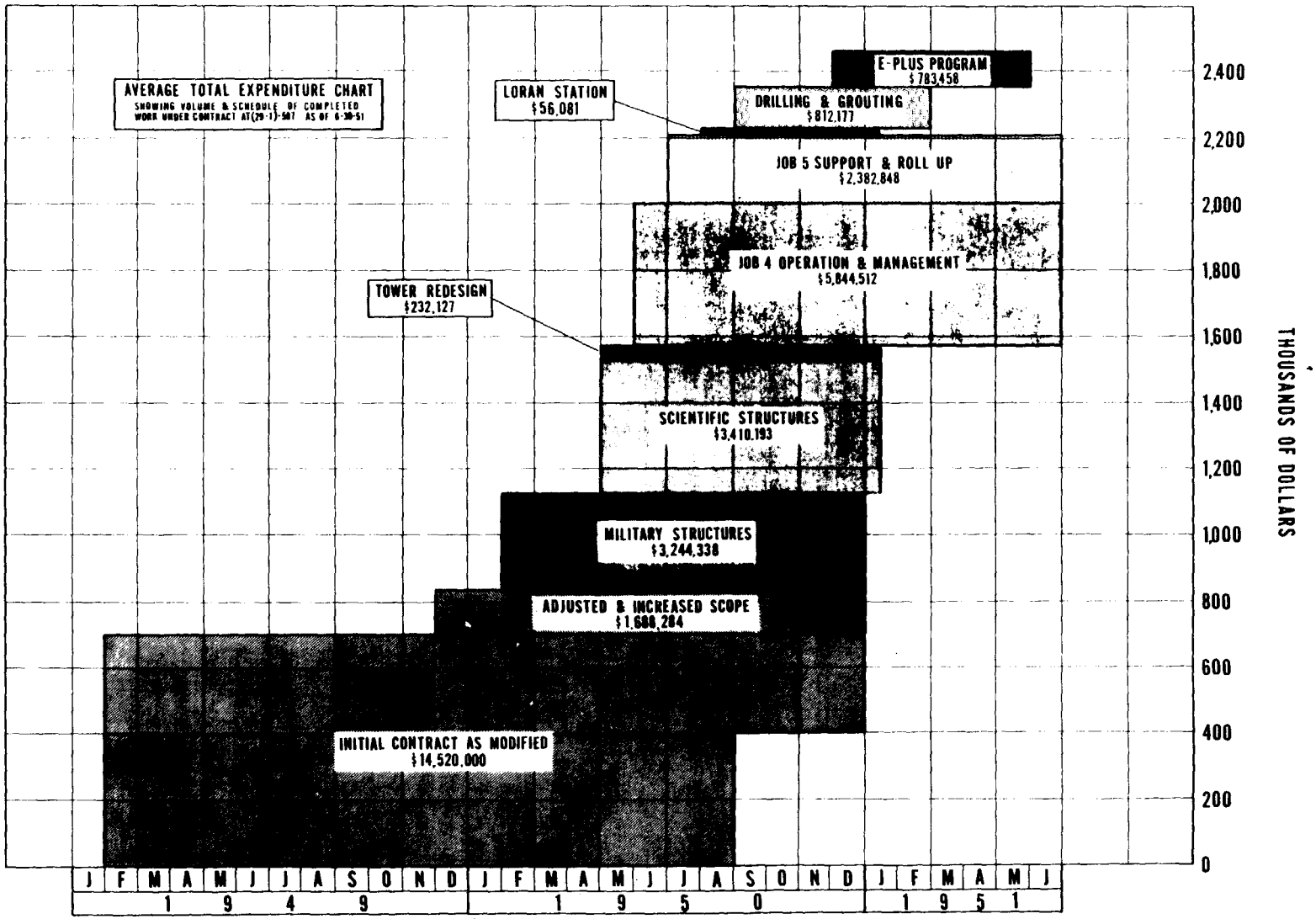


Chart of Average Total Expenditures

Several volumes of purchase order specifications covering material and equipment and construction specifications were prepared and submitted to the AEC. In the case of purchase order specifications, approval was sought prior to purchase. Copies of construction specifications were forwarded to the AEC substantially simultaneously with forwarding to the Jobsite Engineering Department for turnover to construction. Close liaison with Using Agencies was established by the Engineering Division at a very early date and contributed greatly to expediting designs and construction.

In connection with the Military Structures Program, the H & N Engineering Division had not participated in design and was not in a position to contribute to the interpretation of drawings prepared by other groups, because criteria for the drawings were unknown. However, inspection responsibility on these structures, just as in the case of structures designed by Holmes & Narver, was carried by the Jobsite Engineering Department to assure Construction Department compliance with plans and specifications. It should be noted that the basic organization established by H & N at the beginning of the Project and carried through in substantially the same form throughout the Project provided for the necessary checks and balances to assure unbiased performance of all phases of the work in the best interests of the government. Prime responsibility for the operational and construction phases of the Project was assigned to the Holmes & Narver Operations Division. Responsibility for design and field engineering, when authorized, was carried by the Engineering Division operating independently of the Operations Division. Likewise, the H & N Fiscal Division provided an independent monetary check on all activities under the Contract.

Close coordination of the various divisions involved was accomplished through frequent periodic meetings of the responsible division and department heads of all divisions, both at the Home Office and at the Jobsite. Internal reports on daily, weekly, and monthly bases provided current information on all activities to the organizational groups and personnel concerned. The special requirements of the Military Structures Program could be fitted readily into this organizational structure. Thus, even though H & N had not design responsibility, the Home Office Construction Department, under the Operations Division, assured the flow of necessary information to the Jobsite for execution.

Unfortunately, the channels for obtaining approval on the many shop drawings covering fabricated components and the like were somewhat lengthy. Furthermore, it was recognized at an early date that although H & N had an inspection responsibility in connection with the Military Structures Program a gap existed in the engineering services required. This gap became apparent when representatives of the Department of Defense determined that foundation conditions in Structure 3.1.1 on Engebi Island were not satisfactory. As a consequence, a soils expert was retained as a consultant by the AEC and the Department of Defense Agencies concerned, to investigate the condition and to make recommendations. The recommendations made included a program for intrusion grouting under and in back of the structure in question, and Holmes & Narver was directed to supply

support to such a program under the supervision of experts from an organization holding patents on intrusion grouting methods and materials and under the direction of the AEC consultant. The force account services thus required were rendered, and the AEC consultant submitted reports on the results.

The grouting program service is an example of the many ramifications of the construction program which must be considered as a whole in order to permit the proper evaluation of the accomplishments. In this regard, consideration should be given to the following relevant statistics:

UTILITIES

General Trenching	100,655 lin ft
Sanitary Sewer Lines	39,580 lin ft
Water Lines	103,570 lin ft
Water Distillation Facilities	262,000 gal per day capacity
Water Storage	220,000 gal capacity
Power Generation Facilities	28 generators, cap 555 kw
Overhead Power Distribution	271,000 lin ft
Underground Power Distribution	101,750 lin ft
Submarine Power Cable	26,200 lin ft
Transformer Installations	295
Poles for Electrical Distribution	445
Telephone and Public Address Overhead Lines	475,240 lin ft
Submarine Telephone Cable	598,500 lin ft
Submarine and Underground Control and Signal Cable	1,889,900 lin ft
Submarine and Underground Fuel Lines	8,160 lin ft
Piers and Ramps	11

BUILDINGS AND STRUCTURES

Military Structures	26
	83,300 sq ft
Towers	6 75 ft
	2 200 ft
	2 300 ft
Scientific Stations	More than 700
Base Facilities	
Aluminum Buildings, etc.	440,550 sq ft
Tents	198,844 sq ft

MISCELLANEOUS

Blading and Shaping	892,700 sq yd

Asphalt Paving	381,180 sq yd
Concrete	
Coral Concrete	27,265 cu yd
Limonite Concrete	1,210 cu yd
Steel	
Reinforcing Steel	1,240 tons
Structural Steel	1,760 tons
Forms	164,915 sq ft
Material and Supplies handled	53,620 tons (approx)

Another significant factor which must be considered is that with respect to construction, estimates of costs submitted to the AEC total $26,437,410, including the costs of engineering and fees, and as of June 30, 1951, the incurred cost was $24,746,657, including engineering design and fees. It might be noted as well that after the submission of the Reconnaissance Report in January of 1949 it was determined that the estimate of cost therein included indicated that costs of construction at Eniwetok would be approximately two times the cost of construction of comparable facilities on the West Coast of the United States. A study carried out during July of 1951, based upon the cost incurred up to June 30, 1951, shows that the average overseas multiplier lies between 1.8 and 2.1 for the Project as constructed. It should be noted, however, that a multiplying factor in this range would not necessarily apply to specific items of construction requiring unusual construction techniques, material, or equipment.

To support activities at the Jobsite during the construction phases and during the operational phases, a number of auxiliary functions were required. Mess halls were operated at five island sites and aboard a modified LCT used as a transient construction base; power and water distillation plants were maintained and operated to supply the power required for base facilities and scientific uses and the fresh water consumed or used in connection with the operation of certain scientific facilities; a boat pool including tugs, barges, water taxis, LCM's, LSU's, and a variety of other small boats was operated within the lagoon; 24-hour telephone service was provided to more than 700 subscriber lines; medical and dental services were provided; recreation facilities of all types furnished; and more than 1100 Work Orders were executed in direct support of scientific operations.

To make all of the above overseas activities possible, complete supporting services were provided through the Home Office organization. These latter services included recruitment of personnel, procurement of all materials, inspection of fabricated components, expediting services to assure on-time delivery at the Jobsite, and transportation services. It might be noted in connection with transportation that the use of military air transport service facilities was maximized. While at times

personnel were backlogged at Honolulu or Travis Air Force Base awaiting transportation to the Jobsite, the cooperation rendered by all concerned was of material importance in the ultimate accomplishment of the work. All surface transportation of personnel and materials to the Atoll was limited to government-furnished vessels. Of the many thousands of tons of freight shipped by this means, the major difficulty encountered was a direct result of the outbreak of hostilities in Korea at the end of June 1950. Immediately following this event, paramount needs of the military services for available shipping space were recognized and, for a period of approximately 60 days, shipping space for materials urgently needed at the Jobsite was not available. The effect this had was to require rescheduling of construction activities to make use of construction materials on hand. Thus, though a small amount of time was consumed in the redeployment of construction forces occasioned by rescheduling, no standby time was incurred on the basis of material shortages or for other reasons.

In order to indicate the flexibility required throughout the program to accommodate the changes imposed, it is interesting to note that five modifications were issued to the Letter of Intent and that thirty modifications to the Definitive Contract were executed as of June 30, 1951. Of these modifications, four summarized the many changes in the scope of work; and the rest gave clarifications of contract terms, obligations of funds, and similar matters.

As of the date of this report, the Project has reached the standby phase. Roll-up activities are well advanced, although certain operations cannot be scheduled in view of existing radiological hazards. Cyclic maintenance programs are under way.

RECOMMENDATIONS

During the course of the work by Holmes & Narver, from September 1948 through June 30, 1951, under Contract AT-(29-1)-507, certain factors were seen to have a controlling effect on all phases of the work. Some of these factors were recognized in the Reconnaissance Report as influencing the cost of operations at Eniwetok Atoll. However, experience indicates that the magnitude of the effect can be diminished and it is with this end in view that the recommendations in the following paragraphs are submitted for consideration.

SCOPE OF WORK

The semi-permanent facilities at the Proving Ground are now a reality. They have been tested under operational conditions. The various significant capacities of installed and standby facilities are well known and should serve as the basic criteria for further operational utilization. However, for future test operations, new scientific stations will unquestionably be required and, as certainly as developmental change is an indicator of progress, the scope of the construction program embodying such stations will be subjected to change. An A-E-C-M type of contract provides the flexibility needed to absorb the impact of sudden changes and yet permit meeting rigid deadline dates. However, maximum effort should be applied to the definition of a firm construction program at an early date in order to allow sufficient time for the normal processing of procurement, personnel required for construction, and the actual construction itself. Changes made very late in the program are costly. The performance of major, complicated construction work at Eniwetok Atoll, 5000 miles from the West Coast of the United States, on a crash basis, is not economical.

SECURITY

In view of the scientific nature of the establishment at Eniwetok Atoll, and the important bearing which the work done there has on the national security, it is clear that maximum protection should be afforded to the information available at the Proving Ground. On the other hand, it must be realized that the security requirements imposed, at least during construction phases, have an important bearing on the efficiency and cost of construction. In the years since the beginning of World War II many hundreds of thousands of construction and engineering personnel have received some type of security clearance for work on classified projects. Only a very small percentage of such cleared personnel are willing to undertake employment at an isolated, off-shore location such as Eniwetok, and of that small number, fewer still are willing to stand by without compensation to await reinstatement of their clearances. In the case of high-caliber, manual employees willing to undertake overseas employment, the waiting period required for security clearance is a serious drawback. It is strongly recommended that the security requirements for clearance of personnel required during the construction phases of future programs should be reevaluated or, alternatively, that the availability of clearance

checks which can be rapidly accomplished should be explored.

TRANSPORTATION

The transportation services and support supplied to this project by MSTS and MATS are important factors in the ultimate success achieved. The cooperation of service personnel in allocating space and expediting the movement of Holmes & Narver freight and personnel to the Jobsite was at all times maintained at a high level. However, in view of the planning difficulties inherent in the accomplishment of a program characterized by necessary changes in scope, the importance of auxiliary transportation services should not be underestimated. Likewise, such auxiliary services are essential in meeting emergency situations such as were encountered at the outbreak of hostilities in Korea. While the contract provides in Article XXIX:

> "2. It is the intention under this contract in order to effect economies in the work specified, where practical and feasible in the judgment of the AECM contract, to utilize military aircraft, ships, boats, and vehicles of the Armed Forces. If, in the opinion of AECM contractor, such utilization is impractical or not feasible, they will initiate procurement of transportation or negotiate therefor through such other sources as may exist."

approval was not granted on contractor requests to permit utilization of other sources of transportation support. It is appreciated that this problem has many ramifications. On the other hand, it is recommended that the possibility of establishing at least one auxiliary source of surface and air transportation support should be explored.

LIAISON

In the planning, construction, and operation of an installation such as the Eniwetok Proving Ground, the requirement for close liaison between all participants is clear. Frequent periodic meetings of senior AEC and AECM contractor staff personnel for the purpose of frankly discussing current problems and plans are essential to good working relationships and efficient performance. Furthermore the presence at the location of design work and at the Jobsite, of senior, scientific personnel during design and construction of scientific stations, coupled with complete knowledge on the part of such persons of the requirements, is important in expediting construction in accordance with the needs of particular experiments. Such liaison was provided in connection with the construction of a few of the more complicated scientific stations and provided the precedent upon which the recommendation is made that direct, on-site liaison with scientific personnel, subject to the supervision of senior AEC representatives, should be effected.

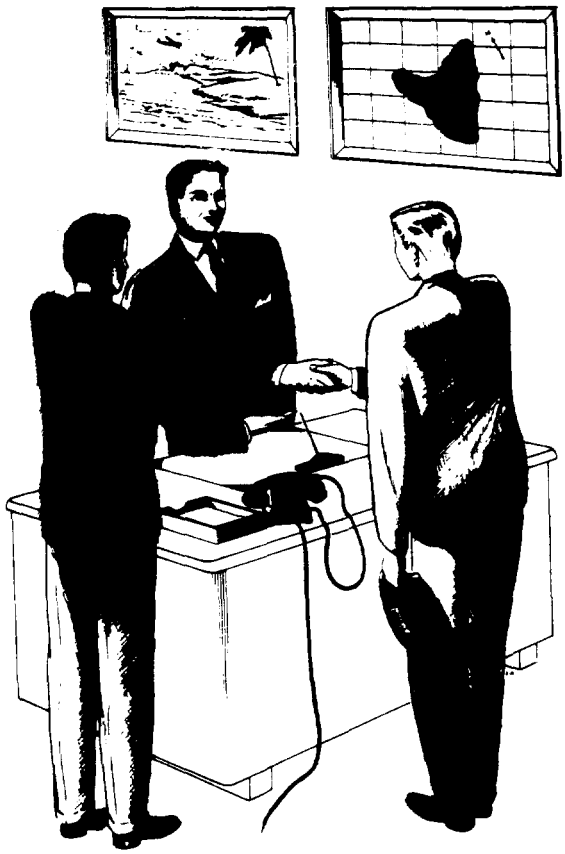
SUPPORT ACTIVITIES

Many factors contribute to the efficiency of performance of assigned tasks by Jobsite personnel. Adequate intra-atoll surface and air

transportation is essential in maintaining a close-knit, well-scheduled construction operation. In addition, the rates of pay offered, extra benefits introduced as incentives, food and lodging at the Jobsite, recreational facilities provided, all contribute to the calibre of personnel induced to undertake reasonably long term employment at this isolated site. It will be noted that the wages provided under approved schedules were somewhat less than the existing wage scale in the Los Angeles area. A bonus incentive for completion of contracts made up part of the wage differential and served also to reduce the turnover of cleared personnel. A further part was made up by the provision of realistic support of construction activities in the form of good food, adequate housing, and the provision of a well rounded recreational program. Labor turnover statistics indicate a lower than normal turnover rate experience in the more than two years of Holmes & Narver stewardship. This experience is submitted as the basis of the recommendation that the support services provided during the construction phase of future programs at the Proving Ground should not be less than the support provided in the past.

Section 1

INTRODUCTION



CHAPTER 1.1

PURPOSES OF THE CONTRACT

At the time of Operation Sandstone in the spring of 1948, a decision was reached by the Atomic Energy Commission that full-scale test activities would be a definite part of the future program of the Los Alamos Scientific Laboratory. It was decided, too, that if a proving ground was to become a regular adjunct of the laboratory it would be necessary to develop semi-permanent facilities for use in these tests. An additional decision was made that a single engineering firm would be engaged to carry out the entire engineering and construction program for these facilities.

In accordance with these decisions and after investigations of several possible sites, Eniwetok Atoll was selected by the AEC as the site for the new semi-permanent proving ground. Eniwetok Atoll had first been used as an atomic weapon proving ground in tests carried out by Task Force Seven during Operation Sandstone. In that operation, four of the islands of the Atoll - Runit, Aomon, Biijiri, and Engebi - were used as sites, but the operations had been mainly ship-based and did not require the construction of extensive permanent or semi-permanent facilities. Upon completion of the operation, only a small military garrison remained on the Atoll to provide security against unauthorized intruders.

It was on the basis of these decisions that preliminary conversations were held between representatives of the U. S. Atomic Energy Commission and Holmes & Narver at Los Alamos early in September 1948.

The discussions at these meetings were initially directed toward the establishment of Holmes & Narver's background and experience in overseas areas, particularly in the Pacific area; in dealing with scientific personnel; and in designing and developing technical installations of various types. Additional inquiry was made into the capabilities of the firm with respect to master planning, site planning, and design and development work in the relevant engineering fields. Experience of the firm in construction and management problems was also discussed.

After these matters had been treated, discussion was turned towards the planning of the work to be undertaken and the general purposes of the proposed engineering and construction. These were summarized in a prospectus[1] which was given to Holmes & Narver representatives during these initial meetings. This prospectus stated, in part:

> "The general philosophy of the engineering and construction program for the forthcoming tests will be for J-Division to engage one engineering firm to carry out the entire engineering and construction program. The first phase of this program will consist in ascertaining the approximate requirements by conferences with J-Division, and then making an engineering study or

[1] LAB-J-491, September 8, 1948.

analysis of the requirements. This study will involve visiting the Atoll and examining the various possibilities of accomplishing the construction. (Since four steel towers, 250 feet high, will be required for the tests, it is expected that design drawings and procurement of steel and electrical and mechanical components for the personnel elevator and main hoist can be accomplished by an early date.) A report covering the engineering study and preliminary recommendations for the construction will then be submitted to J-Division and decision made regarding the construction. It is hoped that the engineering report containing the recommendations can be submitted to J-Division approximately one month after the visit to the Atoll.

"The second phase of the engineering program will involve making detailed design drawings of the installations, procuring materials, and doing the construction work. The engineering firm will be expected to be responsible for performing all the construction specified in the contract. In the event they subcontract some or all of the work, they will be expected to be responsible for the work; that is, they turn over to J-Division a finished job with mechanical and electrical machinery in working condition.

"The third phase of the engineering program involves participation of the engineering firm during the tests, to the extent that they will furnish technicians required for operating diesel-electric plants, air conditioning units, water distillation units, ice and refrigeration machinery, and communications equipment."

In this prospectus, criteria were also established for the following features of construction:

1. Inter-island communication
2. Electrical power
3. Housing
4. Refrigeration
5. Water supply
6. Experiment Island camps
7. Headquarters buildings
8. Inter-island causeways
9. Landing piers

In addition to the base facilities noted above, it was understood that (aside from the "zero" towers) the structures required for the

various experiments to be carried out at the Proving Ground would be supplied as the experimental programs became firm. In other words, it was acknowledged that the establishment of the Proving Ground as a semi-permanent installation required that base facilities be constructed initially, and that thereafter the scientific structures would be designed and built as integral parts of the scientific phase of the program because the characteristics of such structures would be intimately related to the experimental procedure established. The towers, on the other hand, were deemed to be the type of facility which could be designed and fabricated at an early stage of the work because their characteristics would not wholly depend on the detailed measurement program ultimately decided upon.

It should be noted at this point that the employment of Eniwetok Atoll as a site for future operations depended, of necessity, upon the radiological decontamination of the islands used for Operation Sandstone and upon considerations of logistic support raised by the remoteness of the site. Thus, in the light of these factors, the phases of work to be undertaken were limited until all of the relevant fundamental problems of this type could be resolved.

It was therefore decided that, while the philosophy of the undertaking was as documented in LAB-J-491, quoted above, the work immediately to be undertaken would be the following:

1. To conduct a preliminary reconnaissance and study of the Eniwetok site to determine information necessary to formulate a construction program.

2. To recommend suitable types of permanent and temporary construction.

3. To prepare reports covering master planning, site planning, utilities, and structures, together with a definitive construction program, time schedule therefor, and a cost estimate thereof.

As a result of these discussions, a Letter-of-Intent covering this phase of the work and formally authorizing Holmes & Narver to proceed was prepared at the close of the meetings. The Letter-of-Intent, which was issued on September 16, 1948, carried the number AT-(29-1)-507 which was ultimately given to the Definitive Contract covering Architect, Engineering, Construction, Maintenance, and Management services for and at the Eniwetok Proving Ground. A copy of the Letter-of-Intent is reproduced at the end of this volume (Exhibit A).

CHAPTER 1.2

INTERESTED AGENCIES

The development of the Proving Ground within the objectives outlined in Chapter 1.1 was to be carried out under the auspices of the Atomic Energy Commission through its Santa Fe Operations Office headquartered at Los Alamos, New Mexico. The Division Leader of J-Division (Full-Scale Weapons Tests) of the Los Alamos Scientific Laboratory was responsible for the technical direction of activities at the Proving Ground. (See SF Bulletin 122 reproduced in Figure 1.2-1.) These offices thus represented, at the outset, the agencies of primary interest.

At the time of the September meetings of the representatives of the Santa Fe Operations Office, the Los Alamos Scientific Laboratory, and Holmes & Narver, only a relatively few groups outside of the Atomic Energy Commission were definitely scheduled to participate in the experiments planned for 1951 under the control and direction of the Los Alamos Scientific Laboratory. These were the Naval Research Laboratory, Naval Ordnance Laboratory, Ballistics Research Laboratory, Edgerton, Germeshausen & Greir, Inc., and the National Bureau of Standards. In addition, military participation was considered likely; however, its extent was not firm beyond the knowledge that military support would be necessary at least for security, inter-island liaison plane transportation, and drone aircraft operation.

As the planning for the 1951 operation moved forward, the extent of the scientific program increased substantially. The approval of Program 2 (Bio-Medical Program, requiring the activation of Japtan island as a camp, laboratory, and animal colony) was followed in due course by the approval of Programs 3 through 8, expanding the list of participating groups to include a number of agencies of the Department of Defense. The ultimate full extent of the military scientific programs involved still other Department of Defense agencies and groups as well, but this participation did not require the major efforts associated with Programs 2 and 3.

The final rounding-out of the list of participants in the scientific program occurred concurrently with changes in the emphasis in the program of the LASL at the end of 1949, when the plans for the tests to be carried out in 1951 were modified in order that data pertinent to thermonuclear research could be obtained. This change required an extensive revision of many aspects of the operation. the construction of a new tower of somewhat different design from those already procured; the installation of more than 170,000 feet of special rigid coaxial cable; and a substantially increased amount of support during scientific operations. As a result of this change, a second group from the Naval Research Laboratory and a group from the University of California Radiation Laboratory were added to the list of participants.

In all, approximately 78 different groups participated in the scientific program and were concerned, through the offices of the AEC and the

FOR OFFICIAL USE ONLY
ATOMIC ENERGY COMMISSION
Santa Fe Operations Office

BULLETIN
SF-122

ORGANIZATION AND MANAGEMENT
Delegations of Authority

Administration of Contract No. AT(29-1)-507, Holmes & Narver, Engineers

FOR: Santa Fe Operations Office:
Staff Divisions and Branches
Chief, Los Angeles Procurement Office
All Field Managers
Director, Los Alamos Scientific Laboratory
Holmes & Narver, Engineers

1. The subject CPFF contract with Holmes & Narver, Engineers, Los Angeles, California, provides for Architect-Engineer-Construction-Management services in connection with work the Atomic Energy Commission is performing at the AEC Proving Grounds at Eniwetok Atoll, Marshall Islands. Because the contractor's engineering and administrative offices are in Los Angeles and the site of the work itself at Eniwetok, it automatically becomes difficult to administer the contract and supervise operations thereunder. Conflicting instructions are rectified slowly at best and may lead to delays in construction. Long distance telephone tolls may become excessive as a result, and no single person or group knows the complete story of what is going on under the contract. Stringent budget limitations and procedures make necessary a correspondingly close surveillance of the contractor's over-all operations, particularly since the contract is the CPFF type. As a consequence, this Bulletin delineates definite responsibilities for administration and supervision of the contract, as outlined below.

a. Technical Construction and Operational Supervision: By letter dated November 5, 1948, from the Manager, SFO, to the Director, Los Alamos Scientific Laboratory, and the Director's reply dated November 26, 1948, it was agreed that Dr. Alvin C. Graves, Division Leader, J-Division would represent the AEC in all matters pertaining to technical, construction, and operational matters at the proving ground. It was further agreed that an AEC-employed assistant to Dr. Graves would be assigned. In accordance with this agreement Mr. P. W. Spain, Assistant to the Director, Office of Engineering and Construction, SFO, is hereby designated as assistant to Dr. Graves, to assist in any way possible in engineering, construction, and administrative matters, and to place at the disposal of Dr. Graves and his staff the AEC facilities available through the SFO.

b. Correspondence and Records: All incoming correspondence pertaining to the contract, regardless of the addressee, will be routed to Mr. Spain, Office of Engineering and Construction, SFO, who will, in turn, forward the correspondence to the division or person appropriate for necessary action. Outgoing correspondence, regardless of signature,

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FIGURE 1.1-1. Bulletin SF-122

(Paragraph 1-b, continued)

will be routed through Mr. Spain before dispatching. It will be his responsibility to see that informational or action matters are brought to the attention of parties concerned, and to resolve and eliminate any conflicting instructions to the contractor. In order to eliminate delays in routing to and from J-Division, J-Division will establish a messenger service at such intervals deemed necessary between the Office of Engineering and Construction and J-Division. All correspondence records shall be maintained by J-Division except original contract documents and related papers which will continue to be maintained in the Contracts Division, SFO. J-Division will maintain the records in such order that they may be returned to SFO records in toto upon termination of the contract.

c. Procurement and Property: Within the above delegation to Mr. Spain the scanning of the contractor's procurement program for equipment, materials, and supplies is assigned to Mr. Harry S. Allen, J-Division, Los Alamos Scientific Laboratory, as is the case of other J-Division contractors. It will be Mr. Allen's responsibility to keep abreast of the contractor's procurement program in order to be certain on behalf of the AEC that the program is the reasonable minimum necessary to prosecute the work. Requests of this contractor for procurement assistance or for Government-owned equipment or materials will be channeled through Mr. Allen to the Supply Division, SFO, and in addition, he will maintain all property records as required by the AEC.

d. Fiscal Matters: J-Division is charged with the responsibility of budgeting for the proving grounds program and will furnish such information and assistance as may be required to the Budget Division, SFO. Contract auditing and cost accounting will continue to be the responsibility of the finance Division, SFO.

e. Personnel, Security, Safety, and Legal Maters: The Personnel and Organization, Security, Safety and Fire Protection, and Legal Divisions will furnish such action, assistance, and advice as may be requested by J-Division or the Office of Engineering and Construction on those matters relating to these respective fields.

2. A spirit of mutual cooperation and assistance is enjoined upon all parties concerned and will be of inestimable value in the successful prosecution of the contract, particularly because of the out-of-the-ordinary administrative procedure, distances involved, and the urgency of the program.

3. This Bulletin is effective as of September 1, 1949. Bulletin SF-41 is being amended to include designation of Mr. Spain as Contract Representative for the Holmes & Narver contract.

Carroll L. Tyler
Manager

Issuance Date: September 15, 1949

FIGURE 1.1-1 (Continued)

Scientific Director, with the various services performed by H & N forces at the Proving Ground, at Honolulu, and on the West Coast of the United States. Among the principal agencies involved were the following:

Program 1. AEC Los Alamos Scientific Laboratory Experiments

Armed Forces Special Weapons Project
Ballistics Research Laboratory (Army)
Edgerton, Gemeshausen, & Grier, Inc.
National Bureau of Standards
Naval Ordnance Laboratory
Naval Research Laboratory - H
Naval Research Laboratory - K
Sandia Corporation
University of California Los Alamos Scientific Laboratory
University of California Radiation Laboratory

Program 2. Bio-Medical Experiments

Air Materiel Command (Air Force)
Bureau of Medicine (Navy)
California Institute of Technology
Naval Medical Research Institute
Naval Radiological Defense Laboratory
Oak Ridge National Laboratory

Program 3. Military Structures Experiments

Air Materiel Command (Air Force)
Armed Forces Special Weapons Project
Bureau of Yards & Docks (Navy)
Office of the Chief of Engineers (Army)
Sandia Corporation

Program 4. Cloud Physics Experiments

Armed Forces Cloud Research Laboratory

Program 5. Radiological Detection Device Experiments

Air Materiel Command (Air Force)
Bureau of Aeronautics (Navy)
Naval Radiological Defense Laboratory
Office of Chief Signal Officer (Army)

Program 6. Physical Tests & Measurements

Ballistics Research Laboratory (Army)
Bureau of Aeronautics (Navy)
Chemical Warfare Service (Army)
Naval Radiological Defense Laboratory
Office of Quartermaster General (Army)

Program 7. Air Force Experiments

AFOAT

Program 8. Blast Studies on Aircraft

Air Materiel Command (Air Force)

Section 2

PRELIMINARY PHASE

CHAPTER 2.1

THE RECONNAISSANCE SURVEY

Shortly after the issuance of the Letter-of-Intent on September 16, 1948, plans were made for the departure of a group to conduct the preliminary reconnaissance of the site. The departure date was soon established as October 1, 1948, with an itinerary including, in addition to Eniwetok Atoll, conferences at Headquarters, Commander-in-Chief, Pacific Fleet; at Headquarters, 14th Naval District; and at the Naval Operating Base, Kwajalein. Arrangements and clearances for the trip were made through the Navy, and travel was accomplished by military air transport under Department of the Navy orders.

The H & N personnel in the reconnaissance group were five "Q"-cleared engineers whose backgrounds, experience, and fields of specialization were particularly relevant to the undertaking. Three of the five had been connected with the extensive master planning, site planning, and design engineering project just completed by Holmes & Narver at Okinawa. Three representatives of the Los Alamos Scientific Laboratory, including the engineering liaison representative of J-Division, completed the group.

The party arrived at Eniwetok on October 4 (local time). Upon arrival, conferences were held with staff officers of the military garrison on Eniwetok in order to brief them on the objectives of the survey group and in order to arrange for further meetings during which required information could be elicited. Arrangements were made at this time for transportation by air and by small boat to the various islands of the Atoll.

In view of the original thinking that all activities would be centered on Eniwetok Island (see, for example, Paragraph I (B) LAB-J-491), and that this site would serve as the location of the AEC headquarters building and main camp site, a detailed study of existing facilities and development potentials of this island was scheduled as the first order of business. A map showing existing structures and their condition was developed, and details concerning the various structures were observed and noted for later reference. Inventory was taken of materials and equipment in various warehouses and an attempt made to determine the property rights in them. The mode of living of the garrison and its manpower potential for supporting construction personnel, for providing inter-island transportation, and for supplying communication and other services, were determined in meetings with garrison personnel.

In order to acquaint the members of the reconnaissance team with the over-all picture of the Proving Ground and the inter-relationship of the various land masses in the Atoll, a sweep of the Atoll by air and surface craft was carried out. This was done during the early stages in order that the later investigation of each of the islands would be carried out on the basis of the relationship between each particular island and the other islands. This was considered necessary in determining the most economical construction plan and the maximum utility of the master plan involved.

Voluminous notes were taken by all members of the party on subjects of general interest relevant to the objectives of the reconnaissance and in the fields of specialty represented by the several members. Condition of equipment and structures, maintenance problems, and environmental effects on all items of construction were all matters which received full treatment. The ultimate decision to use aluminum as structural material and siding had its source in detailed notes on the corrosion effects on various materials at the scrap airplane dump on Eniwetok island.

Following the substantial completion of the detailed investigation of Eniwetok Island, a detailed investigation was made of the islands used for operational purposes during the Sandstone tests: Engebi, Aomon-Biijiri, Runit, Aniyaanii, Parry, and the Coral Head. Existing structures were examined. The condition of the various islands, including the radioactivity level, amount of debris, condition of stabilizing media employed during Operation Sandstone, location of potential aggregate quarries, existence of insect life, and many other related subjects were covered. Soundings were taken between and adjacent to the various islands in order to develop the necessary information for causeways. Currents within the lagoon were investigated for the purpose of determining further causeway information, future pier locations, and locations of sanitary sewer outfalls. Survey monuments from the BOWDITCH and JTF-7 surveys were recovered to the extent necessary to determine the task faced in later surveys.

One of the more important objectives of the reconnaissance team was the examination of sites for a fourth experiment island; therefore a considerable amount of data was developed on Bogombogo and Bogallua as potential "zero" points. Wind directions were studied, soundings were made, currents were determined, information was obtained on the permanence of the sand spit associated with Bogallua, and other physical measurements were recorded. Also, potential sites for temporary camps were examined. All in all, sufficient data were accumulated to warrant a decision.

While these detailed studies of the operational islands were being carried on, tests were made of installed underwater cables used for control and signal purposes during Operation Sandstone. These tests involved locating and cleaning terminals at the various operational sites and checking conductivity and insulation resistance. Further tests were carried out on surplus cable in storage at Parry Island. After determination of the usability of this cable, arrangements were made to move it to covered storage.

Having completed the study of the potential of the various sites and the condition of the facilities existing on each of them, the party departed from Eniwetok Atoll on October 17, 1948, for further conferences at the Naval Operating Base, Kwajalein. At this installation, meetings with staff officers were productive of considerable information on logistics problems, on environmental effects, with particular emphasis on corrosion, on criteria for base facilities of an advance base type; and on many other related subjects. Departure from Kwajalein took place on

October 17, and the party arrived at Honolulu on the following day. Here, further meetings were held with officers of Cincpac staff, Fourteenth Naval District Public Works Office, and Usarpac. Details of the operation of various units of installed equipment employed during Operation Sandstone were discussed, and the recommendations of the various officers responsible for phases of the Sandstone support were noted. Other discussions of a preliminary nature dealt with the establishment of operating and logistic procedures. These discussions produced many important pieces of information for the planning of the proposed project. Details of the amount of support that could be expected were made known to the reconnaissance group, and suggestions on the channels to be followed in arriving at agreements to meet such requirements were noted.

The party returned to the United States on October 22 and immediately began the task of collating the data accumulated. The development of the master plans for the Proving Ground, for the program of construction, and for operations during test periods followed rapidly. Meetings were held during November and December with AEC and J-Division personnel in order to obtain the formulation of the necessary broad policies and detailed criteria. The final draft of the Reconnaissance Report was completed late in December 1948, and issued on January 7, 1949.

CHAPTER 2.2

DESCRIPTION OF SITE

Although the entire Reconnaissance Report of January 7, 1949, is presented in Appendix A of this report as a necessary part of the documentation of engineering, construction, and operations at the Proving Ground, the description of the site as it was at the time of the reconnaissance merits summarization at this point as an orientation for the discussions of specific problems and activities.

NATURAL CONDITIONS

Eniwetok Atoll is a typical coral atoll, located at the northwestern extremity of the Marshall Islands and forming a roughly circular chain of islands 22 nautical miles in diameter. It is situated about 4500 nautical miles from Los Angeles, with Honolulu at approximately the halfway point between the two.

The islands along the westerly side of the Atoll were found to be low in elevation and usually submerged at high tide. The easterly half consisted of a number of emerged islands of varying sizes, covered with coral sand, and approachable at all tides. The entire Atoll perimeter is a shelf-like coral reef dotted with projecting irregular masses of hard coral around and between the islands. On the ocean side and on much of the lagoon side, this shelf dipped abruptly into deep water; however, in a few places on the lagoon side, sandy beaches formed a transition into the deeper water. On the ocean side, a line of breakers marks the edge of the shelf, several hundred feet out from the shores. It was learned that there are two navigable entrances to the lagoon, one of which is suitable for most deep water vessels. With the exception of a few coral shoals, the lagoon is navigable for all ordinary purposes.

Coconut palm trees and varying degrees of underbrush covered most of the islands, although some of the islands had been entirely denuded of vegetation during the war or during Operation Sandstone.

The weather was found to be typically tropical, very humid and fairly uniform in temperature, averaging around 80°F. Because the Atoll lies in a tradewind area, there are frequent rains in periodic squalls, rather than any regular rainy season.

Flies and small night-flying insects were found to be numerous throughout the Atoll, and control of flies was a continuous health problem. On Parry, Runit, Aomon, and Engebi, insect life was especially profuse.

HOUSING FACILITIES

The military garrison of about 80 men on Eniwetok Island, occupied a few of the remaining serviceable buildings on the island. Practically all of the sheet metal buildings constructed during World War II and

rehabilitated for Operation Sandstone were found to be rapidly deteriorating, and only a relatively small number was considered worthy of rehabilitation. Capacity of the garrison to expand its complement was very limited, not only in housing, but in repair facilities and warehousing. Buildings on Parry Island were found in a similar state of deterioration, and other islands had virtually no usable buildings, although on Japtan and other islands some ammunition storage hutments were intact.

MARINE STRUCTURES

For most of the major islands, including all of the experiment islands and bases of supply, short stub piers had been constructed to permit the loading and unloading of craft of relatively shallow draft. These were in poor repair. At Parry, a small craft marine railway was found in poor condition, the rails partially embedded. A sheet steel pile solid-fill causeway between Aomon and Biijiri Islands was in good condition, although it had been considerably attacked by corrosion. Lack of island approaches sufficient for oceangoing vessels indicated that off-loading of cargo by lighter would be necessary.

PAVING AND AIRSTRIPS

The area surrounding the zero tower on Engebi had been paved, but the broken and crushed condition of this paving pointed to the necessity of a comprehensive study of different types of paving and their ability to withstand blast effects and heat. On Eniwetok Island, there were roadways ranging from dust-alleviation type to light surface paving.

There were airstrips in varying degrees of repair on six important islands. The main strip, which furnishes connection with the outside world, was on Eniwetok Island. This was 6400 feet long, with a coral surface in smooth and serviceable condition. The one on Parry was rough, and nearly half its length was grassy. The Aniyaanii strip was 40 x 630 feet, extending clear across the island. It had a steel mat surface, but was not in favor with pilots who felt that it was too short. The Runit airstrip was located about 50 degrees off wind, presumably to get the 40 x 800 foot strip on the narrow island. It seemed to be rapidly deteriorating. The Biijiri strip was found to be poorly surfaced and rather short; grading had been partially completed for a parallel and somewhat longer strip. The airstrip on Engebi had a coral surface satisfactory for operations, but had poor drainage.

COMMUNICATIONS

A considerable amount of submarine cable existed between the operational islands, and some cable was on hand in open storage. Terminals of all cables were in serviceable condition and, although cable landings were exposed to sea action and were considerably scoured, the cable system appeared usable, subject to electrical tests.

TOWERS

Four 75-foot steel towers were in existence, one each on the islands of Aniyaanii, Parry, and Eniwetok, and one in the lagoon. It was thought that with proper maintenance they could serve through the contemplated tests as photographic towers. The Parry control tower used during the Sandstone experiments was re-usable.

EXPERIMENT ISLAND EQUIPMENT

Special equipment in some of the concrete buildings on experiment islands survived the blast. Scientific instruments had been removed. Air conditioning units were partially dismantled, but, in many cases, were capable of rehabilitation. The experiment towers had largely disappeared, with only occasional fragments of steel left on the concrete foundations. The tops of the foundations were badly shattered, either from the blast itself or from possible security demolition.

OTHER EQUIPMENT

Outworn and discarded equipment and machinery from the preceding operation and from war-time activity at the Atoll were much in evidence. On the southerly end of Runit a large number of landing boats in poor condition had been beached. Parry Island appeared to be a veritable graveyard for all kinds of rolling and stationary equipment, only a small portion of which could be classified as salvageable.

SURVEYS

Survey data from the JTF-7 survey preceding Operation Sandstone proved to be undependable because of deformation. Large areas near the zero towers were apparently depressed considerably, invalidating any benchmarks; and some triangulation stations were ruined. New surveys would therefore be necessary through the Atoll.

RADIOACTIVITY

The reconnaissance party found some radioactivity in evidence on all islands used in the Sandstone Operation. Work in contaminated areas was limited accordingly, by considerations of daily radiation tolerance doses and normal precautions against personnel contamination.

BLAST EFFECTS

The devastating effects of the Operation Sandstone tests were revealed in the wreckage on and near the experiment islands. On each of these islands was found scattered debris from earlier camps and experimental structures. This was especially true on Engebi, where the reconnaissance party found mangled corrugated iron and other structural parts from various service structures, camp buildings, and abandoned equipment. The area within a radius of approximately 1000 feet of the detonation point on each experiment island was practically denuded. There were no weeds growing in these areas, although heavy growths of weeds were in evidence elsewhere on the islands.

CORROSION

One of the most important findings of the reconnaissance group was the pronounced deterioration of all quonset type buildings and equipment as the result of climatic conditions. Rusting of ferrous material exposed to tropical salt air and sea spray was to be expected, but at Eniwetok Atoll this action appeared to be so excessive that the reasonably economical procurement of more durable building material for construction purposes became a prime problem involving prolonged study and discussion between the various agencies concerned in the prospective new tests.

CHAPTER 2.3

RECONNAISSANCE RECOMMENDATIONS

Twenty-eight basic recommendations were made in the Reconnaissance Report. It is notable that, of these twenty-eight recommendations, twenty-six were approved by the AEC and were either followed completely or varied in only minor detail. The two remaining recommendations related to the use of hot mix asphalt for roads and paved areas, and to the reorientation of the Sandstone gamma buildings. In connection with the first of these, it might be noted that later research and tests at the Atoll revealed substantial economies possible through the use of bitumuls; on the subject of the gamma buildings, the experimental procedures established for the 1951 tests did not involve the utilization of these buildings as had been originally contemplated.

The basic recommendations contained in the report are as follows:

1. That the engineering design should be accomplished in the Zone of the Interior to facilitate liaison with the Laboratory at Los Alamos and with supply sources.

2. That immediate occupancy of the site by small advance engineering and construction forces would be desirable and economical.

3. That the period of time for construction should be spread to limits consistent with sound planning and with the then scheduled experiment target dates.

4. That Parry Island should be developed for a construction camp and later converted to headquarters island for the scientific operations.

5. That Eniwetok Island should be reserved for use and exploitation by the military.

6. That the existing garrison facilities on Eniwetok should be rehabilitated and maintained.

7. That camps should be established on each experiment island except Aomon-Biijiri, for which the camp should be established on Rojoa Island, and that a causeway should be constructed between these islands.

8. That the Island of Bogallua should be designated as the site of a fourth experiment island, should a fourth experiment be desirable for testing and research.

9. That a maximum use should be made of Zone of the Interior fabrication to reduce "on the site" labor to a minimum.

10. That the use of corrosive-resistant materials in the construction of non-expendable items would be justified.

11. That concrete, except concrete for gamma buildings, should be made from coral aggregate produced locally.

12. That triangular-type guyed towers, 300 feet high, should be used for the zero towers.

13. That existing gamma buildings should be reorientated for the new tower height by tilting.

14. That sea water should be distilled to provide for all potable uses and for limited domestic service.

15. That small plants throughout the Proving Grounds should be used for generation of power.

16. That permanent, protected enclosures should be provided for power plants adjacent to timing buildings and living camps on experiment islands.

17. That overhead distribution of electrical power should be used on Eniwetok and Parry Islands and in the living camps on or adjacent to the experiment islands.

18. That a local system of telephones, backed up by a radio system, should be installed for inter-island communication and that these systems of communications should be operated by civilian personnel. That dependence should be placed upon the military for the necessary communication connecting link with locations outside of Eniwetok Atoll.

19. That permanent horizontal and vertical control surveys should be established.

20. That existing submarine control and signal cables should be re-tested periodically during construction.

21. That hot-mix asphaltic paving should be used for the areas surrounding zero towers and for airstrips.

22. That asphaltic road-mix surfacing should be used for frequently traveled roads.

23. That asphaltic road-mix surfacing should be used for the stabilization of zero line and other areas for the purpose of reducing the amount of dust.

24. That existing piers near the south end of Eniwetok, the north pier on Parry, and piers on Runit, Aomon, and Engebi Islands should be repaired and reconstructed.

25. That new piers should be constructed near the north end of Eniwetok, near the airstrip on Parry, at Rojoa, and at Bogallua if that island was to be used.

26. That new fuel storage and submarine receiving lines to deep water should be provided.

27. That sheet aluminum alloy should be immediately allocated for building construction.

28. That the entire program of planning, design, construction, operation, and maintenance could best be accomplished under a single contractual agreement covering all phases of the program.

CHAPTER 2.4

RECONNAISSANCE REPORT COST ESTIMATES

The estimated cost presented in the Reconnaissance Report of January 7, 1949, were developed on the basis of the recommendations given in Chapter 2.3. In preparing these estimates, due consideration was given to all of the factors which affect overseas construction in a remote location such as Eniwetok. Time consumed in travel, the cost of transportation of personnel, materials, and supplies; equipment usage under the abnormal conditions existing at the Atoll - all these were taken into account.

For the purposes of this Completion Report, a study has been made of all of the items of work contemplated in the estimate presented in the Reconnaissance Report as compared with the actual costs incurred during the course of the Project. The results of this study are presented in tabulated form in Table 2.4-1.

Although variations exist between predicted costs and those actually incurred on particular units of work involved, the similarity of the totals is significant when one remembers that costs were affected by a supervening war, by increases due to continually expanded and changing requirements, and by other factors. It should be noted that it was necessary to arrive at an adjusted total of the Reconnaissance Report estimate by deducting for government-furnished transportation and equipment in accordance with the formulas established during the course of the Project. (See Section 3, "Contract History.") These deductions were necessary inasmuch as such deductions are reflected in the actual unit costs incurred. Furthermore, the amount established in the Reconnaissance Report for the Bogallua site (which was not activated beyond initial grading) was subtracted from the total given in that report.

TABLE 2.4-1. COMPARISON OF ESTIMATED AND ACTUAL COSTS OF ITEMS ORIGINALLY CONTEMPLATED IN RECONNAISSANCE REPORT

Item No.		Recon. Rept. Direct Cost	Recon. Rept. Indirect Cost	Recon. Rept. Direct & In-Direct Cost	Deduction For Govt.-Furnished Transportation	Deduction For Govt.-Furnished Equipment	Total Recon. Rept. Net Cost Including Bogallua	Total Recon. Rept. Net Cost Without Bogallua	Unit	Rec. Rept. Quantity	Incurred Unit Cost June 30, 1951	Total Incurred Cost Applied to Recon. Rept Quantity
1	Blade, Shape, & Stabilize Area	583,600	286,500	870,100	None	166,700	703,400	676,500	Sq. Yd.	620,700	1.04	645,528
2	Asphalt Paving											
	Test Areas									145,600	1.22	177,600
	Airstrip	1,657,500	813,700	2,471,200	262,900	249,400	1,958,900	1,883,900	Sq. Yd.	16,900	2.45	41,405
	Roads									163,400	2.45	400,330
3	Dust Palliative	80,400	39,200	119,600	25,000	2,200	92,400	88,900	Sq. Yd.	163,400	.06	9,804
4	Causeway Biijiri To Roja	179,600	88,000	267,600	7,000	19,000	241,600	232,400	Each	1	---	215,660
5	Shot & Photo Towers	201,300	98,700	300,000	9,700	9,000	281,300	270,500				
	75-ft.								Each	6	31,578.00	189,470
	300-ft.								Each	3	290,244.00	870,731
6	Buildings & Tents	2,950,900	1,448,800	4,399,700	285,000	84,800	4,029,900	3,875,700				
	Bldgs.								Sq. Ft.	293,700	13.04	3,876,792
	Tents								Sq. Ft.	389,000	2.49	256,984
	Tent Slabs								Sq. Ft.	99,600	.50	49,800
7	Refrigeration Plant & Accessories	225,900	110,800	336,700	6,000	1,900	328,800	316,200	Cu. Ft. Plant	11,050	12.77	141,108
8	Water Facilities	1,312,000	644,100	1,956,100	36,900	28,400	1,890,800	1,818,400	(Distilled) G.P.D.	111,000	7.29	809,170
9	Sewers	428,800	210,400	639,200	8,800	9,700	620,700	596,900	L. Ft.	55,500	12.24	679,320
10	Fuel Facilities	502,400	246,600	749,000	22,900	32,000	694,100	667,500	Bbl. Plant	17,000	10.72	182,122
11	Electrical Facilities	757,700	371,900	1,129,600	34,700	32,200	1,062,700	1,022,200	KW	2,630	510.61	1,342,904
12	Telephone System	1,047,300	514,100	1,561,400	31,700	111,600	1,418,100	1,363,800				
	Submarine Cable								L. Ft.	579,300	1.45	839,203
	Instruments								Distribution Phones	290	934.90	271,121
13	Control & Signal System	302,200	148,300	450,500	10,100	26,500	413,900	398,000	L.S.	1	---	1,260,750
14	Radio Backup System	33,200	16,200	49,400	500	600	48,300	46,500	L.S.	1	---	20,606
15	Public Address System	5,500	2,600	8,100	200	100	7,800	7,500	L.S.	1	---	986
16	Furniture	109,600	53,700	163,300	1,300	1,100	160,900	154,700	L.S.	1	---	165,629
17	Equipment	113,600	55,700	169,300	1,300	1,100	166,900	160,500	L.S.	1	---	762,038
18	Pier Construction	418,000	205,100	623,100	12,400	96,700	514,000	494,300				
	Pontoon Type								Each	5)		
	Mole Type								Each	4)		897,245
19	Special Shot Island Bldgs.	92,500	45,300	137,800	23,100	3,100	111,600	107,300				
20	Phase I Field Work	196,500	96,400	292,700	5,300	15,200	272,200	261,800	L.S.	1	427,010.00	427,010
	TOTAL	11,198,300	5,496,100	16,694,400	784,800	891,300	15,018,300	14,443,500				14,533,306

Section 3

CONTRACT HISTORY

CHAPTER 3.1

CONTRACT NEGOTIATIONS

The basic philosophy underlying the formulation of the contract for the development of the Proving Ground indicated the desire of those charged with the development to engage a single firm to carry out the engineering, construction, and operations required. The logical preliminary to the formulation of a Definitive Contract required considerable study and analysis as well as the evolution of major policies. The first step was implemented by the Letter-of-Intent, dated September 16, 1948, which obligated $125,000 and authorized the reconnaissance of the Eniwetok Atoll site and the preparation of master plans, recommendations, and estimates for construction. In addition, the Letter-of-Intent provided, in effect, that, contingent upon agreement between the Atomic Energy Commission and Holmes & Narver, the latter would produce such designs, specifications, and material lists as would be required to facilitate the purchase of materials, supplies, equipment, and structures necessary for the construction program.

Upon the completion of the first step, the reconnaissance, and upon the submission of the Reconnaissance Report, it was anticipated that it would be possible to define the extent of base facilities required and to execute a formal contract. However, after careful study of the data obtained on the reconnaissance, and before the issuance of the Reconnaissance Report, it was recognized that the base facilities which would be recommended would be extensive and would require a substantial expenditure. This was made known to AEC and J-Division personnel during meetings in November 1948, and policy decisions were seen to be necessary before the contract negotiations were advanced. Such policy decisions were made, the scope of activities to be recommended in the Reconnaissance Report fixed, and by late December of 1948, it was possible to discuss, with representatives of the AEC Office of Construction and Engineering and J-Division, the details of the plan which would be presented and the general schedule of engineering, construction, and operation activities to be proposed.[1]

As a result, a Memorandum of Understanding, substantially summarizing the negotiations to date was executed on December 21, 1948. (A copy of this Memorandum of Understanding is reproduced as Exhibit B at the end of this volume.) This agreement is significant in that it established the developmental nature of the undertaking, and the broad scope and varied nature of the work. In the Government's interest, the agreement set a general time schedule on major phases of the construction work to be performed, and established a Cost-Plus-Fixed-Fee Contract as the vehicle to provide funds for performance. The scope of work covered by the Memorandum of Agreement was to a great extent that which ultimately appeared in the Definitive Contract. It covered principally the design and construction of base facilities and operation of the facilities through the

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[1] AEC letter LAB-J-509, November 29, 1948.

test period scheduled for the spring of 1951. The dearth of information of the scientific structures is noteworthy in view of the ultimate inclusion of some eight hundred scientific stations, ranging in complexity from simple stake markers to complicated collimator-limonite-shielding-recorder station combinations.

Thus, as of December 21, 1948, a tentative agreement had been reached, subject to approval by the Atomic Energy Commission, Washington, D. C. The following adaptation from Schedule I of the Memorandum of Understanding indicates the planned scope of the work as of its issuance on December 21, 1948:

DESIGN: OVER-ALL SCOPE

1. Tower design and orientation.

2. Utilities.

   a. Water supply
   b. Sewerage
   c. Power plants and distribution
   d. Communication
   e. Cable installation and maintenance

3. Housing.

4. Gamma buildings tube reorientation.

5. Aggregate and fill sources.

6. Grading of tower areas.

7. Paving.

8. Piers.

9. Causeways.

10. Field surveys.

11. Miscellaneous buildings.

CONSTRUCTION: OVER-ALL SEQUENCE OF STEPS

1. Field surveys.

2. Additional cable tests.

3. Maintenance until construction time.

4. Procurement.

5. Initial construction crew to build camp and for No. 8.

6. Shipping of men and materials.

7. Interim construction program.

8. Rehabilitation of existing buildings at Atoll (?) Airstrips (?).

9. Proection of cable landings.

10. Ultimate construction program.

CONSTRUCTION: PHASE I, FEBRUARY 1949 TO JULY 1, 1949

1. Establish resident engineer at site.

2. Grade Engebi, Aomon, and Runit for radioactivity safety.

3. Clear and grub Bogallua, if selected as fourth site.

4. Maintain airstrips (remove weeks, reshape and blade, roll and water surface).

5. Remove condemned buildings from Eniwetok and Parry.

6. Sustain the garrison's facilities to care for fifty guests.

7. Control insects on Eniwetok, Parry, Aniyaanii, Rojoa, Runit, Biijiri, Aomon, Muzin, Engebi, Bogombogo, and Bogallua.

8. Give protective coatings to the three 75-foot towers.

9. Make land survey (triangulation, mapping, design data).

10. Test cables.

11. Repair and maintain heavy equipment and boats.

12. Perform initial procurement.

13. Perform causeway protection work.

CONSTRUCTION: PHASE II, JULY 1, 1949 TO DECEMBER 1, 1949

1. Assist in Eniwetok garrison power supply maintenance.

2. Assist in Eniwetok garrison water supply maintenance.

3. Assist in Eniwetok garrison piping systems maintenance.

4. Assist in Eniwetok garrison water transportation repair and replacement.

5. Assist in Eniwetok garrison aircraft maintenance repair and replacement.

6. Assist in Eniwetok garrison land transportation repair and replacement.

7. Build construction camp with self-contained utilities (Parry).

8. Rebuild piers on Eniwetok, Parry, Runit, Aomon, and Engebi.

9. Build pier and shoot channel on Bogallua, if fourth site selected.

10. Open quarries at Rojoa, Runit, Engebi, and Begombogo.

11. Install cable landing protection.

12. Install temporary inter-island communication; use existing cable; add line to Bogallua.

13. Perform procurement for kitchen and camp equipment.

14. Perform procurement for construction material.

15. Perform procurement for construction equipment.

16. Transport equipment and materials procured.

17. Transport construction workers.

CONSTRUCTION: PHASE III, NOVEMBER 1949 TO NOVEMBER 1950

1. Construct temporary type 150-man camp on Bogallua, Engebi, Rojoa, and Runit complete with utilities, temporary power, and concrete slabs.

2. Build causeway from Biijiri to Rojoa.

3. Set up crusher, batch plant, and paving mix machine.

4. Lay cable.

5. Erect tower.

6. Rehabilitate warehouse space on Parry.

7. Construct permanent electrical distribution.

8. Construct permanent power plant or plants.

9. Construct permanent reefer plant.

10. Construct airstrip sub-base and paving.

11. Construct permanent water supply and distribution.

12. Construct permanent sewers.

13. Ship total bill of materials.

14. Perform concrete construction and build permanent buildings.

15. Purchase boats and vehicles for operating phase.

16. Complete communications facilities.

17. Pave roads and areas on Bogallua, Engebi, Aomon, Runit, and Parry.

OPERATION: PHASE IV, JULY 1, 1949 TO JUNE 30, 1951

1. Operate utilities.

2. Operate camp services.

3. Provide installation crews and equipment.

4. Perform late construction of special buildings and instrumentation.

ROLL-UP: PHASE V, JUNE 30, 1951 TO JANUARY 1, 1952

1. Salvage equipment and supplies.

2. Provide dehumidified storage.

3. Provide resident maintenance personnel.

4. Perform demobilization.

5. Provide security and radioactivity safety.

DEFINITIVE CONTRACT

The negotiations which led to the execution of the Definitive Contract included Holmes & Narver's submission of a proposed draft in February 1949. The representatives of H & N and the AEC then held a series of discussions of the detailed provisions, including those covering advance funds, reimbursement items, and reimbursible and nonreimbursible overhead. Later, in April 1949, approval of principle and details of the mechanical and procedural provisions was granted by the Atomic Energy Commission in Washington, D. C., and negotiations were entered into at Los Alamos on May 17, 1949, for the determination of the fee covering the scope of the work as it was conceived as of May 1949. (See Appendix "D" of the Contract, reproduced as Exhibit C at the end of this volume.) These negotiations were carried out between the Director of the Division of Construction and Engineering, Santa Fe Operations Office, and the President of Holmes & Narver.

For purposes of fulfilling requirements which were unknown to H & N, the total fee agreed upon was divided by the AEC to cover the various jobs

established by the Contract. The only stipulation interposed by H & N was raised with respect to the portion of the fee applicable to the performance of work in connection with the preparation of the Reconnaissance Report. This was raised in order to make provision for ease of accounting and for the contemplated change in H & N's business organization from a copartnership to a corporation. Aside from this requirement, the allocation of portions of fees was performed by the AEC. It is noted that the fee formulas established at this first fee negotiation with respect to Jobs 1, 2, and 3 were followed throughout the remainder of the fee negotiations which took place. In view of the nebulous conception of the actual amount of work which would be involved in Jobs 4 and 5, it was recognized that the formula first established would not be applicable in the event of a major increase in activities in these categories. Holmes & Narver representatives carried this philosophy into the fee negotiations which took place during the latter part of June and the early part of July 1951 on the modification covering the increase in scope of these two jobs from approximately $2,500,000 to approximately $12,500,000.

The general procedure followed in all fee negotiations was the preparation of estimates and agreement by the representatives of H & N and the AEC on the increases or decreases in scope to be covered. In practically every instance such agreements were readily reached, although the accumulation of the data for these discussions was often tedious and often required a considerable period of time. Upon agreement on the dollar value involved in changes in scope (as compared to changes in cost), fee negotiations were made. As in the first negotiation of this type, final agreement was reached in a comparatively short time.

CONTRACT MODIFICATIONS

From time to time during the life of Contract AT-(29-1)-507 various matters of substance and form in the Contract were dealt with through negotiations which ultimately resulted in modifications, reimbursement authorizations, etc. which are tabulated chronologically later in this section. The major negotiations on such items are set forth below as indicative of the many aspects of the work involved in keeping the contractual relationship between the AEC and H & N flexible to meet the changing demands of the Project.

On December 19 and 20, 1949, conferences were held with representatives of the AEC to clarify certain aspects of Appendix "D" to the Definitive Contract. The problems discussed and the actions taken are summarized as follows:

1. Although the Definitive Contract had been negotiated on the basis of the recommendations of scope and estimated costs of construction as outlined in the Reconnaissance Report of January 7, 1949, it was noted that Appendix "D" as it appeared in the Contract had incorporated some of the recommendations and additional scope of work discussed in Supplement No. 1 to the Reconnaissance Report, dated July 8, 1949, without effecting a corresponding increase in the extimated construction cost.

2. In arriving at the total estimated cost of construction expressed in Appendix "D", all of the transportation costs of materials, supplies, and equipment had been deleted on the assumption that this item constituted the cost of water transportation only, which was to be furnished by the government at no cost. By negotiation, a formula was established whereby a percentage of the total transportation cost was assigned to water transportation, and it was agreed that this percentage would thereafter be deducted from all estimates of cost which included transportation items.

3. It was decided that Appendix "D" should be revised to show estimated costs by island locations.

4. It was brought out that because the scope of the scientific structures program was not known at the time of the execution of the Definitive Contract, no provision had been made for them as a separate program.

5. Revised estimates were requested for the facilities on Japtan Island because the scope of work there had been changed after the issuance of work authorization for that program.

6. The provision of funds for services under Jobs 4 and 5 was discussed, but AEC representatives decided to take no action because the matter was to be the subject of further study.

On January 19, 1950, another meeting was held with representatives of AEC in order to clarify the items of transportation costs and equipment costs, which were distinct features of all H & N cost estimates. These items had been thoroughly checked against factual experience in order to determine what portion of transportation costs were actually being paid for out of construction funds and what portion was represented by government water transportation. Jobsite stevedoring cost was to be included as part of the transportation cost, and since H & N would do the actual Jobsite stevedoring, this item would be allowed in estimates. On the subject of estimated equipment costs, factual information was presented to show what portion of the total estimated equipment cost was covered by so-called government-furnished equipment. This information was accepted and a formula arrived at to be used in crediting future estimates for so-called government-furnished equipment. The general agreement was that all estimates should be prepared showing the full estimated transportation and equipment cost and that provisional deductions based on these formulas should be shown for government-furnished water transportation and government-furnished equipment.

On June 2, 1950, representatives of AEC and H & N met to discuss negotiations for a modification based on revised estimates which had been submitted covering all new work and increases and decreases in the scope of the work covered by the Definitive Contract. During earlier negotiations on these estimates, discussions had been based on revised estimates for each island location, including Eniwetok Island, for which revisions

had been made to account for construction of base facilities by an Army construction battalion. (See the Memorandum of Agreement reproduced as Exhibit D at the end of this volume.) The modifications effected as a result of these negotiations included work on the Loran Station, rehabilitation of warehouse on Parry Island, the AMC 8-2 program, Program 3 (military), and the instrumentation for these structures. The final results are detailed in Modification No. 7 to the Contract. The major changes in scope effected by this modification are summarized in Tables 3.1-1 through 3.1-4.

On September 27, 1950, representatives of AEC and H & N met to discuss contract modifications for fee increases for increases in the scope of the work covered by the scientific structures program. This increased scope of work was based on a summarization of cost estimates for the scientific structures submitted to AEC in H & N letter CHN-891, dated September 2, 1950, and later amended by H & N letters CHN-917, dated September 14, 1950, and CHN-932, dated September 21, 1950. As a result of this discussion, Modification No. 13 to the Contract was issued to cover construction in connection with the scientific programs. Table 3.1-5 shows the additions to the scope of the work by programs. A detailed list of items of additional scope under Modification No. 13 appears at the end of this volume (Exhibit E).

It should be noted that the design information had already been submitted, drawings prepared and approved, and construction started on many of the structures involved.

On January 4, 1951, representatives of AEC and H & N met to discuss contract modifications for increased scope of work and additional fee based on work under Jobs 1, 2, and 3, (other than the scientific structures program), which had been authorized as a result of the negotiations which brought about Modification No. 7. The list of items did, however, include some additional scientific structures which had not been covered by Modification No. 13. During the negotiations it was also brought out that on those additional items which were defined by AEC as being merely increases in the construction cost of the completed facility, H & N would be allowed the additional necessary funds but would not be entitled to additional fees on these increased costs. As an example, in the construction of one of the military structures it was necessary to place additional concrete as a fill in order to support the foundations of the building. This increased the cost of the building, but according to AEC's interpretation did not constitute a basis for increased fees. There was some discussion about this matter, for it was maintained by H & N representatives that any work not originally contemplated but later required either by field conditions or by changes in methods of construction constituted an increase in the final constructed cost of the facility and therefore called for a fee based upon the entire cost. Inasmuch as there were borderline cases falling in this category, and as some of the change in methods of construction were initiated by H & N field forces, it was finally agreed to accept certain items merely as increases in cost for the purpose of obligation of funds but not for the purpose of entitling H & N to additional fee. The items which were found to constitute increases in scope were embodied in Modification 24 and are tabulated at the end of this volume (Exhibit F).

After the completion of the January 4, 1951, negotiations and the issuance of Modification No. 24, contractual activities lagged in spite of the fact that there remained for negotiation almost 300 Field Change Orders, the construction of more than 100 scientific stations, and the increased scope of work involved in Jobs 4 and 5 which, it will be recalled, had not been changed from the token amounts included in the original Definitive Contract. Various attempts were made to resolve this problem, but in view of the high pitch of activities occasioned by the operational phase of the Project in the spring of 1951, progress was slow. The attempts made included a visit to Los Alamos on February 27, 1951, and a series of telephone conversations.

On May 11, 1951, conferences were held in Los Angeles, and between May 16, and May 29, further conferences were held at Eniwetok. These resulted in the resolution of the dollar value of all changes, including changes in cost which did not affect fees and changes in scope which did. Thereafter, and during July 1951, fees were negotiated to cover the work not covered in previous modifications and to essentially establish the final scope of work for Jobs 1, 2, and 3.

Negotiations for Jobs 4 and 5 were not entered into from the date of inception of the Contract until July 1951. The dollar amounts allocated to this part of the work under the Contract had been based upon the scope of the work, as conceived at the time of the Reconnaissance Report, and no attempt had been made to include in the Contract a definitive account of the ultimate scope of this work. It was, therefore, necessary to await more specific information concerning the scope of Jobs 4 and 5.

On May 16, 1950, H & N advised AEC that Jobs 4 and 5 were about to be activated and that revised estimates in the light of the developed scope were being prepared. On July 21, 1950, a tentative estimate for Jobs 4 and 5 totaling approximately $8,500,000 was orally transmitted. This estimate was considered to be too high, and new criteria supplied by AEC resulted in a revised estimate of slightly more than $6,500,000. This amount was reduced further when AEC representatives insisted that operations be limited to the barest essentials required to keep the Project going.

In May 1951, agreement was reached on the scope of the work, and the fees covering the work were agreed upon during meetings at Los Alamos in July 1951. Table 3.1-6 offers a comparison between token Reconnaissance Report amounts originally specified in the Contract and those negotiated in May 1951.

In all, 30 modifications were made to the Definitive Contract at various times from its issuance until June 30, 1951. As of that date, negotiations were still in progress on modifications involving $1,626,350 in increase of scope of Jobs 1, 2, and 3 and $10,022,985 in increase of scope of Jobs 4 and 5. These pending modification negotiations cover changes in scope of Jobs 1, 2, and 3 since January 1951 and changes in scope of Jobs 4 and 5 since the inception of the Contract.

TABLE 3.1-1. COMPARISON OF QUANTITIES AND COSTS
APPENDIX "D" AND MODIFICATION NO. 7

Feature	Quantities Appendix "D"	Quantities Mod. No. 7	Total Cost Appendix "D"	Total Cost Mod. No. 7
1. Aluminum Bldgs:	Sq. Ft.	Sq. Ft.		
Parry	142,400	158,520		
Eniwetok	117,100	176,818		
Engebi	11,400	9,665		
Aomon	11,400	7,780		
Runit	11,400	8,735		
Japtan	(none)	18,336		
Bogallua	(none)	1,470		
2. Tents on Frame and Concrete Slab:	Sq. Ft.	Sq. Ft.		
Parry	50,000	10,710		
Eniwetok	150,000	136,230		
Engebi	63,000	17,685		
Aomon	63,000	10,395		
Runit	63,000	10,395		
Japtan	(none)	(none)		
Bogallua	(none)	4,200		
Misc. Sites	(none)	1,200		
Extra Concrete Slabs for Tents	99,600	(none)		
Total for 1 & 2			$4,125,000	
3. Water Purification and Systems:	Gal. Per Day	Gal. Per Day		
Parry				
Distilled	45,000	57,600		
Salt	90,000	No Info.		
Eniwetok				
Distilled	45,000	115,200		
Salt	90,000	No Info.		
Engebi, Aomon, Runit, Each				
Distilled	7,000	(No data		
Salt	7,000	available)		
Japtan	(none)	8,160		
Bogallua	(none)	4,080		
Misc. Sites	(none)	(No data available)		

TABLE 3.1-1. COMPARISON OF QUANTITIES AND COSTS
APPENDIX "D" AND MODIFICATION NO. 7 (Continued)

Feature	Quantities Appendix "D"	Quantities Mod. No. 7	Total Cost Appendix "D"	Total Cost Mod. No. 7
4. Sewage Disposal Systems:		Lin. Ft.		
All Operational Islands			$ 550,000	
Parry		13,930		$ 125,625
Eniwetok		13,540		286,839
Japtan		3,000		57,620
Runit		2,500		73,280
Aomon		2,200		73,320
Engebi		2,985		73,270
Bogallua		—		—
Misc. Sites (Latrines)		(4 ea.)		2,985
5. Power and Communications:	KW	KW		
(a) Power Generation and Distribution			$1,480,000	
Parry (Max.)	300	852		$ 363,095
Eniwetok (Max.)	425	710		571,540
Engebi (Max.)	200	236		202.480
Aomon Group (Max.)	200	236		202,440
Runit (Max.)	200	236		202,460
Japtan	—	193		170,040
Bogallua	—	193		117,005
Misc. Sites (Total)	—	230		
(b) Communications			1,375,000	
Parry				
Instruments	100	185		
Switchboard	220-line	220-line		
Eniwetok				
Instruments	100	120		
Switchboard	200-line	200-line		
6. Piers & Causeways:	Ft.		$ 545,000	
Engebi	40 x 100			$ 112,670
Aomon	40 x 100			236,020
Runit	40 x 100			112,670
Parry)				112,670
Eniwetok)	Repair			79,465
Rojoa)				—
Japtan				6,600
Bogallua				218,205

TABLE 3.1-2. ITEMS ADDED BY MODIFICATION NO. 7

Item No.		Net Estimated Construction Cost
3	Japtan	$ 843,605
7	Bogallua	804,040
9	Military Structures including Instrumentation	3,484,545
10	8.2 Program	165,140
11	Loran Station	100,000
13	Job 4	1,511,000
14	Job 5	1,000,000
	Total	$ 7,908,330

TABLE 3.1-3. MODIFICATION NO. 7 INCREASE IN SCOPE OF FACILITIES INCLUDED IN APPENDIX "D"

Item No. in Mod. No. 7		Appendix "D"	Mod. No. 7	Change in Scope
2	Eniwetok	$ 5,072,140	$ 5,822,805*	$ 750,665
1	Parry)		(5,190,555)	
4	Runit)		(1,343,835)	
5	Aomon Group)	9,447,860	(1,637,500)	1,118,035
6	Engebi)		(1,405,435)	
8	Misc. Sites)		(694,370)	
12	Towers)		(294,200)	
	Totals	$ 14,520,000	$ 16,388,700	$ 1,868,700

*Includes $2,390,765 for labor furnished by Construction Battalion.

TABLE 3.1-4. SUMMARY, MODIFICATION NO. 7

Item	Estimated Cost
Appendix "D"	$ 14,520,000
Increase in Scope of Appendix "D"	1,868,700
Addn's New Scope - Mod. No. 7	7,908,330
Sub-Total	24,297,030
Less Military Labor - Eniwetok	- 2,390,765
Total Mod. No. 7	$ 21,906,265

TABLE 3.1-5. ITEMS ADDED BY MODIFICATION NO. 13

Item No.	Description	Estimated Construction Cost
15.	N.O.B.L. Program	$ 215,520.00
16.	J-7 Program	6,090.00
17.	N.B.S. Program	1,143,080.00
18.	E.G.G. Program	191,660.00
19.	N.R.L. Program	202,510.00
20.	J-3 Program	144,855.00
21.	LD-50 Program	83,840.00
22.	T-B Program	57,500.00
23.	M-D Program	16,610.00
24.	A.M.C. Program	3,600.00
25.	All Users	336,290.00
26.	U.C.R.L. and N.R.L.K Program	576,310.00
27.	O.S.C.O Program	180.00
28.	Meteor Program	7,680.00
29.	RAD-CHEM Program	57,000.00
30.	N.R.D.L. Program	1,800.00
31.	AFOAT Program	37,520.00
32.	A.C.C. Program	950.00
33.	BRL-APG Program	1,000.00
	Total Estimated Construction Cost - - - - - - - -	3,083,995.00
	Revised Total Estimated Construction Cost - - -	$22,479,260.00
	Revised Total Estimated Cost including Camp Operation, Maintenance & Management, and Support and Roll-up Services - - - - - - - - -	$24,990,260.00

NOTE: The above cost is exclusive of fees.

TABLE 3.1-6. COMPARISON OF ORIGINAL AND REVISED SCOPE OF OPERATIONS JOBS 4 AND 5

Item	Original Estimate (Jan. 1949)	Revised Estimate (June 1951)	% Increase
Number of AEC personnel to be based ashore during operations	250 Maximum	1300 Maximum	420%
Total labor to be furnished by H & N labor pool	500 Man-months	3200 Man-months	540%
Total period H & N labor pool to be maintained	5 Months	10 Months	100%
Number of mechanics and helpers to be employed in H & N labor pool	100 Average	320 Average	220%
Total labor (other than labor pool) to be furnished for Job 4 support operations (camp operation, maintenance, and management)	1250 Man-months	4671 Man-months	274%
Over-all period for Job 4 and 5 operations	8 Months	13 Months	63%
Number of support personnel (other than labor pool) to be employed for Job 4	250 Maximum	959 Maximum	284%
Total personnel to be supported during operations (design population for camps)	1800 Maximum	2802 Maximum	56%
Cost Estimates			
Job 4	$1,511,000	$ 6,894,685	356%
Job 5	1,000,000	3,172,900	317%
Total	$2,511,000	$10,067,585	301%

CHAPTER 3.2

CONTRACT CHRONOLOGY

Throughout the development of the Project, numerous changes and revisions were made to the Contract in order to keep pace with the rapidly changing and expanding requirements of the work. The extent of the changes and revisions made necessary may be grasped from a recapitulation of the changes in the scope of the work.

In addition to numerous changes to preliminary drawings, there were more than 1300 changes made to final drawings after "final approval." A great number of these were required by AEC. Beyond these design changes, a great number of field changes were required as conditions affecting construction made their impact. These changes required 329 Change Orders and 9 Extraordinary Work Orders. Furthermore, between January 1, 1951, and June 30, 1951, there were 1,123 Job 5 Work Orders for many different services rendered to the various participating agencies at the Proving Ground. These Job 5 Work Orders totaled approximately $1,700,000.

Table 3.2-1 summarizes the various changes in scope of the work made from the inception of the work under Contract AT-(29-1)-507 in September 1948 through the end of the fiscal year 1951.

During this same period, 16 notifications were sent to the AEC in accordance with the provisions of the Contract which required notification that expenditures and commitments had reached 85 per cent of the funds obligated, and 4 were sent advising that expenditures and commitments had reached or would soon reach 100 per cent of obligated funds. Table 3.2-2 summarizes the obligation of funds from the inception of the Project through June 30, 1951.

The following chronological account of the development of the Contract, its 30 modifications, and the 26 reimbursement authorizations required to correct, revise, and clarify its intent and to care for unforeseen circumstances offers details supporting and elaborating upon these statistics for changes to the Contract.

September 16, 1948 — The Letter-of-Intent constituting the base of authority for the work to be performed was issued. Provision was made that a Definitive Contract would be executed in 120 calendar days.

September 28, 1948 — Modification No. 1 to the Letter-of-Intent approved the schedule of job classifications applicable to the work to be performed.

October 13, 1948 — Memorandum (SFF-2) called attention to the fact that Letter Contract made no specific reference to a fixed-fee, travel reimbursement, salaries, overtime approval,

TABLE 3.2-1. SUMMARY OF CHANGES IN SCOPE, CONTRACT AT-(29-1)-507

Contract Item	Location or Description	Mod. 7	Mod. 13	Mod. 24 Cost	Mod. 24 Scope	Deletions from Mod.7 Scope	Additional Auth. Facilities Cost	Additional Auth. Facilities Scope	Change Orders Cost	Change Orders Scope	Sub - Totals Cost	Sub - Totals Scope	Total Estimated Contract Cost
1.	B Parry	5,190,555		34,849	537,110	(84,825)	23,075	68,130	205,435	280,455	263,359	5,991,425	6,254,784
2.	A Eniwetok	3,432,040				(67,790)	8,475		93,530	148,975	102,005	3,513,225	3,615,230
3.	L Japtan	843,605		12,570	19,270	-0-	-0-	-0-	30,010	45,290	42,580	908,165	950,745
4.	C Runit	1,343,835			5,000	(57,185)	-0-	-0-	16,090	59,470	16,090	1,351,120	1,367,210
5.	D Aomon	1,637,500		24,900	5,470	(52,265)			56,980	93,385	81,880	1,684,090	1,765,970
6.	E Engebi	1,405,435			196,105	(65,020)	-0-	-0-	16,665	328,600	16,665	1,865,120	1,881,785
7.	F Bogallua	804,040				(747,340)						56,700	56,700
8.	Miscellaneous	694,370				(266,135)			5,945		5,945	428,235	434,180
9.	Military Struct.	3,484,545		236,150	37,860				2,120		238,270	3,522,405	3,760,675
10.	8.2 Program	165,140										165,140	165,140
11.	Loran	100,000					170		100		270	100,000	100,270
12.	Towers	294,200		42,900							42,900	294,200	337,100
13.	Job 4	1,511,000						5,375,030	8,655		8,655	6,886,030	6,894,685
14.	Job 5	1,000,000						2,172,900				3,172,900	3,172,900
15.	N.O.B.L.		215,520					11,460				226,980	226,980
16.	J-7		6,090						490		490	6,090	6,580
17.	N.B.S.		1,143,080					(3,220)				1,139,860	1,139,860
18.	E.G.G.		191,660	159,990	3,635			53,560		430	159,990	249,285	409,275
19.	N.R.L.		202,510		52,980			(54,615)	1,265		1,265	200,875	202,140
20.	J-3		144,855	109,465						40,455	109,465	185,310	294,775
21.	LD-50		83,630		18,480			18,890				121,000	121,000
22.	T-B		57,500				1,940	4,900	610		2,550	62,400	64,950
23.	M-D		16,610					1,500				18,110	18,110
24.	A.M.C.		3,600				3,110	6,450			3,110	10,050	13,160
25.	All Users		336,290									336,290	336,290
26.	U.C.R.L. & N.R.L.K.		576,310		241,490		(57,465)	47,275	420		(57,045)	865,075	808,030
27.	O.S.C.O.		180		7,550							7,730	7,730
28.	METEOR		7,680				8,145				8,145	7,680	15,825
29.	RAD-CHEM		57,000	38,600	375,920			1,590			38,600	434,510	473,110
30.	N.R.D.L.		2,010		1,275			23,425	1,835		1,835	26,710	28,545
31.	A.F.O.A.T		37,520					(9,150)				28,370	28,370
32.	A.C.C.		950									950	950
33.	B.R.L. - A.P.G.		1,000									1,000	1,000
34.	A.E.C.		-0-		330			6,755				7,085	7,085
35A.	Grouting Program							530,375				530,375	530,375
35B.	Drilling Program							118,860				118,860	118,860
36.	E-Plus			24,900				721,525	1,765	1,430	26,665	722,955	749,620
	TOTALS	21,906,265	3,083,995	689,324	1,502,475	(1,340,560)	(12,550)	9,095,640	441,915	998,490	1,113,689	35,246,305	36,359,994

	designation of contracting officer, provision for location of the Home Office, or reimbursement of overhead.
December 21, 1948	A Memorandum Agreement was issued, summarizing negotiations to date and defining major phases of the scope of work to be performed.
December 29, 1948	Modification No. 2 to the Letter Contract incorporated the December 21, 1948, Memorandum Agreement into the Contract and formally increased the obligation of funds from the original limit of $125,000 to $530,000. This modification deleted from the Letter Contract the requirement for AEC approval on purchase orders, commitments for material, etc., in excess of $2,000.
February 1, 1949	Modification No. 3 to the Letter-of-Intent extended the date for the execution of the Definitive Contract 60 days beyond the 120 days provided in the Letter-of-Intent, stating that this extension was not due to inability to reach agreement but to reasons beyond the control of either of the parties.
February 10, 1949	A rough draft of the proposed Definitive Contract was submitted by H & N to AEC.
March 15, 1949	Modification No. 4 to the Letter-of-Intent extended the execution of the Definitive Contract an additional 30 days.
May 9, 1949	Modification No. 5 to the Letter-of-Intent increased the obligation of funds from $530,000 to $780,000 and extended the date for the completion of the Definitive Contract to June 1, 1949, in order to provide more time required for the drafting of the agreement.
May 17, 1949	Definitive Contract AT-(29-1)-507 executed.
May 27, 1949	Detailed information was transmitted on the provisions regarding advance funds to be incorporated in the Contract.
June 1, 1949	H & N letter (HN-835) advised AEC that further funds would be required or that alternatively all commitments other than payroll would have to be suspended.
June 27, 1949	Modification No. 1 to the Definitive Contract issued, increasing the obligation of funds from $780,000 to $930,000.

TABLE 3.2-2. SUMMARY OF MODIFICATIONS, CONTRACT NO. AT-(29-1)-507

Item	Date	Description	Amount Obligated Increase	Amount Obligated Total to Date
Letter-of-Intent	9-16-48	Reconnaissance Services and Report	$ 125,000	$ 125,000
Mod No. 1	9-28-48	Approved Job Classifications		125,000
Mod No. 2	12-29-48	Obligation of Funds	405,000	530,000
Mod No. 3	2-1-49	Extend Date		530,000
Mod No. 4	3-15-49	Extend Date		530,000
Mod No. 5	5-9-49	Obligation of Funds	250,000	780,000
Contract	5-17-49	A-E-C-M Services for Basic AEC Facilities		780,000
Mod No. 1	6-20-49	Obligation of Funds	150,000	930,000
Mod No. 2	6-30-49	Obligation of Funds	9,300,000	10,230,000
Mod No. 3	7-1-49	Partnership changed to Corporation		
Mod No. 4	7-5-49	Addition of Japtan Island Facilities		
Mod No. 5	3-21-50	Obligation of Funds	3,350,000	13,580,000
Mod No. 6	5-25-50	Obligation of Funds	1,420,000	15,000,000
Mod No. 7	6-6-50	Revision of Scope of Work to date, Addition of Military Structures & Instrumentation, Loran Station and Partial Scope of Jobs 4 & 5		
Mod No. 8	6-30-50	Obligation of Funds	1,250,000	16,250,000

Mod No. 9	6-30-50	Obligation of Funds	1,000,000	17,250,000
Mod No. 10	7-28-50	Obligation of Funds	2,000,000	19,250,000
Mod No. 11	8-28-50	Obligation of Funds	2,656,265	21,906,265
Mod No. 12	10-11-50	Increase in Total Contract Cost and Obligation of Funds	758,000	22,664,265
Mod No. 13	10-12-50	Addition of Scientific Structures Program		
Mod No. 14	10-30-50	Obligation of Funds	2,000,000	24,664,265
Mod No. 15	11-15-50	Increase in Total Contract Cost and Obligation of Funds	1,179,995	25,844,260
Mod No. 16	11-27-50	Obligation of Funds	799,475	26,643,735
Mod No. 17	12-27-50	Obligation of Funds	1,000,000	27,643,735
Mod No. 18	1-2-51	Corporate Officers Salaries & Change in Overhead Allowance		
Mod No. 19	1-16-51	Obligation of Funds	1,000,000	28,643,735
Mod No. 20	1-24-51	Change in Reporting of Commitment Percentage		
Mod No. 21	1-29-51	Obligation of Funds	1,000,000	29,643,735
Mod No. 22	2-9-51	Obligation of Funds	1,000,000	30,643,735
Mod No. 23	2-27-51	Obligation of Funds	1,000,000	31,643,735
Mod No. 24	3-20-51	Revision and Addition to Scope of Work		
Mod No. 25	3-21-51	Obligation of Funds	1,000,000	32,643,735
Mod No. 26	4-10-51	Obligation of Funds	2,000,000	34,643,735
Mod No. 27	5-2-51	Obligation of Funds	1,000,000	35,643,735
Mod No. 28	5-28-51	Obligation of Funds	1,000,000	36,643,735
Mod No. 29	5-18-51	Clarification of Intent of Overhead Provisions		
Mod No. 30	6-29-51	Obligation of Funds	2,167,336	38,811,071

June 30, 1949	Copies of the Definitive Contract, executed on May 17, 1949, and approved in Washington on June 15, 1949, were transmitted to H & N. Total estimated construction cost under this Contract was $14,520,000, exclusive of fee.
July 1, 1949	Work Authorization No. 50-507-2 authorized activation of Japtan Island and the initiation of work towards this end. It required construction of minimum facilities for the breeding of mice as soon as possible for the deadline not later than December 1, 1949.
July 1, 1949	Modification No. 2, dated June 30, 1949, was executed, increasing the obligation of funds to $10,230,000.
July 15, 1949	Modification No. 3 changed the designation of the Contractor from a partnership to a corporation.
July 16, 1949	Reimbursement Authorization No. 1 was issued, providing for revisions and additions to approve employment policies and wage and salary schedules, including corrected salary for Director of Procurement and revisions and additions to overseas and Home Office job classifications.
August 11, 1949	Reimbursement Authorization No. 2 revised Appendix "A" of the Definitive Contract to include holidays and approved leave of absence in computing the 40-hour week for overtime purposes.
August 29, 1949	Work Authorization No. 50-507-3 was issued authorizing activation of Eniwetok Island. This Work Authorization was rescinded and superseded at a later date.
September 12, 1949	Work Authorization No. 50-507-1 was issued, confirming instructions effective September 16, 1948, and authorizing initiation of work on all items listed in Appendix "D" of the Definitive Contract, except work connected with Eniwetok Island. Authority was also granted to proceed with Job No. 4 of the Contract on a scale necessary to support construction activities.
September 19, 1949	Modification No. 4, dated July 5, 1949, was transmitted to H & N covering the work authorized in Work Authorization No. 2, increasing the scope of work under the Contract by an estimated $934,000, and providing a fixed-fee to cover the increase in scope.
September 21, 1949	Reimbursement Authorization No. 3 was issued, revising sick leave provisions, elaborating on travel fund

deductions and return transportation of terminated employees, providing for fringe benefits, and providing for revision of Appendix "A", Part 5, Item 8.

September 21, 1949 Reimbursement Authorization No. 4 was issued, changing the designation of certain guard forces and security personnel.

September 29, 1949 Reimbursement Authorization No. 5 was issued, revising per diem rates for key employees and others during on-continent and off-continent travel.

November 1, 1949 Work Authorization No. 50-507-4 was issued, covering activation of Bogallua Island at an estimated cost of $399,150. Work was to be completed by March 1, 1950, in order to meet the deadline tentatively established for the performance of a so-called "quick and dirty" operation.

November 2, 1949 Work Authorization No. 50-507-5 was issued, authorizing work on Japtan Island at a cost of construction not to exceed $731,500, by not later than August 1, 1950.

November 3, 1949 Work Authorization No. 50-507-6 was issued, covering the activation of Eniwetok Island. Reference was made to Work Authorization No. 50-507-3 and authorization given to proceed with plans, specifications, procurement of construction materials (except tents, furnishing, mess and infirmary equipment) for the entire scope of work on Eniwetok Island as then contemplated. Construction not authorized because it was contemplated that construction would be done by a military construction battalion. Limited services in connection with construction operation and maintenance were to be rendered by H & N.

December 15, 1949 AEC letter SC-516-A supplemented Work Authorization No. 50-507-4 for the activation of Bogallua Island and added the requirement for a stabilized strip of land as a prolongation of the principal axis of the island.

January 13, 1950 Work Authroization No. 50-507-7 confirmed teletype authorization to proceed with final plans, specifications, and procurement of all materials and equipment (except that furnished by the Coast Guard) required for the construction of a Loran Station on Eniwetok Island. Construction was to be performed by the military construction battalion.

January 30, 1950 A meeting was held at JTF.3 Headquarters, attended by representatives of JTF.3, of the construction

battalion which was to perform work on Eniwetok Island, of AEC, and of H & N. Agreement was reached as to the extent of participation of the various groups represented. The agreements reached included the following: H & N was to perform all design services and was to procure all materials and equipment, except hand tools, construction equipment, furnishings, etc. specifically mentioned. Stevedoring services were to be supplied by the battalion; however, the operation of all boats engaged in stevedoring was to be the responsibility of H & N. Certain supervisory technicians and craftsmen were to be supplied by H & N to assist the construction battalion in the performance of the construction services.

February 7, 1950 — AEC letter (SD 5297) transmitted copies of the Memorandum Agreement of January 30, 1950 and requested H & N to supply detailed estimates of costs in order to enable the AEC to secure necessary additional funds from JTF-3.

February 9, 1950 — Work Authorization No. 50-507-8 was issued in order to initiate activity on certain scientific structures which were referred to in general terms. Significantly, this authorization stated that the total scope of work involved in the Scientific Structures Program could not be established at the time nor for some time to come because of the experimental nature of the program.

March 1, 1950 — Reimbursement Authorization No. 6 was issued, revising Appendix "A", Part 3, of the Overseas Salary and Wage Schedule and clarifying the overtime policy for various groups.

March 2, 1950 — H & N letter (HN-3332) notified the AEC that commitments had reached 85 per cent of the total funds obligated under Modification No. 2 of the Contract.

March 14, 1950 — Work Authorization No. 50-507-9 was issued, confirming previous instructions and authorizing H & N to proceed with the procurement, construction, and instrumentation of the various Army, Navy, and Air Force structures involved in the Military Structures Program. Completed drawings prepared by their Architect-Engineers were to be furnished to H & N for use as bases for the preparation of estimates of cost and material lists and for the procurement of the necessary materials. (Details of the work performed in connection with the Military Structures Program appear in Volume III of this report.) It should be noted that the Military Structures Program required of Holmes & Narver

	not only the construction of the various structures involved but the performance of certain services in connection with the instrumentation of these structures.
March 22, 1950	AEC letter (SD 5409) transmitted Modification No. 5, dated March 21, 1950, increasing the obligated funds from $10,230,000 to $13,580,000.
March 28, 1950	Amendment No. 1 to Work Authorization No. 50-507-9 authorized additional military structures subject to conditions outlined in the Work Authorization 50-507-9. In addition, H & N was authorized to proceed with the construction of additional tower footings on Engebi Island and Eberiru Island, and stabilization and paving around these footings.
April 3, 1950	Reimbursement Authorization No. 7 was issued revising the policy covering the payment of fringe benefits and adding certain classifications to the non-manual overseas wage and salary schedule.
April 21, 1950	H & N letter (HN-3889) was transmitted to the AEC advising that commitments had reached 85 per cent of the total funds obligated under Modification No. 5.
May 10, 1950	Work Authorization No. 50-507-11 authorized H & N to proceed with the preparation of final plans, specifications, cost estimates, procurement, and construction for a 200-foot tower. This authorization anticipated that it might later be necessary to provide a mock-up section of the tower cab, hoist, elevator, and other parts for use in the layout of experimental equipment under design for use in the cab.
May 13, 1950	The procurement of materials for the mock-up section of the tower was specifically authorized on May 13, 1950.
May 18, 1950	Reimbursement Authorization No. 8 was issued, authorizing additional classifications in the Los Angeles area wage schedule.
May 22, 1950	Work Authorization No. 50-507-12 was issued to initiate activity in connection with the design and construction of the CMR building on Parry Island.
May 25, 1950	Work Authorization No. 50-507-12 was supplemented by AEC letter (SD 5651).
May 25, 1950	Modification No. 6 was issued, increasing the obligated funds under the Contract from $13,580,000 to $15,000,000.

June 2, 1950	A meeting was held between representatives of the AEC and H & N in order to discuss the increased scope of work authorized to date.
June 9, 1950	Reimbursement Authorization No. 9 was issued, which provided for the addition of certain classifications to the overseas wage schedule.
June 12, 1950	Work Authorization No. 50-507-13 was issued, covering various items of additional scope which had previously been authorized including the mock-up section of the 200-foot tower, the rehabilitation of warehouses on Parry Island, additional camp facilities for Engebi Island, and additional animal colony facilities for Japtan Island.
June 13, 1950	AEC letter transmitted Modification No. 7, dated June 6, 1950. This modification covered the revisions in the scope of work previously authorized in Appendix "D" and added new items not covered by previous modifications. The estimated cost under the Contract was revised upward to $21,906,265, including engineering, construction cost, camp operation, maintenance management, and support and roll-up services.
June 15, 1950	H & N letter (HN-4647) was transmitted to the AEC as notification that commitments under the contract had reached 85 per cent of the total amount obligated under Modification No. 6.
June 22, 1950	Work Authorization No. 50-507-11 was issued to cover certain major changes in the 200-foot steel tower. These resulted from a conference of the various groups of scientific personnel interested.
June 30, 1950	Modification No. 8 was issued, increasing the obligated funds under the Contract from $15,000,000 to $16,250,000.
June 30, 1950	Modification No. 9 was issued, increasing the total of obligated funds from $16,250,000 to $17,250,000.
July 11, 1950	Supplement No. 2 to Work Authorization No. 50-507-4 was issued, calling for the resumption of construction activities on Bogallua Island. These had been suspended by AEC letter (SD 5239), dated January 17, 1950.
July 14, 1950	Reimbursement Authorization No. 11 was issued, covering additional classifications in the overseas wage schedule.

July 17, 1950	H & N letter (HN-5121) notified the AEC that commitments had reached 85 per cent of the obligated funds under Modification No. 9.
July 28, 1950	Modification No. 10 was issued increasing the obligated funds under the Contract from $17,250,000 to $19,250,000.
August 2, 1950	Reimbursement Authorization No. 12 was issued, approving additional classifications in the on-continent wage schedule.
August 7, 1950	H & N letter (HN-5430) advised the AEC that commitments had reached 85 per cent of the funds obligated under Modification No. 10.
August 10, 1950	Reimbursement Authorization No. 13 was issued, effective as of May 29, 1950, approving revisions in certain classifications in the on-continent wage schedule.
August 15, 1950	AEC letter (SD 5949) confirmed certain changes in scope, including the cancellation of all work on Bogallua Island, substitution of a 300-foot steel tower for the 200-foot tower planned for Runit Island, and authorization of the continuation of erection of the 200-foot tower on Eberiru Island. It also confirmed certain changes in procurement, including suspension of limonite and iron punching purchases in accordance with the revised program and the cancellation of the 300-foot aluminum tower which had been ordered.
August 28, 1950	Reimbursement Authorization No. 14 was issued, approving certain revisions in the overseas wage classifications and additions to the classifications list.
August 28, 1950	Modification No. 11 was issued, increasing the obligated funds under the Contract from $19,250,000 to $21,906,265.
September 1, 1950	H & N letter (HN-5822) was issued, notifying the AEC that commitments had reached 85 per cent of the total funds obligated under Modification No. 11.
September 5, 1950	Reimbursement Authorization No. 15 was issued, effective as of August 1, 1950, approving the addition of certain classifications to the overseas wage schedule.
September 7, 1950	Reimbursement Authorization No. 16 was issued, effective as of June 7, 1950, approving numerous

revisions, deletions, and new additions to Parts 5 and 6 of Appendix "A" of the Contract. The purpose of this Reimbursement Authorization was to reflect the original intent of this section of the Contract.

September 15, 1950 — Reimbursement Authorization No. 17 was issued, containing a complete revision of Appendix "A" and consolidating all previous revisions covered by Reimbursement Authorizations 1 through 16.

September 27, 1950 — A meeting was held between representatives of the AEC and H & N in order to discuss and negotiate a modification of the contract to cover scientific structures added to the scope of work. Negotiations were based upon an estimated construction cost of approximately $3,000,000.

September 29, 1950 — An AEC letter transmitted Reimbursement Authorization No. 17, dated September 26, 1950, providing authority to add, delete, or re-evaluate individual classifications within the approved rate structures in the new Appendix "A", transmitted with Reimbursement Authorization No. 17.

October 9, 1950 — Work Authorization No. 51-507-14 was issued covering thirteen items of additional construction work. These items included additional facilities and equipment for Japtan Island, additional facilities for Parry Island, grouting and foundations investigation work in connection with the Military Structures Program, and other smaller items. At about this time it was agreed to discontinue the practice of the issuance of Work Authorizations, inasmuch as the subjects usually covered were also included in official correspondence and formal modifications to the Contract.

October 11, 1950 — Modification No. 12 was issued, increasing the obligated funds under the Contract from $21,906,265 to $22,664,265.

October 16, 1950 — Reimbursement Authorization No. 17 was issued, revising reimbursement provisions for travel of employees joining or leaving the staff.

October 19, 1950 — Modification No. 13, dated October 12, 1950, was transmitted, increasing the total scope of the Contract by the addition of a number of structures of the Scientific Structures Program, in the amount of $3,083,995. This addition increased the total estimated cost under the Contract to $24,990,260, exclusive of the fixed-fee.

November 1, 1950	Modification No. 14, dated October 30, 1950, was transmitted, increasing the obligated funds under the Contract from $22,664,265 to $24,664,265.
November 8, 1950	H & N letter (HN-6705) notified that AEC that commitments had reached 85 per cent of the total amount of funds obligated under Modification No. 14.
November 15, 1950	Modification No. 15 was issued, increasing the obligated funds of the Contract from $24,664,265 to $25,844,260.
November 20, 1950	Letter CHN-1069 was prepared by H & N in order to provide the AEC with a basis for the obligation of additional funds.
November 21, 1950	H & N letter (HN-6886) advised the AEC that commitments had reached 85 per cent of the funds obligated under Modification No. 15.
November 27, 1950	Modification No. 16 was issued, increasing the obligated funds under the Contract from $25,844,260 to $26,643,735.
December 20, 1950	H & N letter (HN-7251) advised the AEC that commitments had reached 85 per cent of the funds obligated under Modification No. 16.
December 27, 1950	Modification No. 17 was issued, increasing the obligated funds under the Contract from $26,643,735 to $27,643,735.
January 4, 1951	A meeting was held between representatives of the AEC and H & N to discuss accumulated additions to the scope of work and to negotiate a modification to the Contract to cover these additions.
January 8, 1951	Modification No. 18 was transmitted. This modification was designed to correct the wording of the Definitive Contract to reflect the original intent of the parties with respect to reimbursement of overhead items.
January 9, 1951	H & N letter (HN-7541) advised the AEC that commitments had reached 85 per cent of the funds obligated under Modification No. 17.
January 16, 1951	Modification No. 19 was issued, increasing the obligated funds under the Contract from $27,643,735 to $28,643,735.
January 19, 1951	H & N letter (HN-7725) advised the AEC that commitments had reached 85 per cent of the funds obligated under Modification No. 19.

January 23, 1951	Reimbursement Authorization No. 17 was issued, relating to paragraph 7, Section A, Part 1, of Appendix "A" of the Contract, which had required that any change or revision in salary and wage scales under the Contract would require prior written approval of the AEC.
January 24, 1951	Modification No. 20 was issued, revising the provisions of the Contract so that notification to the AEC would be required when commitments reached 95 per cent of obligated funds.
January 29, 1951	Reimbursement Authorization No. 17F authorized additional classifications in the overseas wage schedule and revised the provisions of Appendix "A" with respect to incentive compensation to overseas employees who signed renewal contracts.
January 29, 1951	Modification No. 21 was issued, increasing the obligated funds under the Contract from $28,643,735 to $29,643,735.
February 8, 1951	H & N letter (HN-8058) advised the AEC that commitments had reached 95 per cent of the funds obligated under Modification No. 21.
February 15, 1951	AEC letter transmitted Modification No. 22, dated February 9, 1951, increasing obligated funds under the Contract from $29,643,735 to $30,643,735.
February 20, 1951	H & N letter (HN-8194) advised that AEC that commitments had reached 95 per cent of the funds obligated under Modification No. 22.
March 1, 1951	AEC letter transmitted Modification No. 23, dated February 27, 1951, increasing the obligated funds under the Contract from $30,643,735 to $31,643,735.
March 6, 1951	H & N letter (CHN-1309) advised the AEC that 100 per cent of the funds obligated under the Contract would be committed within a few days.
March 7, 1951	Reimbursement Authorization No. 17H was issued to revise the provisions of Appendix "A", Part I, Section A with respect to the furnishing of medical and dental services to employees enroute to or from the Jobsite.
March 21, 1951	Modification No. 25 was issued, increasing the obligated funds from $31,643,735 to $32,643,735.
March 28, 1951	H & N letter (CHN-1324) advised the AEC that commitments had exceeded 100 per cent of the total funds obligated under Modification No. 25.

March 31, 1951	AEC letter transmitted Modification No. 24, covering the scope of work negotiated on January 4, 1951, and additional items of cost which were agreed upon during meetings on February 27, 1951. The total scope of work described in the Contract was increased to $27,177,059, exclusive of fees. This total included the original token amount established for Jobs 4 and 5, which amounts had by this time been demonstrated to be wholly inadequate.
April 12, 1951	AEC letter transmitted Modification No. 26, dated April 10, 1951, increasing the obligated funds under the Contract from $32,643,735 to $34,643,735.
April 23, 1951	H & N letter (CHN-1357) advised the AEC that on or about April 30, 1951, commitments would reach 100 per cent of the funds obligated under Modification No. 26.
May 2, 1951	Modification No. 27 was issued, increasing obligated funds under the Contract from $34,643,735 to $35,643,735.
May 3, 1951	Reimbursement Authorization No. 17I approvied additional classifications in the on-continent salary and wage schedule.
May 21, 1951	H & N letter (HN-8959) advised the AEC that commitments had reached 95 per cent of the total funds obligated under Modification No. 27.
May 28, 1951	Modification No. 28 was issued, increasing the obligated funds under the Contract from $35,643,735 to $36,643,735.
June 4, 1951	Reimbursement Authorization No. 17J was issued, approving additional classifications in the on-continent salary and wage schedule.
June 6, 1951	AEC letter transmitted Modification No. 29, dated May 18, 1951, effective as of September 16, 1948, clarifying the intent of the overhead provision of the Contract in order to exclude therefrom "Help Wanted" advertising. This item of expense should have been included as a directly reimbursible item and was treated as such during the life of the Contract.
June 12, 1951	H & N letter (HN-9107) advised the AEC that commitments had reached 95 per cent of the funds obligated under Modification No. 28.

June 29, 1951	Modification No. 30 increased the obligated funds under the Contract from $36,643,735 to $38,811,071.
June 30, 1951	Efforts were under way to negotiate a modification of the Contract to cover the scope of work done under Jobs 4 and 5 as well as to cover additions in scope in the construction program, including facilities for a fourth shot site (to be completed on Engebi Island after the detonation of the second weapon on that island).

Section 4

ORGANIZATION

CHAPTER 4.1

H & N ORGANIZATION

The type of contract between the Atomic Energy Commission and Holmes & Narver, covering as it did the complete responsibility for design, construction, and operating functions for the Proving Ground facilities, made it imperative that the organization established to perform these functions should be characterized by an effective system of checks and controls between functional units. This characterization was mandatory in order to assure the complete and unbiased performance of design and field engineering duties, construction duties, and operational duties. Of particular importance in this respect, in view of the fact that the responsibility for both engineering design and construction resided in the Holmes & Narver organization, was the necessity for making certain that Title III Engineering Services, including inspection of construction, reports of progress, and other duties, were effective. Likewise, control from the monetary standpoint and security control of all activities were prime considerations in this system of organizational checks and balances.

In addition to the above considerations the economies to be realized under such a contract included operational facility and coordination, advantages in procurement timing, and organizational flexibility to absorb changes in the scope, character and detail of work to be performed.

On the basis of the principles noted, the organizational breakdown of functions for the Proving Ground project followed existing lines in the H & N organization. The prime responsibility for the performance of the work under this contract resided in the Operations Division and specifically was under the immediate supervision of the Project Manager; however, in order to maintain the required control and independence of action, responsibility for design engineering activities was directly delegated to the Engineering Division. Fiscal control and supporting services were rendered by the Fiscal and Administrative Divisions, and the Security Division established the necessary procedures and liaison to fulfill the requirements for clearances, information control, and physical security.

Within the Operations Division, departmental organization covered on-continent and Jobsite construction, procurement, personnel, Jobsite security, service operations, Jobsite fiscal, and engineering functions.

Figure 4.1-1 shows the functional responsibility breakdown existing at the inception of the project. The manning of the organization and the establishment of the various functions involved merely the assignment of responsibilities for the performance of duties in connection with the Proving Ground Program as the needs of the project required. Seasoned H & N personnel occupied substantially all of the key positions involved. The recruitment of other personnel to flesh out the ultimate organization is discussed in more detail in Section 8, Personnel.

The performance of construction and operation activities at the remote location of the Proving Ground required a Jobsite organization which

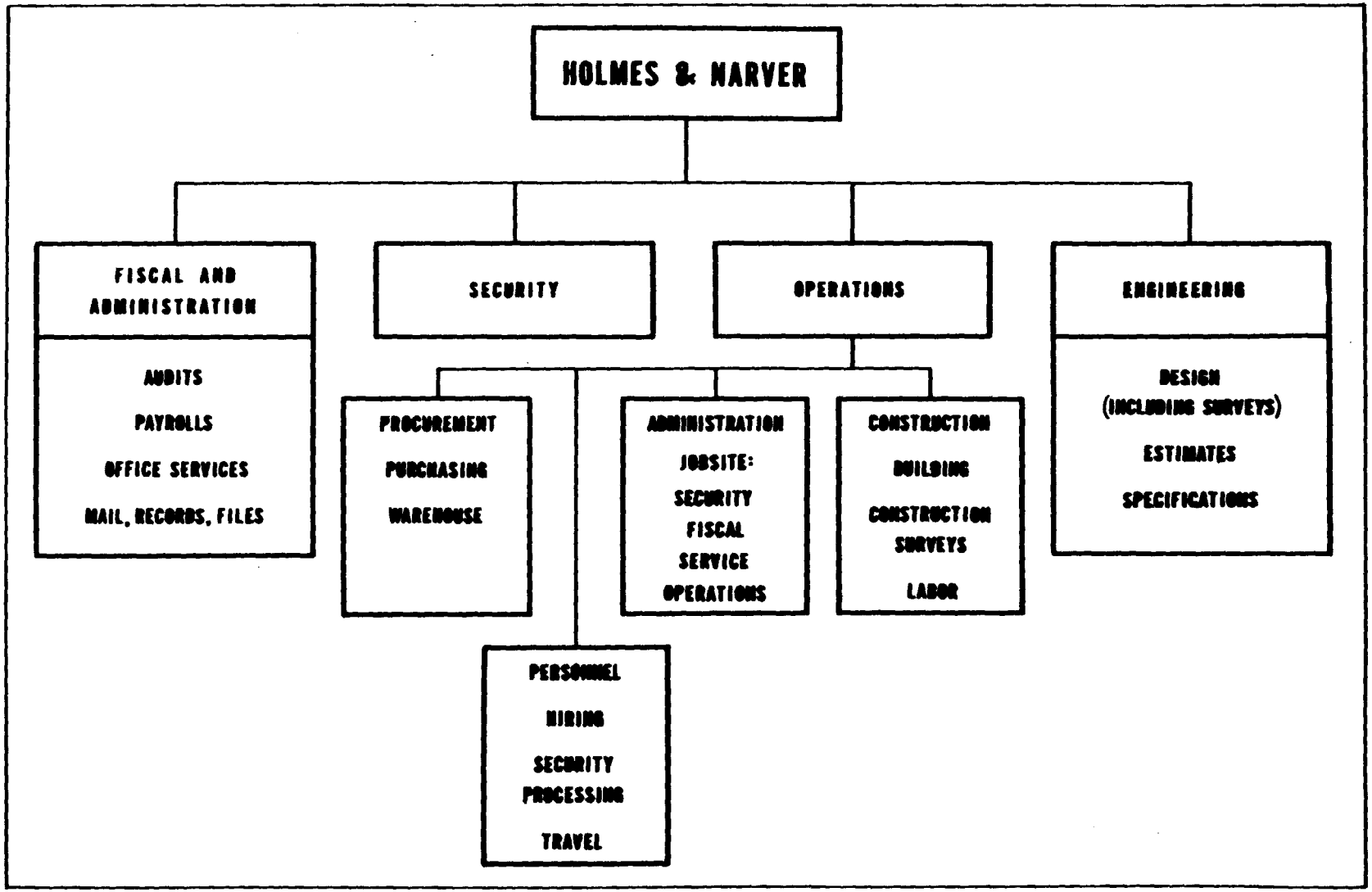

Figure 4.1-1 Holmes and Narver Organization at Inception of Project

would also reflect the basic principles noted above in order to assure efficient utilization of manpower, proper performance of the work in accordance with plans and specifications, with maximum coordination of the multiplicity of activities being carried out at the fifteen different locations within Eniwetok Atoll. Figure 4.1-2 shows the functional organization plan employed.

In the course of time, minor organizational changes were effected to meet changing conditions. Thus, for example, in January 1950, when the functions of the Estimating Department had changed from those particularly related to engineering activities to broader alliance with construction activities, the Estimating Department was transferred from the Engineering Division to the Operations Division. Likewise, by this time the advantages to be gained by continuation of the issuance of requisitions for construction materials and supplies by the Engineering Division had become minimal. In addition, authorization had been given for the construction of the elements involved in the Military Structures Program in which the H & N organization had no design engineering responsibilities and only supplied manpower for limited field engineering services at the direction of Department of Defense representatives. Thus, the desirability of transferring the material requisitioning and control functions to the Construction Department was apparent and this organizational change was accomplished at this time together with the more complete manning of this Home Office department to meet the increasing work load.

At the inception of the overseas portion of the work the supporting activities required for construction were not of such a magnitude as to require the establishment of a separate Service Operations Division. Thus, as shown in Figure 4.1-2, operation of boats, camp operations, and utilities operations were all designated as the responsibility of the other Jobsite Departments. By the summer of 1950, as substantial completion of base facilities at Parry Island had been accomplished and more of the construction work effort was being shifted to the operational islands to the north of Parry, the time came for the establishment of the Service Operations Department in order to avoid distortion of construction costs. This was accomplished in accordance with original plans, and the necessary transfers of responsibility from other Jobsite departments to the Service Operations Department were effected to reach the result shown in Figure 4.1-3.

In order to indicate the manpower division among the various functional units shown on the charts in this section, reference is made to Table 4.1-1 in which manpower levels during January 1951 and July 1951 are compared.

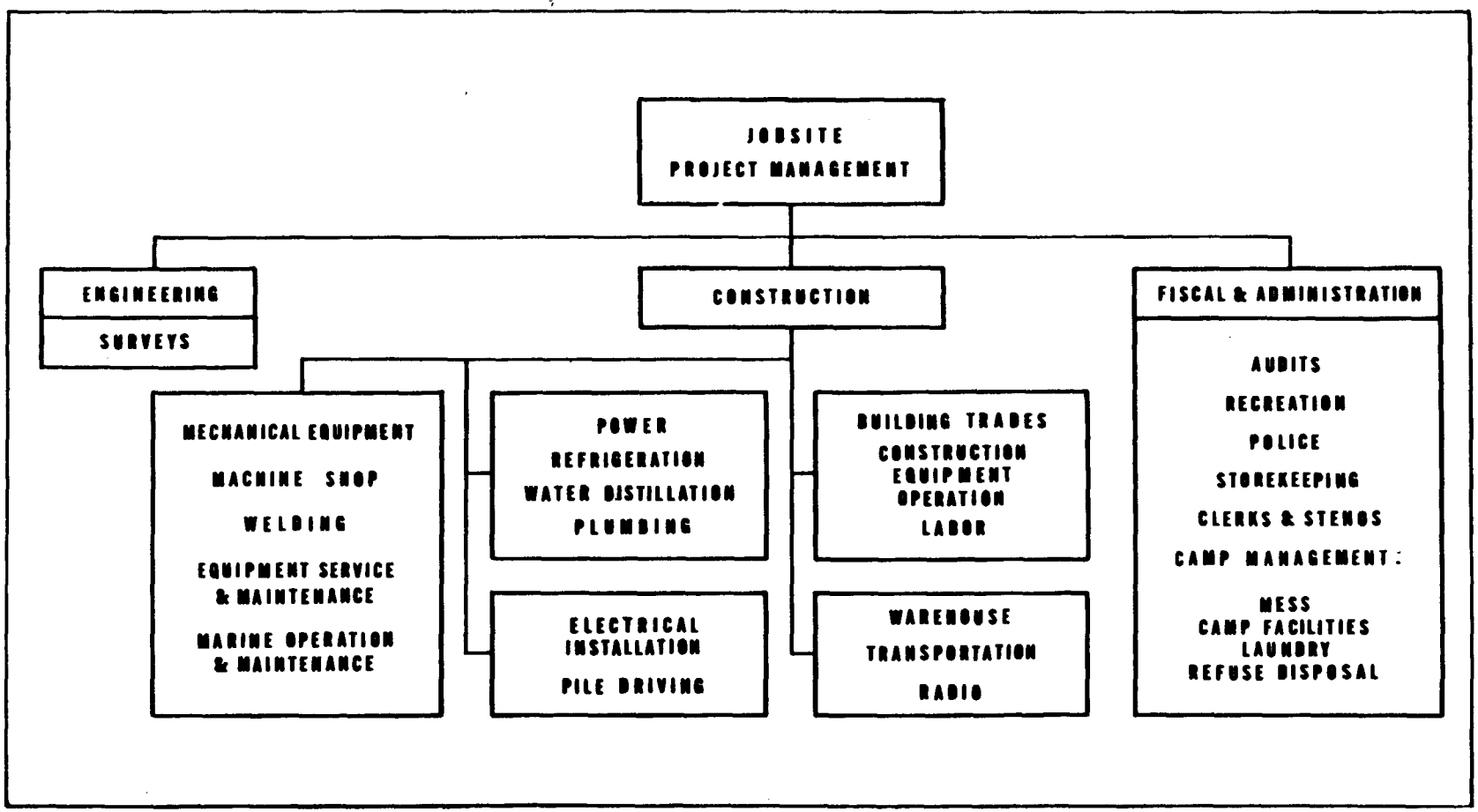

Figure 4.1-2 Initial Jobsite Organization

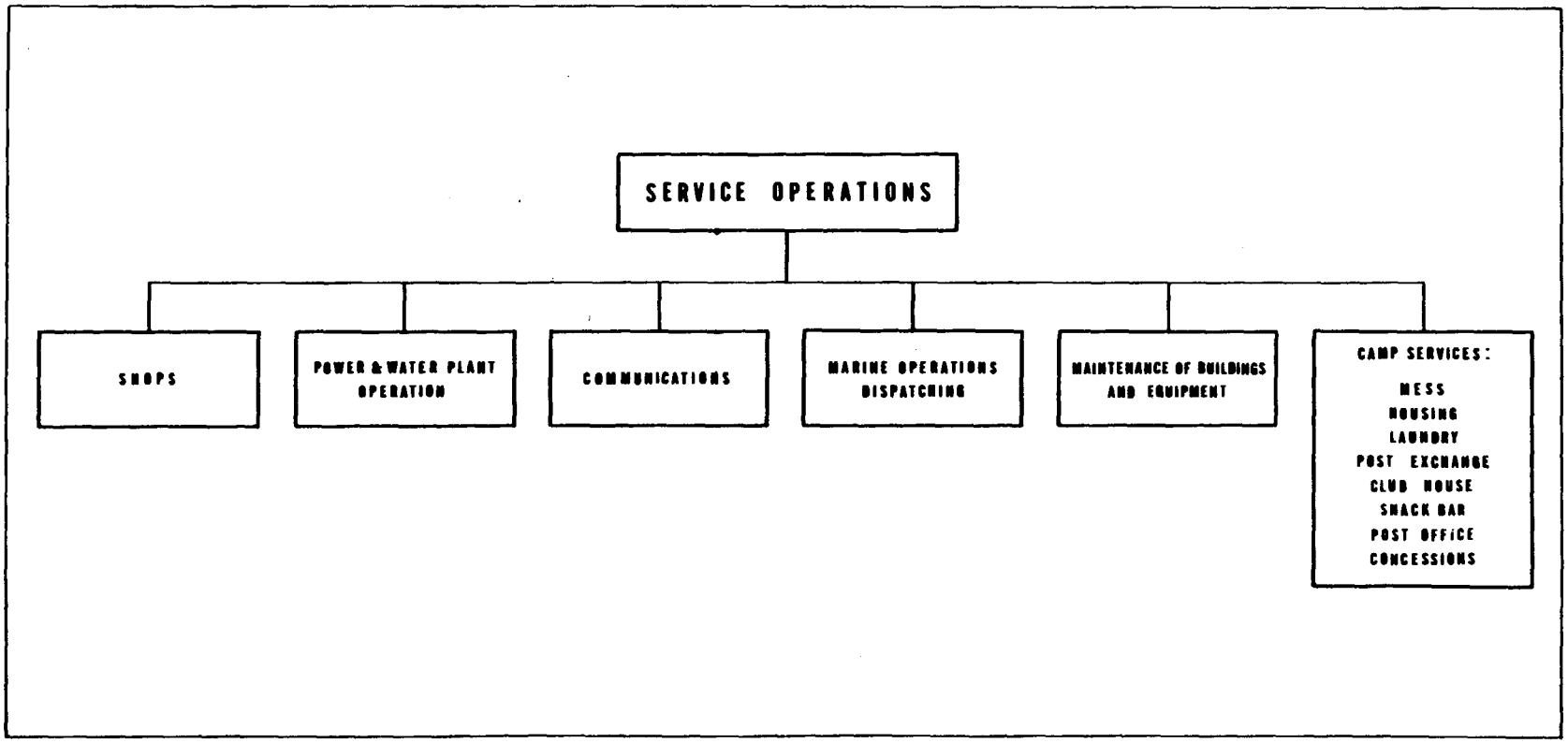

Figure 4.1-3 Service Operations Organization

TABLE 4.1-1. MANPOWER COMPARISON, JANUARY 1 AND JUNE 30, 1951

DIVISION OR DEPARTMENT		Jan. 1, 1951	June 30, 1951
HOME OFFICE			
Engineering	Full time	20	11
	Part time	96	40
Operations	Full time	2	1
	Part time	0	1
Administration	Full time	17	2
	Part time	0	17
Construction	Full time	2	0
	Part time	0	4
Procurement	Full time	82	23
	Part time	0	19
Estimating	Full time	11	0
	Part time	0	10
Personnel	Full time	28	16
	Part time	0	13
Fiscal	Full time	9	8
	Part time	58	50
Budget Control	Full time	0	0
	Part time	1	2
Security	Full time	11	0
	Part time	0	6
TOTAL HOME OFFICE		337	223
JOBSITE			
Service Operations		665	205
Construction & Maintenance		681	188
Administration		151	79
Fiscal		30	21
Engineering		71	9
TOTAL JOBSITE		1598	502
GRAND TOTAL		1935	725

NOTE: Part time employees indicate those who were "Q"-cleared and available for work on Contract AT-(29-1)-507 as required.

CHAPTER 4.2

LIAISON WITH AEC AND OTHER GROUPS

The need for flexibility in organization to absorb the impact of changing and expanding requirements has been noted in Chapter 4.1. In addition, it was necessary to maintain adequate and proper liaison with the AEC and the multiplicity of other agencies involved in Proving Ground activities. Procedural arrangements to meet these requirements were of necessity among the early decisions. However, these decisions and the resultant arrangements depended for operability upon the provision of a suitable orgniazational structure.

The interrelationships between the Holmes & Narver organization, the AEC, and other groups were based upon direct liaison as far as practical and consistent with orderly contractual and fiscal relationships. Figure 4.2-1, -2, and -3 show in chart form the development in the course of time of the interrelationships under discussion and illustrate the organizational arrangement employed to expedite the flow of information to all interested groups. It will be noted that, with the passage of time, even though the impact of liaison requirements became heavier, the basic Holmes & Narver organizational structure did not change. Procedural changes were effected to meet new requirements but such changes were readily encompassed within the existing functional arrangements.

As an example of the type of arrangement referred to, reference is made to Figure 4.2-4 which shows the flow of Job 5 support requirements from the many groups engaged in scientific activities to the H & N organization and the ultimate accomplishment of the work.

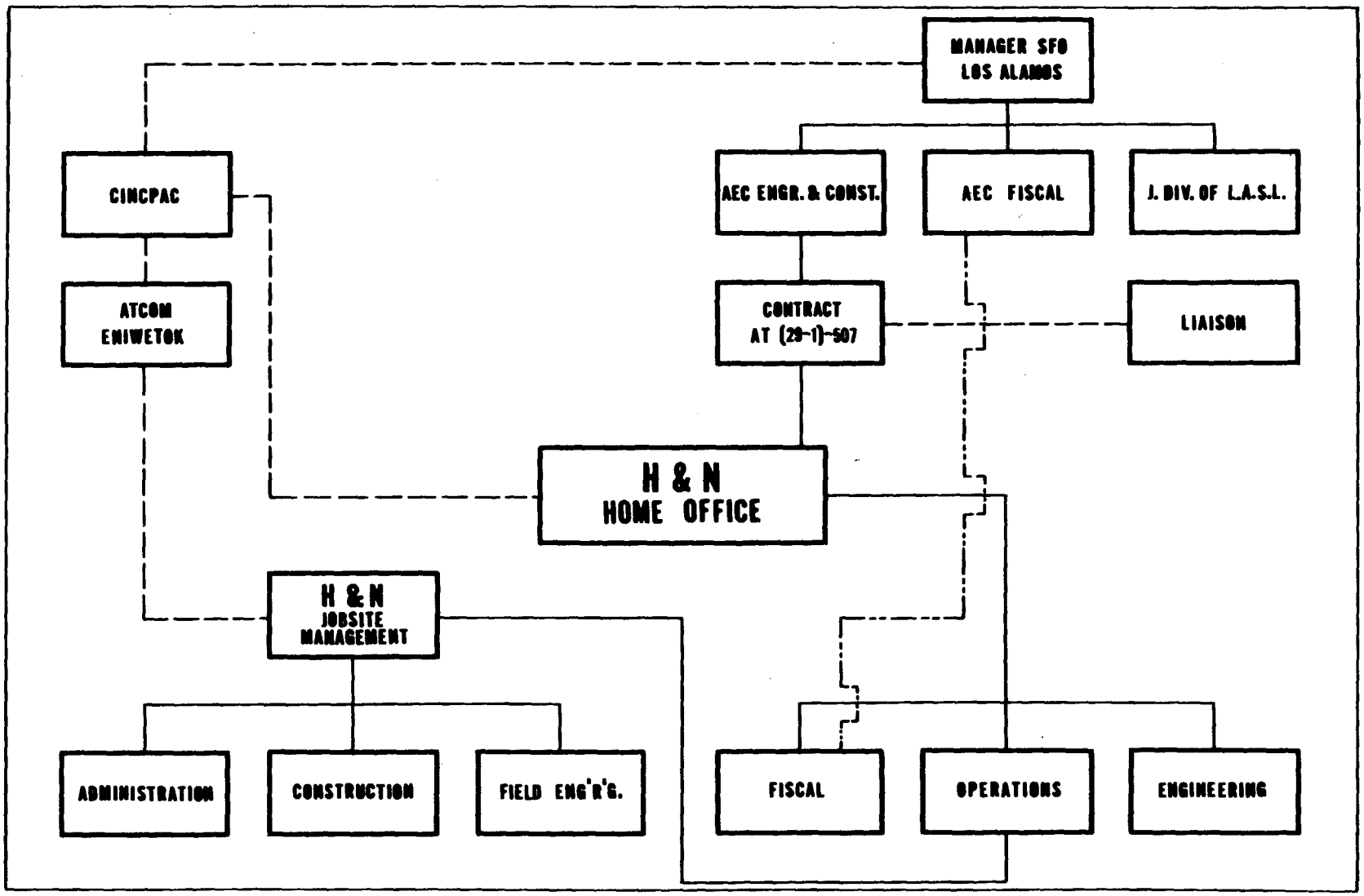

Figure 4.2-1 Liaison Chart, September 1948 to November 1949

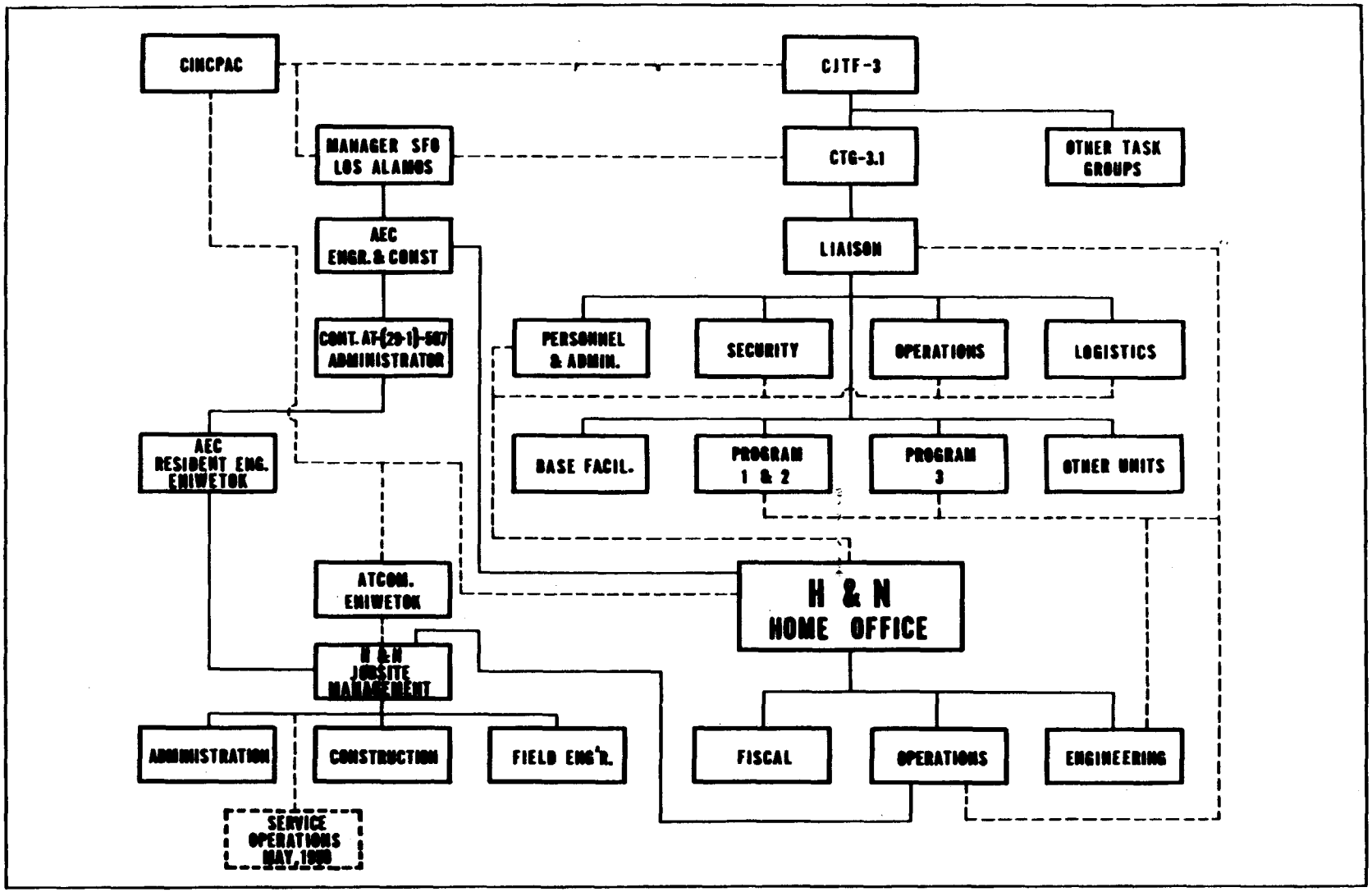

Figure 4.2-2 Liaison Chart, December 1949 to February 1951

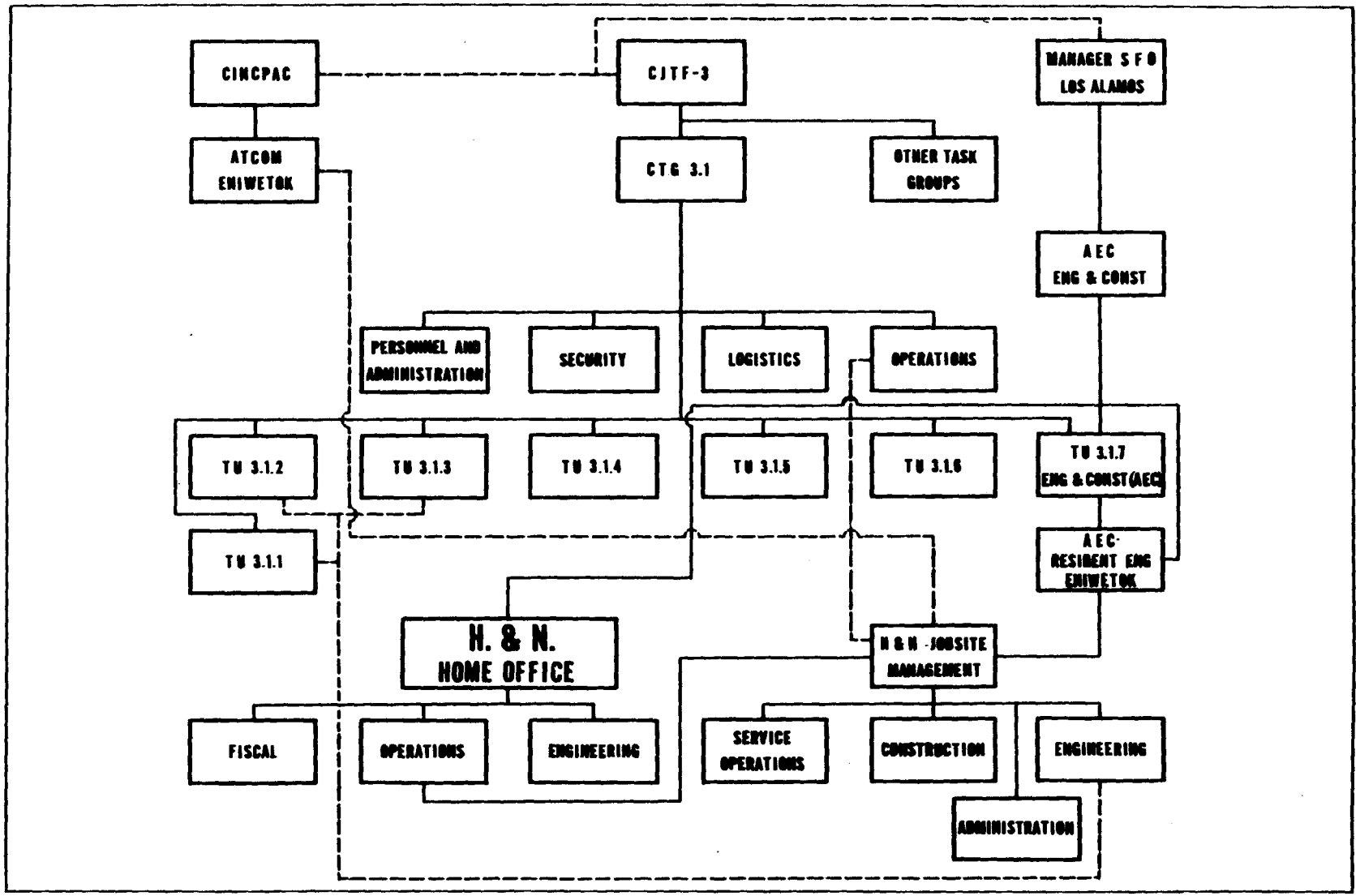

Figure 4.2-3 Liaison Chart, March 1951 through June 1951

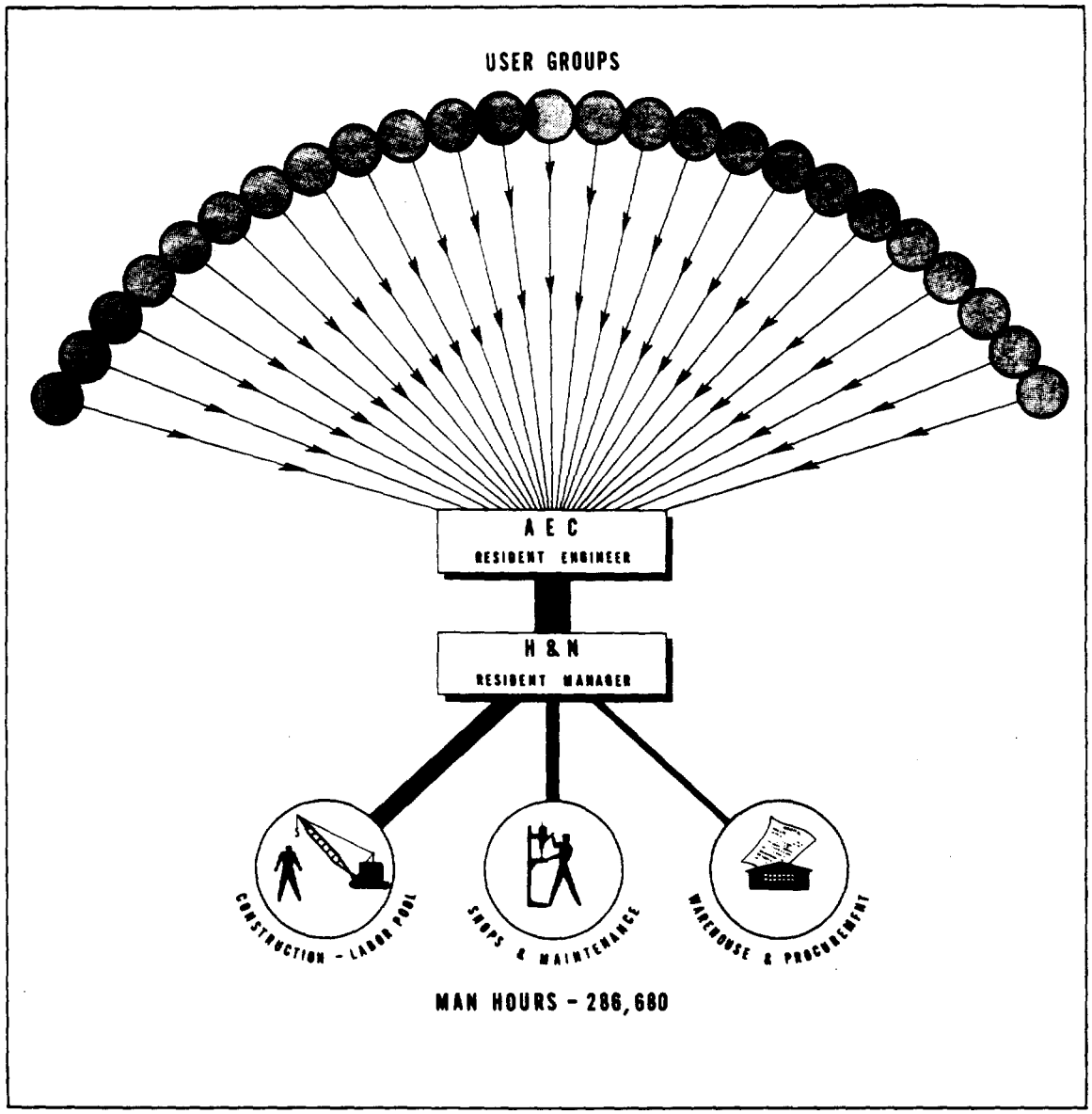

Figure 4.2-4 Flow of Job 5 Support Requirements

EXHIBIT A

Letter-of-Intent, Contract
No. AT-(29-1)-507

UNITED STATES
ATOMIC ENERGY COMMISSION
SANTA FE OPERATIONS OFFICE
LOS ALAMOS, NEW MEXICO

IN REPLY REFER TO:
SFC

Contract No. AT-(29-1)-507
Date: September 16, 1948

Holmes and Narver, Engineers
824 Figueroa Street
Los Angeles, California

Gentlemen:

It is the desire of the Atomic Energy Commission (hereinafter called the "Commission"), acting on behalf of the United States of America (hereinafter called the "Government"), to enter into a contract with you for the performance of architect-engineer services, necessary to cover the initial programming and preliminary planning required in connection with preparations of the Los Alamos Scientific Laboratory for weapon testing activities, as follows:

(1) Preliminary reconnaissance and study of proving ground site at the Eniwetok Atoll for the purpose of determining such information as is necessary to formulate a construction program.

(2) Recommend types of permanent and temporary construction suitable for the purposes of the testing program.

(3) When and as agreed upon by you and the Commission produce such design, specifications, and material lists as are required to facilitate the purchase of materials, supplies, equipment and structures necessary in connection with the program.

(4) Deliver written reports on results of reconnaissance and studies covering site development plans, utilities and structures.

(5) Submit written comprehensive recommendations on a definitive construction program with a time schedule and a cost estimate coordinated with the program.

(6) Perform such other related architect-engineer services as may be mutually agreeable from time to time.

Exhibit A. Letter-of-Intent

Holmes and Narver
September 16, 1948

Pending execution of a definitive contract an order is hereby placed with you for the performance of the above described work. It is proposed that by your acceptance of this order that you undertake without delay to enter into negotiations with the Atomic Energy Commission looking to the execution of a definitive contract. Such definitive contract will contain all applicable articles required by Federal Law, executive order or regulations of the Commission which are incorporated herein by reference. The definitive contract will also contain detailed terms and conditions as agreed to by the parties which may or may not be at variance with the provisions of this letter.

Pending the execution of the definitive contract you will proceed with the performance of the above described work. Provided, however, that each order, subcontract, or commitment for materials, equipment or supplies made by you in the furtherance of this work for an amount in excess of Two Thousand Dollars ($2,000.00) will be subject to the prior approval of the Commission: and any commitment made by you to pay rates in excess of existing rates to pay to personnel employed on the work shall be subject to the prior approval of the Commission. Subject to the foregoing limitations reimbursements will be made to you currently for all expenses incurred in performing the work upon submission by you of certified payrolls, paid invoices and/or such other supporting documents required by the Commission: provided, however, you will not expand or obligate funds in excess of One Hundred Twenty Five Thousand Dollars ($125,000.00) in the performance of this letter contract unless the Commission specifically authorizes you in writing to exceed said amount.

In case a definitive contract is not executed within one hundred and twenty calendar days (or within such additional time as may be mutually agreeable) from the date of this letter because of the inability of the parties to agree upon its terms and conditions, the order contained herein will terminate. In the event of termination pursuant to this paragraph, you and the Commission will attempt to agree upon a negotiated settlement on reasonable terms of the amount to be paid by reason of such termination. If you and the Commission are not able to agree upon such negotiated settlement within ninety (90) days after the effective date of the termination (or within such longer period as at any time may be mutually agreed upon), the

Exhibit A. Letter of Intent (Continued)

Government binds itself (without duplication of any of the following payments or of payments previously made) to reimburse you for the reimbursable costs incurred by you in the performance of the order contained herein and for any amounts paid by you or for your account in settling with the approval of the Commission your obligations for commitments made in the performance of this order. In lieu of reimbursing you for expenditures made by you in settling any of your obligations for commitments, the Government, in the discretion of the Commission may assume such obligations or any of them. The total of such reimbursement and of all payments made previously, together with the amount of any obligations assumed shall not exceed the amount above specified.

Disclosure of Information: (a) It is understood that disclosure of information relating to the work contracted for hereunder to any person not entitled to receive it, or failure to safeguard all Restricted Data, Top Secret, Secret, Confidential and Restricted matter that may come to you, or any person under your control in connection with the work under this contract, may subject you, your agents, employees, and subcontractors to criminal liability under the laws of the United States. See Title I of an Act approved June 15, 1917 (40 Stat. 217; 50 U.S.C. 31-42 as amended by an Act approved March 28, 1940 (54 Stat. 79), and the provisions of an Act approved June 12, 1938 (52 Stat. 3: 50 U.S.C. 45-45d), as supplemented by Executive Order No. 8381, dated March 22, 1940, 5 F.R. 1147.

(b) You agree to conform to all security regulations and requirements of the Atomic Energy Commission. Except as the Commission may authorize, in accordance with the Atomic Energy Act of 1946, you agree not to permit any individual to have access to restricted data until the Federal Bureau of Investigation shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual and the Commission shall have determined that permitting such person to have access to restricted data will not endanger the common defense and security. The terms "restricted data" as used in this paragraph means all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production

of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security. You will insert in all subcontracts under this contract, provisions similar to the text of paragraph (b) of this Article.

Patents: (a) Whenever any discovery of invention is made by your organization or any of your employees, or by any subcontractor or any of its employees, in the course of the work called for in this contract, you will furnish the Commission with complete information thereon and the Commission shall have the sole power to determine whether or not and where a patent application shall be filed, and to determine the disposition of the title to and the rights under any application for patents that may result. The judgment of the Commission on such matters shall be accepted as final, and you agree that you will execute all documents and do all things necessary or proper to carry out the judgment of the Commission.

(b) Without waiving the rights of the Government under the foregoing provision, it is agreed that all provisions of the Atomic Energy Act of 1946 relating to patents and inventions are hereby incorporated by reference. No claim for pecuniary award under the provision of the Act shall be asserted by you or your employees or by any subcontractor or its employees with respect to any invention or discovery made in the course of the work called for herein.

(c) You will insert appropriate provision to effectuate the purposes described in paragraphs (a) and (b) above, in contracts with your employees and subcontractors.

You will not subcontract any part of the work you are obligated to perform under this letter agreement except as may be authorized in writing by the Commission. The sums to be expended by the Government hereunder are chargeable to appropriation 8990100.001 904-101 SP320-10.

If you agree to the provisions of this letter, please indicate your acceptance by affixing your signature on this letter and three copies thereof, and returning to this office the original and two copies. Such acceptance will constitute this letter a contract on the terms set forth herein.

Exhibit A. Letter-of-Intent (Continued)

Holmes and Narver
September 16, 1948

The terms "Atomic Energy Commission" and "Commission" as used herein mean the United States Atomic Energy Commission or its duly authorized representative. This instrument is authorized by and negotiated under the Atomic Energy Act of 1946.

Sincerely yours,

THE UNITED STATES OF AMERICA

By: _____
Carroll L. Tyler, Manager
Santa Fe Directed Operations
U. S. Atomic Energy Commission

Receipt of the foregoing letter is hereby acknowledged and acceptance given to its terms and conditions this 16 day of Sept., 1948.

HOLMES AND NARVER, ENGINEERS

By: _____
Partner

By: _____
Partner

Exhibit A. Letter-of-Intent (Continued)

EXHIBIT B

Memorandum of Understanding Pertaining to Negotiation of an Architect-Engineer-Management Contract Between the Atomic Energy Commission and Holmes and Narver

December 21, 1948

LAB-J-513 HN-176

MEMORANDUM OF UNDERSTANDING
PERTAINING TO NEGOTIATION OF AN ARCHITECT ENGINEER MANAGEMENT CONTRACT
BETWEEN THE ATOMIC ENERGY COMMISSION AND HOLMES AND NARVER, ENGINEERS

1. There is set forth herein understanding between the Atomic Energy Commission, represented by officials of the Santa Fe Operations Office, and Holmes and Narver, Engineers, 824 South Figueroa Street, Los Angeles 14, California, developed during negotiations for a definitive contract covering a considerable scope of work in connection with preliminary reconnaissance, reports, designs, construction, maintenance, operation and special services to be performed in the development of a permanent proving ground at Eniwetok Atoll.

2. It is the intent of the Atomic Energy Commission to continuously employ Holmes and Narver from the project's inception to its completion, subject to satisfactory performance. The Architect Engineer shall establish his planning on this basis and the definitive contract shall contain optional provisions for phases of future work which cannot be obligated under contract for budgetary reasons.

3. As of December 21, 1948, status of present contract arrangements is as follows:

> Letter Contract No. AT (29-1)-507, with Modification No. 1, dated September 28, 1948, governs the work now under performance.

Preliminary field reconnaissance and physical surveys have been accomplished, along with considerable other preliminary work including special tower designs. Final report is scheduled for submission January 15, 1949, which report shall be utilized to form a basis for complete definition of scope, determination of cost estimates, and other definitive data required for formal contract purposes.

Exhibit B. Memorandum of Understanding

4. Because of the broad scope and varied nature of the work to be performed under the definitive contract, it is agreed that a reimbursable type Architect Engineer Construction Management contract, with special provisions to cover maintenance, operation and other specific services, shall be entered into. It is the intent of both parties to utilize lump-sum subcontracts and purchase orders insofar as practicable.

5. In order that certain approved phases of the work can be initiated at an early date, and in conformance with schedules required to meet the over-all plan on the most economical basis, it is agreed that all preliminary work up to and including time of submission of the final report shall be covered by a negotiated fixed fee under contractual arrangements permitting full reimbursability for such costs as are agreed upon and contained in the contract.

6. Following completion of negotiations on the report phase, contractual arrangements will be entered into, covering the herein described general scope of work by agree phases, in accordance with predetermined time schedules covering budgetary periods. Appended hereto as Schedule 1 is a preliminary description of the major elements of the over-all scope of work, set forth according to respective time phases.

7. The Commission desires accomplishment of the following activities, described herein general terms, phased into the over-all time schedule. The Architect Engineer shall coordinate his planning, design, procurement and other operations to accomplish the desired objectives in accordance with the schedules and within monetary allotments established in the contract. Following are the objectives:

A. Because of the similarity of radiological conditions at Trinity and the Eniwetok Proving Ground and because of the experience that Holmes and

Exhibit B. Memorandum of Understanding (Continued)

Narver personnel can gain, it is desired to conduct an operation at the Trinity site consisting of rendering the present crater radiologically safe by such methods as are mutually agreed to be the Architect Engineer and representatives of the Los Alamos Scientific Laboratory of the University of California. Exact details and contractual arrangements will be worked out following survey and recommendations.

B. Construction Phase I - Target Dates, February, 1949 to June 30, 1949: Holmes and Narver shall provide necessary personnel, supplies, equipment, and services to initiate preliminary engineering and construction work in connection with site clearance and preparation, building rehabilitation and maintenance, facility and equipment repairs and maintenance, and shall accomplish the necessary procurement in connection with the above. During this period they will initiate architectural and engineering work in connection with Phase II construction. In addition to the procurement necessary for Phase I of the operation, Holmes and Narver shall procure towers in accordance with the designs already prepared by them and shall procure, or negotiate toward the procurement of, such other material and equipment as may be approved by the contracting officer. It is not anticipated that all of the above-outlined work can be completed within five months after starting, but as much will be done as conditions and availability of labor and equipment permit.

C. Construction Phase II - Target Dates, July 1, 1949 to December 1, 1949: Holmes and Narver shall, upon invoking of the option in the contract covering Fiscal Year 1950 work, furnish the necessary personnel, equipment, materials, supplies and services to carry on architectural and engineering services and initiate the major reconstruction program during the period of time above defined.

Exhibit B. Memorandum of Understanding (Continued)

Phase II is intended to accomplish major repairs and rehabilitation, as well as to inaugurate the major phases of the construction program.

D. Construction Phase III - Target Dates, December 1, 1949 to December 1, 1950: Holmes and Narver shall, upon invoking of the option in the contract, prosecute Phase III to its completion. Phase III includes the completion of engineering design and construction of semi-permanent and permanent facilities.

E. Operating Phase IV - Time of Service, July 1, 1949 to June 30, 1951: During the above stipulated period Holmes and Narver shall, upon invoking of the option in the contract, operate utilities and camp services, shall provide installation crews and equipment, shall accomplish such engineering and construction not previously included in Phases II and III, generally for special buildings, instrumentation and other scopes connected with the actual test operation; and shall provide labor, materials, equipment and services for such assistance to the Commission as the contracting officer may direct.

F. Roll-Up Phase V - June 30, 1951 to January 1, 1952: During the above-mentioned period Holmes and Narver shall, upon invoking of the option in the contract, accomplish the necessary work for roll-up of the operation, consisting generally of salvage, storage, demobilization and establishment of maintenance personnel to insure full protection of all structures and utilities, culminating in the conversion of the proving ground to a stand-by condition. In the event that continued services during the non-active period following January 1, 1952 are desired, such services will be considered an increase in scope and will be the subject of separate definitive contract arrangements.

8. In connection with performance of the above-outlined scope of work, the following understanding regarding the subjects listed shall prevail unless

Exhibit B. Memorandum of Understanding (Continued)

instructions to the contrary are received from the Atomic Energy Commission:

(a) Equipment

It is the intention of the parties, in order to effect economies in the work specified, where practical and feasible in the judgment of the Architect Engineer, to utilize equipment, supplies and material from the Armed Forces. If, in the opinion of the Architect Engineer, procurement from the Armed Forces stores is impractical or not feasible, they will initiate procurement of equipment or negotiate for the use thereof through such other sources as may exist.

(b) Transportation

It is the intention of the parties, in order of effect economies in the work specified, where practical and feasible in the judgment of the Architect Engineer, to utilize military aircraft, ships, boats, and vehicles of the Armed Forces. If, in the opinion of the Architect Engineer, such utilization is impractical or not feasible, they will initiate procurement of transportation or negotiate therefore through such other sources as may exist.

(c) Warehousing

The Atomic Energy Commission will acquire or lease adequate warehousing space in the continental United States to facilitate supply of the operation. Operational control of such warehousing shall be delegated to Holmes & Narver. Costs in connection with the warehousing operation shall be reimbursable.

(d) Logistic Support

Approved costs in connection with logistic support of personnel furnished by Holmes and Narver shall be reimbursable. The term logistic support shall include messing facilities, commissary, medical facilities and supplies.

Exhibit B. Memorandum of Understanding (Continued)

recreational services and such other services and supplies as are necessary in order to adequately conduct the operation.

(During the course of the contract, quarters provided employees under this operation shall be rent-free.)

9. The usual appendices to the contract covering details of reimbursement, personnel policy and salary-wage schedules, and such other appendices as are required for the accomplishment of the contract will be incorporated at a later date.

10. By virtue of the additional scope of work added to existing contractual arrangements, the monetary limit specified in Letter Contract No. AT (29-1)-507 is increased to a total of $530,000.00, exclusive of fees. Fixed fee for the services rendered will be determined when negotiations for a definitive contract are completed, for which the target date is January 15, 1949.

Encl: Schedule I

APPROVED:

HOLMES AND NARVER, ENGINEERS

By_____

_____

Date: December 22, 1948

APPROVED:

FOR THE ATOMIC ENERGY COMMISSION

By_____
Carroll L. Tyler
Manager, Santa Fe Operations Office

Date: December 22, 1948

Exhibit B. Memorandum of Understanding (Continued)

HN-176

MASTER PLANNING

Report, First Reconnaissance Trip

Design - Over-all Scope

1. Tower Design and orientation
2. Utilities:
   (a) Water Supply
   (b) Severage
   (c) Power Plants and distribution
   (d) Communication
   (e) Cable installation and maintenance
3. Housing
4. Gamma Buildings tube reorientation
5. Aggregate and fill sources
6. Grading, tower areas
7. Paving
8. Piers
9. Causeways
10. Field Surveys
11. Miscellaneous Buildings

Construction - Over-all Sequence of Steps to be Taken

1. Field Surveys
   (a) Trinity - filling of crater
2. More cable tests
3. Maintenance between now and construction time
4. Procurement
5. Initial construction crew, to build camp and for #8
6. Shipping of men and materials
7. Interim Construction Program
8. Rehabilitation of existing buildings at atoll? Airstrips?
9. Protection of cable landings.
10. Ultimate construction program.

Field performance is itemized on following sheets, in various phases.

SCHEDULE I -1-

Exhibit B. Memorandum of Understanding (Continued)

SCOPE OF ACTIVITY

Construction Phase I

February 1949 to July 1, 1949
___Months

1. Establish resident engineer at site.
2. Grading of Engebi, Aomon, and Runit for radio safety.
3. Clear and grub Bogallua, if selected as fourth site.
4. Maintain air strips (weed removal, reshape and blade, roll and water surface).
5. Remove condemned buildings from Eniwetok and Parry.
6. Sustain the garrison's facilities to care for fifty guests.
7. Insect control on Eniwetok, Parry, Aniyaanii, Rojoa, Runit, Biijiri, and Aomon; Nuzim, Engebi, Bogombogo, and Bogallua.
8. Protective coatings for towers, (3, 75 feet)
9. Land survey (triangulation, mapping, design data).
10. Cable testing.
11. Repair and maintenance of heavy equipment and boats.
12. Initial procurement.
13. Causeway protection work.

Construction Phase II

(Initial construction crew, building trades, etc., to live at garrison. Sliding scale of mobilization fifty to seven hundred fifty men.)

July 1, 1949 to December 1, 1949
5 Months

1. Eniwetok garrison power supply maintenance.
2. Eniwetok garrison water supply maintenance.
3. Eniwetok garrison piping systems maintenance.
4. Eniwetok garrison water transportation repair and replacement.
5. aircraft maintenance repair and replacement.
6. land transportation repair and replacement.
7. Build construction camp, with self-contained utilities (Parry).
8. Rebuild piers, Eniwetok, Parry, Runit, Aomon, Engebi.
9. Build pier and shootchannel, Bogallua, if fourth site selected.
10. Open quarries, Rojoa, Runit, Engebi, Bogombogo.
11. Cable landing protection.
12. Temporary inter-island communication (existing cable, except add line to Bogallua).
13. Procurement, kitchen and camp equipment.
14. Procurement for construction material.
15. Procurement for construction equipment.
16. Transportation of previous items.
17. Transportation of construction workers.

Construction Phase III

Nov. 1949 to Nov. 1950 - 12 Mos.

1. Complete temporary type, 150 man camp, on Bogalluna
   Engebi
   (Utilities & temporary power, concrete slabs) Rojoa
   Runit
2. Causeway, Biijiri to Rojoa.
3. Set up crusher, batch plant, paving mix machine.
4. Cable laying.
5. Tower erection.
6. Rehabilitate warehouse space, Parry.
7. Permanent electrical distribution.
8. Permanent power plant or plants.
9. Permanent Reefer plant.
10. Air strip sub-base and paving.
11. Permanent water supply and distribution.
12. Permanent sewers.
13. Shipping total bill of materials.
14. Concrete construction and permanent buildings.
15. Purchase of boats and vehicles for operating phase.
16. Communications facilities.
17. Paving of roads and areas on Bogallua, Engebi, Aomon, Runit, Parry.

Operating Phase IV July 1, 1949 - June 30, 1951

1. Operate utilities.
2. Operate camp services.
3. Installation crews and equipment.
4. Late construction, of special buildings and instrumentation.

Roll-up Phase V June 30, 1951 to Jan. 1, 1952

1. Salvage
2. De-humidified storage.
3. Resident maintenance personnel.
4. De-mobilization.
5. Security and radio safety.

REQUIREMENTS

OPERATION PHASE I

Services, Personnel and Equipment not Included

Messing, Housing, Laundry, etc.

Office Space

Gasoline and Oil for equipment operation

Local Air Transportation

Operators and Repairs for Boats

Material for repair of Buildings

Replacement of Equipment

Holmes & Narver Required Personnel

8 -MOS 932 - Heavy Equipment operator (4 only if extra equipment not available)

2 -MOS 931 - Truck driver, heavy

1 -MOS 141 - Oiler

1 -MOS 923 - Welder

2 -MOS 144 - Painter

3 -MOS 356, Labor Foreman

8 -MOS 188 - Construction Labor

1 -Resident Engineer

1 -Survey Supervisor

1 -Chief of Party

1 -Transitman

1 -Levelman

1 -Chainman

2 -Diesel Mechanics

1 -Clerk and Stenographer

1 -Stenographer

Exhbit B. Memorandum of Understanding (Continued)

A. Equipment Required and Apparently Available on the Island (in working condition)

1 - 10 C. Y. Scraper (no power unit)
1 - D8 Cat
1 - Motor Patrol
1 - 10-ton Road Roller
1 - 20-tone Crane
1 - 1/2 C.Y. Concrete Mixer

B. Equipment Required and Probably Available on Island

2 - LCVP (or LCM or LCT)
2 - DUKW (occasional use)
1 - LCM (Occasional use)
1 - Boatswain Chair with fittings
1 - Acetylene cutting torch
2 - Portable Inspect Spray outfits
Supply of DDT and diesel
1 - Lock file or locker
Motor repair shop and tools
Miscellaneous small tools, shovels, axes, etc.
Office furniture
Rope, blocks, cable, clips, etc.
Lumber and plywood in limited quantity
1 - Portable gasoline operated pump approximately 200 g.p.m., 100 ft. head for salt water with suction hose, 500 ft. of fire hose, nozzle, etc.
Rat poison

C. Additional Equipment Advisable if Available

2 - D8 Cats
2 - 10 C.Y. Scrapers with power units
1 - Power unit for 10 C.Y. Scraper
2 - Jeeps
2 - 2 1/2 Ton Dump trucks
1 - 3/4 Ton Weapons Carrier
1 - Portable pump as listed on "B"

Exhibit B. Memorandum of Understanding (Continued)

D. Supplies and Equipment to be Purchased

Survey Supplies (Approx. weight 500 lbs.)
Prefer to accompany personnel, 370 lbs. could be separately shipped January 1.

1 - Wild Theodolite complete with tripod (temporary use) and accessories if available from Military Supplies (alternate 6" Berger or equal transit).

1 - Base line stretcher apparatus
2 - 100' Lovar Tapes
4 - Station Lights
2 - 30" Transits & Tripods (Berger or equal)
2 - 18" Dumpy levels & tripods (Berger or equal)
2 - 300' Band Tapes 1/4"
2 - 100' Band Tapes 1/4"
2 - 100' Metallic Tapes
2 - Stadia boards (12' Folding)
2 - Level rods 12' Philadelphia
2 - Level rod Levels
3 - Hand Levels
6 - 16 ounce Plumb bobs
4 - Plumb bob seabboards
3 - Chaining grips
2 - Tension handles
4 - Thermometers
3 - Field Bags
4 - Stake Bags
2 - Umbrellas
4 - Range poles 8' two section
6 - Plumb bob Targets
1 - Tape repair Kit
3 - doz. Field boods (duplicating)
4 - doz. note books, paper cover
6 - Pocket tapes 6' inches and Tenths
1 - Stadia slide rules
2 pr. Binoculars
24 - Sheets 24" x 31" Planetable paper (double mounted)
2 - bottles instrument oil
1 - Set Jewelers screw drivers
6 - Instrument & adjusting pins
4 - Hand axes
400 yds. cotton bunting - 200 white, 100 red, 100 yellow
100 yds. plumb bob string
1 - set steel dies 3/16" Letters and numerals
3 - 5/16" Star drills
2 - Center punches
5 Lbs. roofing tins
9 doz. Lumber crayons, 3 doz. each red, blue, yellow
1 - Spirit Levels 24"

Survey Towers (Approx. weight 18,350 lbs.)
Ship January 15.

5800 BFM Precut No.1 lumber
350 lbs. Galv. bolts & washers.

Exhibit B. Memorandum of Understanding (Continued)

E. Information Maps, etc. Required

1 - cpy. Army-Navy Civil Affairs Hand Book of Marshall Islands

1 - cpy. Department of Commerce 48-Hour Dirpersion Diagrams - Eniwetok

1 - cpy. Department of Commerce, Raobs, Pibals, Rawins, and Surface Weather Data at Eniwetok

6 - cpys. U. S. Hydrographic Office Chart of Eniwetok Atoll - NO. 6033

1 - cpy. Department of Commerce Weather Conditions in the Marshall Islands

6 - cpys. each - Set of four (4) charts. U.S. Hydrographic Office, Marshall Islands, Eniwetok Atoll Field Chart, Nos. 2009, 2010, 2011 and the Chart adjoining 2011 to the West.

TM's Required:

5-255	5-235
5-277	5-632
5-277	5-671
5-2069	5-680
5-3068	5-680A
5-5090	5-680C
5-5160	5-680D
5-9720	5-680E
5-9720	5-680F
5-9720	5-680G
5-285	5-1016
5-295	12-426
	12-427

Exhibit B. Memorandum of Understanding (Continued)

Construction Supplies (Approx. weight 7,370 lbs.)
Ship Jan. 15.

2 - cyl. Acetylene (duplicate shipment in March & May)
6 - " Oxygen (" " " " ")
2 - Oxyacetylene burner tips
1 - Drum Turpentine
1 - drum Thinner
100 - gal. Ready-Mix, Zinc Chromate, metal, primer coat paint
100 - gal. " " " " " finish " "
5 - gal. Lead & oil paint, black (duplicate shipment in Mar. & May)
5 - gal. " " " , white (" " " ")
5 - gal. " " " , red (" " " ")
5 - gal. " " " , green (" " " ")
1 - doz. wire brushes
3 - doz. 3" paint brushes
1 - doz. 2" paint "
1 - doz. 1" " "
40 - doz. Canvas booties
40 - doz. " gloves
200 - lbs. assorted nails, galv.
100 - lbs. assorted bolts & screws, galv.

General Supplies (Approx. weight 500 lbs.)
Prefer to accompany personnel.

1 - Set Carpenter tools
4 - Thermos jugs, 1 gal.
6 - Padlocks, bronze
1 - 72" Drafting table and stool
Stationery, drawing paper, etc.
Misc. office supplies & drafting instruments
1 - Portable typewriter
1 - Calculating machine
1 - Drafting machine

Holmes & Narver Personnel

Personnel weight and personnel baggage, including tools, reference books, etc. - 2400 lbs.

EXHIBIT C

Appendix "D", Contract
No. AT-(29-1)-507

APPENDIX "D"

CONTRACT NO. AT(29-1)-507

SCOPE OF WORK AND SERVICES,

CONTRACT TERMS AND BASIS

FOR PAYMENTS

PART I

DESCRIPTION OF WORK ITEMS

The following are the various design and construction projects on which work will be performed by the A-E-C-M under this contract. Changes may be requested in the work items by means of directives without formal modifications of the contract, except that for changes which materially increase or decrease the scope of the work to be performed hereunder there will be an adjustment in the fixed-fee paid to the A-E-C-M in accordance with Article XIII of the contract.

Item No.	Description			Estimated Construction Cost
1	Operational Buildings, Warehouses, Quarters, Mess Halls and Associated Buildings & Equipment			
	a. (1) Aluminum	Parry Is.	142,400 Sq. Ft.	
		Eniwetok Is.	117,100 " "	
		Engebi Is.	111,400 " "	
		Aomon Group	11,400 " "	
		Runit Is.	11,400 " "	
			293,700 Sq. Ft.	
	(2) Tents on Frame & Concrete Base			
		Parry Is.	50,000 Sq. Ft.	
		Eniwetok Is.	150,000 " "	
		Engebi Is.	63,000 " "	
		Aomon Group	63,000 " "	
		Runit Is.	63,000 " "	
			389,000 Sq. Ft.	
	(3) Extra Concrete Slabs for Tents		99,600 Sq. Ft.	$4,125,000
	b. Refrigeration (all operational islands)			290,000

Exhibit C Contract Appendix "D"

Item No.	Description	Estimated Construction Cost
1	c. Water Purification and Systems, including Distilled and Salt Water Distribution, Capacities:	
	Parry Island Distilled 45,000 GPD Salt 90,000 GPD (Special Fire Protection)	
	Eniwetok Distilled 45,000 GPD Salt 90,000 GPD (Special Fire Protection)	
	Engebi, Aomon Group, Runit, ea. Distilled 7,000 GPD Salt 7,000 GPD	$1,700,000
	d. Sewage Disposal Systems (all operational islands)	550,000
2	Power and Communications	
	a. Power Generation & Distribution Parry - Max. 300 KW Eniwetok - Max. 425 KW Engebi, Aomon Group, Runit ea. Max. 200 KW and 100% backup One plant each operational island underground and overhead distribution	1,480,000
	b. Communications Parry 100 instruments & 200 line board Eniwetok 100 " & 100 " " Engebi 30 " & 50 " " Aomon Group 30 " & 50 " " Runit 30 " & 50 " "	
	Submarine cables inter-island, overhead distribution on islands, radio Backup and PA system on Engebi, Aomon, Runit	1,375,000
3	Transportation Facilities	
	a. Pier Construction	
	Engebi, Aomon, Runit - 100' x 40' coral fill including 36' ramp	
	Parry, Eniwetok & Rojoa Repair as per report and construct personnel pier as shown on each	545,000

Exhibit C (Continued)

Item No.	Description		Estimated Construction Cost
3	Transportation Facilities Cont'd		
	b. Fuel Storage & Handling Facilities		
	Parry		
	2 Tanks, 1000 bbl cap motor gas		
	4 Tanks, 1000 bbl cap diesel fuel		
	Eniwetok		
	4 Tanks 1000 bbl cap aviation fuel		
	4 " " " " Motor fuel		
	3 " " " " diesel oil		
	Submarine pipe lines for off-loading tankers		$650,000
	c. Air Strip Construction & Paving		
	Parry Island	800' x 50'	
	Engebi & Aomon	800' x 50'	
	Runit	600' x 50'	150,000
	d. Roads		
	(1) Paved construction		
	Parry	62,000 Sq. Yds.	
	Eniwetok	52,000 " "	
	Engebi	16,400 " "	
	Aomon	16,500 " "	
	Runit	16,500 " "	
	(2) Stabilized Construction & Dust Palliative, approx. as above (1)		770,000
4	Technical Construction		
	a. Shape, Pave and Stabilize Areas		
	(1) Pave Areas		
	Engebi	55,500 Sq. Yds.	
	Aomon	45,700 " "	
	Runit	44,400 " "	
	(2) Stabilize Areas		
	Engebi	89,000 Sq. Yds.	
	Aomon	66,500 " "	
	Runit	44,400 " "	1,235,000
	b. Causeway Biijini - Rojoa		
	Bailey Bridge or cheaper to cross channel 700' wide x 21' deep		235,000
	c. Towers		
	4 - 300' tripod type		
	6 - 75' " "		650,000

Exhibit C (Continued)

d. Site Preparation Rehabilitation, surveys, maintenance & reorientation of buildings	375,000
e. Control & Signal System Extension of control cables, testing rehabilitation of cable landings	390,000
TOTAL	$14,520,000

Exhibit C (Continued)

EXHIBIT D

Memorandum of Agreement for Participation
in Construction Program, Eniwetok Atoll

MEMORANDUM OF AGREEMENT FOR
PARTICIPATION IN CONSTRUCTION PROGRAM
ENIWETOK ATOLL

1. In view of the rapid approach of the time when actual construction of facilities on Eniwetok Island will begin, it was considered desirable to call a meeting between the various parties having an active interest in this construction for the purpose of final agreement as to the division of responsibility and construction activities between the Atomic Energy Commission and its contractor, Holmes & Narver; and Joint Task Force Three and the Construction Battalion. Accordingly, such a meeting was held at JTF-3 Headquarters, Washington, D.C., on January 30, 1950. The following persons were present:

JTF-3:

Lt. Gen. E. R. Quesada, Commanding
Brig. Gen. Loper
Col. Hale
Col. Tate
Capt. Pahl
Col. Stanford
Lt. Col. Alexander
Mr. Riley

7th Engr. Brigade:

Brig. Gen. Butler
Lt. Col. McCrone
Maj. Lyon
Maj. Detlie

AEC:

Col. Schlatter
Mr. Spain
Mr. LaPlante

Holmes & Narver:

Mr. Holmes
Mr. Lester Kelly

2. The following agreements were made or reaffirmed:

a. The items listed below constitute a complete listing of facilities to be constructed on Eniwetok Island for which AEC will procure materials:

Exhibit D Memorandum of Agreement

Item		Bldg. No.
(1)	Power House Transmitter	3
(2)	Transmitter Building	4
(3)	Latrines	5-8
(4)	36-man Barracks	10
(5)	72-man Barracks	11-13
(6)	Dispatchers Building	14
(7)	Army Task Group Headquarters	15
(8)	Post Office and P.X.	16
(9)	Latrine	17
(10)	18-man Barracks	18-21
(11)	Ward Building	23
(12)	Dispensary	24
(13)	Fire Station	29
(14)	800-man Theatre	30
(15)	Laundry	31
(16)	Reefer Building	33
(17)	Boiler House	34
(18)	Bakery	35
(19)	Mess Hall	36
(20)	Commissary	37
(21)	18-man Barracks	38-42
(22)	Latrines	43-44
(23)	800-man Theatre	45
(24)	Latrines	51-55
(25)	Power Plant & Distillation	56
(26)	Rad. Chem. Building	57
(27)	Drone Headquarters	77
(28)	Air Operations	78
(29)	Power House, Receiver	84
(30)	Receiver Building	85
(31)	Drone Control Ramp	86
(32)	Hydrogen Shack	87
(33)	Weather Instrument Repair Building	88
(34)	Base Operations & Control Tower	89
(35)	Air Task Group Headquarters, AACS, Air Plot, Photo Operations	90
(36)	Crash Truck Shed	91
(37)	L-13 Operations	92
(38)	L-13 Maintenance	93
(39)	P.O.L. Pumphouse	94
(40)	P.O.L. Submarine Lines	--
(41)	P.O.L. Storage Tanks	--
(42)	Fresh Water Tanks	107
(43)	Latrines	109-115
(44)	Loran Station	116
(45)	NRDL 7 Chem. Corps. Area	117
(46)	Tent Slabs & Frames	As shown on Layout

Exhibit D (Continued)

Item		Bldg. No.
(47)	Cargo Pier Extension	--
(48)	Personnel Pier	--
(49)	Runway Extension & Rotation	--
(50)	Parking Areas & Taxiways (including L-13 tiedowns)	--
(51)	Roads and Streets	--
(52)	Electrical Distribution System	--
(53)	Fresh & Salt Water Distribution Systems	--
(54)	Sewage System	--
(55)	Telephone System	--
(56)	Open Air Shower	9
(57)	Ward Building	22
(58)	72-man EM Quarters	46-50
(59)	Gas Storage	95
(60)	JP 1 Fuel	96
(61)	Movie (800-man)	108
(62)	Telemeter Trailer	120
(63)	Elevated Water Storage	121
(64)	Latrines	122-123
(65)	Salt Water Pump Station	124
(66)	Latrine & Decontamination Shower	125
(67)	Latrines	127-130
(68)	Booster Pump House	131
(69)	Rehabilitation of Bldgs. 58-76, 79, 80 82a and b, 83, 98, 99, 100-106	

b. Holmes and Narver will design all facilities listed in paragraph 2a, will furnish 10 complete sets of working drawings to the Battalion, and one transparency of each building floor plan and elevation to JTF-3 Headquarters.

c. Holmes and Narver will construct the facilities in 2a(1), (2), (25), (29), (30), (40), (48), (52), and (54). The Receiving Building and Power House, Nos. 2a(29) and (30), will be constructed by Holmes and Narver after the arrival of the Battalion as a demonstration to battalion personnel of the proper method of erection of the prefabricated aluminum buildings. Item (25) will be constructed by Holmes and Narver complete except for the aluminum building shell and such assistance as the Battalion can render in layout, excavation, concrete placement, and unskilled labor. Item (52) will be constructed complete to the service drops by Holmes and Narver, utilizing such assistance as the Battalion can furnish in layout, setting poles and furnishing apprentice labor. Item (54) will be constructed by the Battalion, except that Holmes and Narver will construct the sewer outfalls from the last manhole on the beach.

d. The Battalion will construct all facilities listed in paragraph 2a except those listed in paragraph 2c above. This includes layout and staking.

Exhibit D (Continued)

e. Holmes & Narver will procure all construction materials to be incorporated into the various structures. This includes cement, commercial explosives for excavation and quarrying, and fixed equipment in the buildings, such as sinks, kitchen equipment, bakery equipment, fixed reefers, toilet fixtures, a reasonable amount of lumber and plywood for tent frames, shelving and lockers, and the like. It does not include form lumber, construction equipment and hand tools, concrete aggregate, hospital equipment other than fixed, office and quarter furnishings, mess table and chairs, crockery and silverware, tents, and special equipment such as weather equipment, shop equipment and the like. Such Holmes & Narver procurement may be from Department of Defense stocks in accordance with existing agreement. A ship will arrive at the site on or about April 7, 1950, with sufficient materials to provide for immediate full-scale construction effort on the part of the Battalion.

f. Task Group 3.2 will frunish all stevedoring services from hold to shore on Eniwetok and Parry Islands. Holmes & Narver will provide stevedoring service from lighter to shore on all other islands. Holmes & Narver will normally operate all boats, tugs, barges and lighters, but will be supplemented by boats from Task Group 3.2 (by mutual agreement) as required.

g. In order to assist the Battalion during the construction period, Holmes & Narver will furnish the following personnel:

One construction superintendent

One each craft foremen: Plumber, steamfitter, interior electrician, exterior electrician, concrete (during initial stage of construction only)

Two each craft journeyman: Plumber, interior electrician (for a 90-day period)

These men will report to the construction superintendent and will direct work only through the commissioned or non-commissioned officers in direct charge of the particular phase of work. The construction superintendent will advise and assist the Commanding General of his designated constructing Engineer and will be the representative of the AEC Resident Engineer for inspection purposes on behalf of the AEC.

h. Holmes & Narver will operate and maintain the electrical generators to the board, water distillation units to the elevated tanks, salt water pumps to the main and refrigeration units. Task Group 3.2 will operate the P.O.L. facilities and Holmes & Narver will maintain these facilities including P.O.L. Submarine Lines. Task Group 3.2 will assist Holmes & Narver in accomplishing the above by furnishing personnel as required.

Exhibit D. (Contined)

1. Holmes & Narver will provide all materials and replacement parts for maintaining the building and facilities listed in paragraph 2a with the exception of item (44). This is to include installed equipment provided by Holmes & Narver from commercial sources.

3. It was agreed that all parties concerned will mutually cooperate and assist. Direct coordination and cooperation between the AEC Resident Engineer and his designees, and the Commanding General and his designees is desirable and is authorized, bearing in mind that changes in the scope of the work must have the approval of the Resident Engineer's home office. Where possible, mutual exchange of construction equipment for specialized jobs will be made, with priority of use being judged by the Resident Engineer.

Approved: /s/ E.P. Morgan, Acting
C. L. Tyler
Manager, Santa Fe Operations
U. S. Atomic Energy Commission

Approved: /s/ E. R. Quesada
E. R. Quesada, Lt. Gen.
Commanding
Joint Task Force Three

Exhibit D (Continued)

EXHIBIT E

Items of Additional Scope, Modification No. 13, Contract No. AT-(29-1)-507

ITEMS OF ADDITIONAL SCOPE

MODIFICATION 13, CONTRACT NO. AT-(29-1)-507

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
N.O.B.L. PROGRAM			
20A	CE	Concrete Wall	10,480
20B	CE	Concrete Wall	10,480
20C	CE	Concrete Wall	10,480
20D	CE	Concrete Wall	10,480
20E	CE	Concrete Wall	10,480
20F	CE	Concrete Wall	10,480
21A	E	Concrete Wall	5,240*
21B	E	Concrete Wall	5,240*
21C	E	Concrete Wall	5,240*
22A	CE	Tents	1,980
22B	CE	Tents	1,980
22	E	Tents	990
23A	VC	Concrete Building	2,960
23A-B	E	Concrete Building	9,470
24A	E	Tent	990
24B	E	Tent	990
25	E	Concrete Building	15,390
26A	E	Concrete Anchorage	490
26B	E	Concrete Anchorage	490
26C	C	Concrete Anchorage	490
27A	EC	Concrete Gauge Mounts	2,320
27B	EC	Concrete Gauge Mounts	2,320
27C	EC	Concrete Gauge Mounts	2,320
27D	EC	Concrete Gauge Mounts	2,320
28A	CVE	Gauge Pipe	1,710
28B	GVE	Gauge Pipe	1,710
28C	CVE	Gauge Pipe	1,710
28D	CVE	Gauge Pipe	1,710
28E	CVE	Gauge Pipe	1,710
28F	CVE	Gauge Pipe	1,710
28G	CVE	Gauge Pipe	1,710
28H	CVE	Gauge Pipe	1,710
281	CVE	Gauge Pipe	1,710
28J	CVE	Gauge Pipe	1,710
28K	V	Gauge Pipe	570
29A	E	Gauge Pipes	570
29B	E	Gauge Pipes	570
29C	E	Gauge Pipes	570
29D	E	Gauge Pipes	570
29E	E	Gauge Pipes	570
29F	E	Gauge Pipes	570
29G	E	Gauge Pipes	570
29H	E	Gauge Pipes	570

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
N.O.B.L. PROGRAM			
29I	E	Gauge Pipes	570
29J	E	Gauge Pipes	570
29K	E	Gauge Pipes	570
30A	EC	Wood Building	9,400
30B	EVC	Wood Building	14,100
30C	EVC	Wood Building	14,100
32A	EVC	Rocket Launcher	600*
32B	EVC	Rocket Launcher	600*
32C	EVC	Rocket Launcher	600*
32D	EV	Rocket Launcher	400*
32E	EV	Rocket Launcher	400*
32F	EV	Rocket Launcher	400*
32G	EV	Rocket Launcher	400*
32H	EV	Rocket Launcher	400*
32I	E	Rocket Launcher	200*
32J	E	Rocket Launcher	200*
32K	E	Rocket Launcher	200*
32L	E	Rocket Launcher	200*
33A	EC	Steel Stakes	220
33B	EC	Steel Stakes	220
33C	EC	Steel Stakes	220
33D	EC	Steel Stakes	220
33E	EC	Steel Stakes	220
33F	EC	Steel Stakes	220
33H	EC	Steel Stakes	220
33I	EC	Steel Stakes	220
34A	EC	Steel Stakes	220
34B	EC	Steel Stakes	220
34C	EC	Steel Stakes	220
34B	EC	Steel Stakes	220
35	EVC	Boom on Tower	1,500*
36A	EV	Ground Shock Station	740
36B	EV	Ground Shock Station	740
36C	EV	Ground Shock Station	740
36D	EV	Ground Shock Station	740
36E	EV	Ground Shock Station	740
36F	E	Ground Shock Station	370
37A	E	Pylons 15' Concrete	3,760
37B	E	Pylons 15' Concrete	3,760
37C	E	Pylons 15' Concrete	3,760
37D	E	Auxiliary to Pylons	280
37E	E	Auxiliary to Pylons	280
37F	E	Auxiliary to Pylons	280
38	EC	Tents	1,220
39A	E	Balloon Anchorage	1,170

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
N.O.B.L. PROGRAM (Continued)			
39B	E	Balloon Anchorage	1,170
39C	C	Balloon Anchorage	1,170
		TOTAL N.O.B.L. PROGRAM.....	215,520

*Denotes figures that are estimated without firm design.

J-7 PROGRAM

40	E	Paved Area	2,030
41	S	Paved Area	2,030
42	V	Paved Area	2,030
		TOTAL J-7 PROGRAM.....	6,090

N.B.S. PROGRAM

50A	EVC	Limonite Block	15,870
50B	EVC	Limonite Block	11,820
50C	EVC	Limonite Block	11,820
50D	EVC	Limonite Block	11,820*
51A	EVC	Post - Limonite	11,490
51B	EVC	Post - Limonite	11,490
51C	EVC	Post - Limonite	11,490
51D	EVC	Post - Limonite	11,490
52	E	Limonite Blocks Spatial Tubes	170,720
52	C	Limonite Blocks Spatial Tubes	170,720
53	EC	Limonite Blocks Spatial Tubes	105,020
54	EC	Spectrometer Building	291,040*
55	EC	Recorder Building	34,240
56	V	Concrete Building	10,670
57	EC	Limonite Building	239,360
591A	EC	Wood Hutments	2,240*
591B	EC	Wood Hutments	2,240*
592A	EC	Tents	1,580
592B	EC	Tents	3,220
592C	EC	Tents	1,580
592D	EC	Tents	3,220
592E	EC	Tents	3,220
593A	EC	Wood Hutments	2,240
593B	EC	Wood Hutments	2,240

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
N.B.S. PROGRAM (Continued			
593C	EC	Wood Hutments	2,240
		TOTAL N.B.S. PROGRAM.....	1,143,080

*Denotes figures that are estimated without firm design.

E.G.G. PROGRAM

60	MNPQ	75' Tower and Cab	------**
61	MNPQ	Batter Hut	16,600
62	NQ	75' Towers	------**
63	NQ	Battery Hut	8,300
64	NQP	Power Plant	59,690***
65	NQP	Tents	1,830
66	NQP	Paving Mat	15,600
68	EVC	Rack in O Tower Cab (Incl. in Item 1)	------
69	EVC	Communications Building	89,640
		TOTAL E.G.G. PROGRAM	191,660

**These items included in contract Modification No. 7.
***Increased scope in power plants allowed in this Modification.

N.R.L. PROGRAM

1	EVC	In Tower Cab (68,130,140 Incl)	21,000*
2	EVC	Wood Building	9,870
3	EVC	Power Outlet on Post (See All Users)	------
4	EVC	Power Outlet on Post (See All Users)	------
5	EVC	Power Outlet on Post (See All Users)	------
6A	EVC	Existing Timing Station	81,420
6B	EVC	Existing Timing Station	69,840
7	MNP	Wood Building	17,880
9	B	Existing Control Tower	2,500*
		TOTAL N.R.L. PROGRAM.....	202,510

*Denotes figures that are estimated without firm design.

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
		J-3 PROGRAM	
10	EVC	Limonite Block	21,135
11	EVC	Limonite Block	40,470
12	EVC	Limonite Block	16,110
13	EC	Gamma Station	------
14	EVC	Limonite Block	12,450
15	EVC	Limonite Block	10,620
16	EVC	Cables and Platforms	6,000*
17	EVC	Winch Base	6,000*
18	EVC	Pump House	20,490
19	VC	Limonite Block	11,580
		TOTAL J-3 PROGRAM.....	144,855

*Denotes figures that are estimated without firm design.

		LO-50 PROGRAM	
70A	EV	Cylinders	1,180
70B	EV	Cylinders	1,180
70C	EV	Cylinders	1,180
70D	EV	Cylinders	1,180
70E	EV	Cylinders	1,180
70F	EV	Cylinders	1,180
70G	EV	Cylinders	1,180
70H	EV	Cylinders	1,180
70I	EV	Cylinders	1,180
70J	EV	Cylinders	1,180
70K	EV	Cylinders	1,180
70L	EV	Cylinders	1,180
70M	EV	Cylinders	1,180
70N	EV	Cylinders	1,180
70O	E	Cylinders	590
70P	EV	Cylinders	1,180
70Q	EV	Cylinders	1,180
70R	EV	Cylinders	1,180
70S	EV	Cylinders	1,180
70T	EV	Cylinders	1,180
70U	EV	Cylinders	1,180
70V	EV	Cylinders	1,180
70W	EV	Cylinders	1,180
70X	V	Cylinders	590
70Y	V	Cylinders	590
70Z	V	Cylinders	590
71A	EV	Cylinders	1,180
71B	EV	Cylinders	1,180

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
LO-50 PROGRAM (Continued)			
71C	EV	Cylinders	1,180
71D	EV	Cylinders	1,180
71E	V	Cylinders	590
71F	V	Cylinders	590
71G	V	Cylinders	590
72A	E	Cylinder	5,900
72B	E	Cylinder	5,900
72C	E	Cylinder	5,900
72D	E	Cylinder	5,900
72E	E	Cylinder	5,900
72F	E	Cylinder	5,900
72G	E	Cylinder	5,900
72H	E	Cylinder	5,900
73A	EVC	Hemisphere	90
73B	EVC	Hemisphere	90
73C	EVC	Hemisphere	90
73D	EVC	Hemisphere	90
73E	EVC	Hemisphere	90
73F	EVC	Hemisphere	90
73G	EVC	Hemisphere	90
73H	EVC	Hemisphere	90
74A	EVC	Hemisphere	90
74B	EVC	Hemisphere	90
74C	EVC	Hemisphere	90
74D	EVC	Hemisphere	90
74E	EVC	Hemisphere	90
74F	EVC	Hemisphere	90
74G	EVC	Hemisphere	90
74H	EVC	Hemisphere	90
511	E	Hemisphere	30
512	E	Hemisphere	30
513	E	Hemisphere	30
5141	E	Hemisphere	30
5142	E	Hemisphere	30
5151	E	Hemisphere	30
5152	E	Hemisphere	30
5161	E	Hemisphere	30
5162	E	Hemisphere	30
5171	S	Hemisphere	30
5172	S	Hemisphere	30
518	S	Hemisphere	30
519	W	Hemisphere	30
		TOTAL LO-50 PROGRAM.....	83,840

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
		T-B PROGRAM	
75	ER	Concrete Building	12,440
76	SN	Concrete Building	9,280
77	T	Wood Building	10,040
78	TC	Wood Building	10,040
79	PC	Wood Building	10,040
80A	EV	Sphere	720
80B	EV	Sphere	720
80C	EV	Sphere	720
80D	EV	Shpere	720
80E	SV	Sphere	720
81	E	Sphere	1,030
82	S	Sphere	1,030
		TOTAL T-B PROGRAM.....	57,500
		M-D PROGRAM	
83A	E	Cylinder	7,960
83B	E	Cylinder	7,960
84A	E	Cylinder	115
84B	E	Cylinder	115
84C	E	Cylinder	115
84D	E	Cylinder	115
84E	E	Cylinder	115
84F	E	Cylinder	115
		TOTAL M-D PROGRAM.....	16,610
		A.M.C. PROGRAM	
90A	E	Steel Box (Box furnished by User)	165
90B	E	Steel Box (Box furnished by User)	165
90G	E	Steel Box (Box furnished by User)	165
90D	E	Steel Box (Box furnished by User)	165
90E	E	Steel Box (Box furnished by User)	165
90F	E	Steel Box (Box furnished by User)	165
90G	E	Steel Box (Box furnished by User)	165
90H	E	Steel Box (Box furnished by User)	165

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTIONS	TOTAL COST
A.M.C. PROGRAM (Continued			
90I	E	Steel Box (Box furnished by User)	165
90J	E	Steel Box (Box furnished by User)	165
91A	S	Steel Box (Box furnished by User)	165
91B	S	Steel Box (Box furnished by User)	165
91C	S	Steel Box (Box furnished by User)	135
91D	S	Steel Box (Box furnished by User)	135
91E	S	Steel Box (Box furnished by User)	135
91F	S	Steel Box (Box furnished by User)	135
92A	P	Steel Box (Box furnished by User)	135
92B	P	Steel Box (Box furnished by User)	135
92C	P	Steel Box (Box furnished by User)	135
92D	P	Steel Box (Box furnished by User)	135
93A	Q	Steel Box (Box furnished by User)	135
93B	Q	Steel Box (Box furnished by User)	135
93C	Q	Steel Box (Box furnished by User)	135
93D	Q	Steel Box (Box furnished by User)	135
		TOTAL A.M.C. PROGRAM.....	3,600
		ALL USERS	
100	E	Power Plant	115,590***
100	VC	Power Plant	190,830***
101	STUF	Power Terminal	6,960
	C	Field Telephone Post Station	1,430
	E	Field Telephone Post Station	2,080
	N	Field Telephone Post Station	390
	P	Field Telephone Post Station	520
	Q	Field Telephone Post Station	520

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTIONS	TOTAL COST
ALL USERS (Continued)			
	R	Field Telephone Post Station	260
	S	Field Telephone Post Station	520
	T	Field Telephone Post Station	130
	V	Field Telephone Post Station	2,080
	C	Power Post and Receptacle	2,750
	D	Power Post and Receptacle	3,500
	E	Power Post and Receptacle	5,500
	S	Power Post and Receptacle	250
	V	Power Post and Receptacle	250
	E	Power Post without Receptacle	840
	S	Power Post without Receptacle	1,890
		TOTAL ALL USERS.....	336,290

*** Increased scope in capacity and building size.

U.C.R.L. AND N.R.L.K. PROGRAM

130	V	Tower and cab (Incl. in Station 1)---	
131A	V	Block House	132,000*
131B	V	- - -	------
132A	EV	1/2 Concrete Building	145,540
132B	EV	1/2 Concrete Building	145,540
132C	EV	Recording Station Power Supply	------
132D	EV	T.L. Terminal	------
132E	EV	Tent	4,440
132F	EV	Tent	4,440
132G	V	Photo Trailer (U.C.R.L. also User)	11,730
133	EV	Tent	4,440
134	EV	Tent	4,440
140A	E	Tank (Incl. in Station 1)	------
140A	V	Tank (Incl. in Station 1)	------
140B	V	Tower Cab (Incl. in Station 1)	----
141A	EV	1/2 Frame Building	29,800
141B	EV	1/2 Frame Building	29,800
142A	V	1/2 Frame Building	15,640
142B	V	1/2 Frame Building	15,640
142C	EV	Machine Shop Trailer	23,460*
143	EV	Concrete Pit with tent over it	9,400
		TOTAL U.C.R.L. AND N.R.L.K.....	576,310

*Denotes figuers that are estimated without firm design.

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTIONS	TOTAL COST
		O.C.S.O. PROGRAM	
5141	E	Hemisphere	30
5151	E	Hemisphere	30
5161	E	Hemisphere	30
5171	S	Hemisphere	30
518	S	Hemisphere	30
519	T	Hemisphere	30
		TOTAL O.C.S.O. PROGRAM.....	180
		METEOR PROGRAM	
421	E	Steel Box	300
423	E	Steel Box	300
424	E	Steel Box	300
425	E	Steel Box	300
426	E	Steel Box	300
427	E	Steel Box	300
428	E	Steel Box	300
429	E	Steel Box	270
4210	S	Steel Box	270
4211	S	Steel Box	270
4212	S	Steel Box	270
4212A	S	Steel Box	270
4213	T	Steel Box	270
4214	P	Steel Box	270
4215	Q	Steel Box	270
4216	Q	Steel Box	270
4217	V	Steel Box	270
4218	V	Steel Box	300
4219	V	Steel Box	300
4220	V	Steel Box	270
4221	V	Steel Box	270
4221A	V	Steel Box	270
4222	R	Steel Box	270
4223	N	Steel Box	300
4224	C	Steel Box	300
4225	C	Steel Box	300
4226	C	Steel Box	300
		TOTAL METEOR PROGRAM.....	7,680

ITEMS OF ADDITONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTIONS	TOTAL COST
A.M.C. PROGRAM (Continued)			
821	E	Foundations	23,895
822	S	Foundations	23,895
823	Q	Foundations	21,325
824	P	Foundations	17,535
825	E	Instrument Shelters	22,765
826	S	Instrument Shelters	18,575
827	Q	Instrument Shelters	18,575
828	P	Instrument Shelters	18,575
		General Layout for 8.2 Program	16,000
		TOTAL A.M.C. PROGRAM.....	181,140
		A.C.C. PROGRAM	
6101	E	Gauge-Hole in Ground 3' Dia. x 3'	190*
6102	E	Gauge-Hole in Ground 3' Dia. x 3'	190*
6103	E	Gauge-Hole in Ground 3' Dia. x 3'	190*
6104	E	Gauge-Hole in Ground 3' Dia. x 3'	190*
6105	S	Gauge-Hole in Ground 3' Dia. x 3'	190*
		TOTAL A.C.C. PROGRAM.....	950

*Denotes figures that are estimated without firm design.

		BRL-APG PROGRAM	
6311	E	Tank	100*
6312	E	Tank	100*
6321	E	Tank	100*
6322	E	Tank	100*
6323	E	Tank	100*
6331	E	Tank	100*
6332	E	Tank	100*
6341	E	Tank	100*
6342	E	Tank	100*
6351	E	Tank	100*
		TOTAL A.C.C. PROGRAM	1,000

*Denotes figures that are estimated without firm design.

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTION	TOTAL COST
		STRUCTURES PROGRAM	
301A	E	Concrete Shelter	26,580
301B	E	Concrete Shelter	31,880
301C	E	Concrete Shelter	31,880
301D	S	Concrete Shelter	21,365
301E	E	Concrete Shelter	26,580
301F	S	Concrete Shelter	20,610
301G	S	Concrete Shelter	21,365
301H	S	Concrete Shelter	20,610
301I	E	Concrete Shelter	33,160
301J	E	Concrete Shelter	35,350
301K	E	Concrete Shelter	25,690
302A	E	Mounts	2,940
302B	E	Mounts	2,940
302C	E	Mounts	2,940
302D	E	Mounts	3,590
302E	S	Mounts	2,290
302F	S	Mounts	1,560
302G	S	Mounts	1,560
302H	S	Mounts	1,080
302J	S	Mounts	1,560
302K	S	Mounts	1,030
302M	S	Mounts	1,560
302N	S	Mounts	1,080
302P	S	Mounts	1,080
302Q	S	Mounts	1,080
302R	S	Mounts	1,080
		TOTAL STRUCTURES PROGRAM.....	322,490

ITEMS OF ADDITIONAL SCOPE (Continued)

STATION NUMBERS	SITES	DESCRIPTIONS	TOTAL COST
		RAD-CHEM PROGRAM	
120A	EV	Piers or Slabs	4,440
120B	EV	Piers or Slabs	4,440
120C	EV	Piers or Slabs	4,440
120D	EV	Piers or Slabs	4,440
120E	EV	Piers or Slabs	4,440
121A	EV	Concrete Blocks	5,300
121B	EV	Concrete Blocks	5,300
121C	EV	Concrete Blocks	5,300
121D	EV	Concrete Blocks	5,300
121E	EV	Concrete Blocks	5,300
123	EV	Battery Hut 4 x 4 x 6	8,300
		TOTAL RAD-CHEM PROGRAM.....	57,000
		N.R.D.L. PROGRAM	
621	E	Concrete Lined Pit	200*
622	E	Concrete Lined Pit	200*
623	S	Concrete Lined Pit	200*
624	S	Concrete Lined Pit	200*
625	T	Concrete Lined Pit	200*
626	T	Concrete Lined Pit	200*
627	W	Incendiary Test Structure	300*
628	W	Incendiary Test Structure	300*
		TOTAL N.R.D.L. PROGRAM.....	1,800
		AFOAT PROGRAM	
771	E	Concrete Vault	8,250
772	V	Concrete Vault	8,250
773	C	Concrete Vault	8,250
774	U	Concrete Vault	9,150
775	A	Wood Building	3,620*
		TOTAL AFOAT PROGRAM.....	37,520

*Denotes figures that are estimated without firm design.

		A.M.C. PROGRAM	
811	E	Rad-Beacon	------
812	V	Rad-Beacon	------
813	C	Rad-Beacon	------
814	A	Rad-Beacon	------

SPECIAL SCIENTIFIC STRUCTURES

SUMMARY BY USER

ITEM	USER	TOTAL COST
1	N.O.B.L.	215,520
2	J-7	6,090
3	N.B.S.	1,143,080
4	E.G.G.	191,660
5	N.R.L.	202,510
6	J-3	144,855
7	LO-50	83,840
8	T-S	57,500
9	M-D	16,610
10	A.M.C.	3,600
11	ALL	336,290
12	U.C.R.L. and N.R.L.K.	576,310
13	O.C.S.O.	180
14	METEOR	7,680
15	RAD-CHEM	57,000
16	N.R.D.L.	1,800
17	A.F.O.A.T.	37,520
18	A.M.C. (Instrument Shelters & Found.)	181,140
19	A.C.C.	950
20	B.R.L. - A.P.G.	1,000
21	STRUCTURES (Military Structures)	322,490
	TOTAL	3,587,625
	LESS ITEMS 18 & 21	503,630
	TOTAL LESS ITEMS 18 & 21	3,083,995

EXHIBIT F

Items of Increased Scope, Modification No. 24, Contract No. AT-(29-1)-507

ITEMS OF INCREASED SCOPE, MODIFICATION NO. 24, CONTRACT NO. AT-(29-1)-507

Item & Feature		Description	Increase in Cost Gross	Increase in Cost Net	Increase in Scope Gross	Increase in Scope Net	Increase in Total Est. Construction Cost Orig. Total	Increase in Total Est. Construction Cost New Total
1	a	Blade and shape additional 6.500 sq. yd.			3,120		213,440	216,560
1	c	Dust palliative additional 3,250 sq. yd.			290		14,925	15,215
1	d	Aluminum buildings, latrines, 3,456 sq. ft.			38,030			
1	d	Connection between AEC and H&N Adm. Bldg., 1,632 sq. ft.			22,200			
1	d	Additional wing to existing mess hall - Parry, 2,184 sq. ft.			27,360			
1	d	Additional cooling facilities, photo lab., 110 sq. ft.			15,800			
1	d	Fence around Bldg. 221, Parry	4,025					
1	d	Extension to Comm. Room, JTF Bldg., Parry, 192 sq. ft.	2,825					
1	d	Water cooler & shelter, Bldg. 323, Parry	2,166				1,744,360	1,856,766
1	f	Additional 50 tents including slabs, frames, & lighting, 25,600 sq. ft.			59,660		57,440	117,100
1	h	Water facilities for 50 additional tents - 600 ft. fresh water lines and 600 ft. salt water lines			6,685		599,705	606,390
1	i	Sewer facilities for 50 additional tents - 600 ft. mains			1,365		125,625	126,990
1	k	Electrical facilities for 50 additional tents - 900 l.f. distribution pole line, 3-10 kva transformers, service drops			4,925		363,095	368,020
1	m	Inter-communication Equipment for Parry (9 master units, 7 sound powered telephones, 6,500 l.f.-16 pair outdoor tel.						

		cable, 65-35 ft. poles, 7,000 l.f. 3/8" messenger cable, & installation of 43 radio-comm. units)		41,055	32,255	73,310
1	q	Additional hot lockers - Parry	27,670		74,475	102,145
1	w	(New item) - CMB Buildings including roads and fencing		344,045		344,045
1	x	(New item) - Underground shelter area - Parry		30,340		30,340
1	v	Government furnished equipment	(778)	(24,775)	-359,795	-385,348
1	v	Government furnished water transportation	(1,059)	(32,990)	-299,565	-333,614
		Subtotal - Net Increase	34,849	537,110	5,190,555	5,762,514
3	c	Additional mouse house, Japtan, 1,056 sq. ft.		14,350	52,955	80,380
3	c	Additional mouse house racks and cages	13,075		52,955	80,380
3	t	(New) Additional new facilities		8,250		8,250
3	s	Government furn. equipment	(230)	(1,210)	-26,970	-28,410
3	s	Government furn. water transportation	(275)	(2,120)	-51,555	-53,950
		Subtotal - Net Increase	12,570	19,270	843,605	875,445
4	h	Protective fencing around towers		5,440		
4	h	200-ft. towers - additional stiffeners, increased size of members	30,245		200,000	235,685
4	t	Government furn. equipment	(2,400)	(200)	-115,810	-118,410
4	t	Government furn. water transportation	(2,945)	(240)	- 93,005	- 96,190
		Subtotal - Net Increase	24,900	5,000	1,343,835	1,373,735
5	h	Protective fencing around towers		5,940		
5	h	200-ft. towers - additional stiffeners, increased size of members	30,245		200,000	236,185

ITEMS OF INCREASED SCOPE, MODIFICATION NO. 24, CONTRACT NO. AT-(29-1)-507 (Continued)

Item & Feature		Description	Increase in Cost Gross	Increase in Cost Net	Increase in Scope Gross	Increase in Scope Net	Increase in Total Est. Construction Cost Orig. Total	Increase in Total Est. Construction Cost New Total
5	t	Government furn. equipment	(2,400)		(220)		-169,535	-172,155
5	t	Government furn. water transportation	(2,945)		(250)		-132,215	-135,410
		Subtotal - Net Increase	24,900		5,470		1,637,500	1,667,870
6	a	Blade and shape for additional camp facilities, 5,000 sq. yd.			3,295		22,250	25,545
6	d	Dust palliative for additional camp facilities, 5,000 sq. yd.			860		6,190	7,050
6	e	Aluminum Bldgs. - infirmary for additional camp facilities, 960 sq. ft.			29,140		106,380	135,520
6	g	Temporary housing for additional camp facilities, 2,495 sq. ft.			14,780		95,670	110,450
6	h	Protective fencing around towers			5,440		91,490	96,930
6	i	Water facilities, salt & fresh, additional camp			12,175		174,060	186,235
6	k	Electrical facilities, additional camp			8,475		202,480	210,955
6	r	Channel linking Engebi and Muzin			156,980		112,670	269,650
6	t	Government furn. equipment			(31,855)		-145,195	-177,050
6	t	Government furn. water transportation			(3,185)		-118,700	-121,885
		Subtotal - Net Increase			196,105		1,405,435	1,601,540
9	a	Additional instrument shelters				6,695)		
9	a	Additional concrete fill, OCE bldg.		27,900		)		

9	a	New firing stations for photographic flares, 3.1		810		
9	a	Additional cost - instrument shelters	47,875		1,271,935	1,355,215
9	b	Additional instrument shelters		230		
9	b	Additional cost - instrument shelters	7,935		78,235	86,400
9	e	Additional instrument shelters		690		
9	e	Additional cost - instrument shelters	3,955		44,125	48,770
9	f	Additional instrument shelters		695		
9	f	Additional cost - instrument shelters	2,830		62,555	66,080
9	g	Additional instrument shelters		1,385		
9	g	Additional cost - instrument shelters	9,060		144,720	155,165
9	h	Additional instrument shelters		690		
9	h	Additional cost - instrument shelters	4,810		54,265	59,765
9	i	Additional instrument shelters		695		
9	i	Additional cost - instrument shelters	9,350		68,705	78,750
9	j	Additional instrument shelters		690		
9	j	Additional cost - instrument shelters	11,930		66,320	78,940
9	k	Additional instrument shelters		695		
9	k	Additional cost - instrument shelters	2,540		38,940	42,175
9	l	Additional instrument shelters		690		
9	l	Additional cost - instrument shelters	3,690		34,310	38,690
9	m	Additional instrument shelters		695		
9	m	Additional cost - instrument shelters	3,690		33,310	37,695
9	o	Additional instrument shelters		2,030		
9	o	Additional cost - instrument shelters	22,950			
9	o	New firing stations for photographic flares, 3.3		4,050	507,390	536,420
9	p	Additional instrument shelters		695		
9	p	Additional cost - instrument shelters	6,810			
9	p	High speed photo markers, 3.3 - Muzin		5,580	179,730	192,815
9	q	Additional cost - instrument shelters	270		248,210	248,480
9	r	Additional instrument shelters		10,845		
9	r	Additional cost - instrument shelters	70,555		489,095	570,495
		Subtotal - Net Increase	236,150	37,860	3,484,545	3,758,555

ITEMS OF INCREASED SCOPE, MODIFICATION NO. 24, CONTRACT NO. AT-(29-1)-507 (Continued)

Item & Feature	Description	Increase in Cost Gross	Increase in Cost Net	Increase in Scope Gross	Increase in Scope Net	Increase in Total Est. Construction Cost Orig. Total	Increase in Total Est. Construction Cost New Total
12 a	Additional stiffeners, increased size of members		24,900			294,200	319,100
12 b	(New) Mock-up section, 200-ft. towers		18,000				18,000
	Subtotal - Net Increase		42,900			294,200	337,100
18	Stations 190, 191, 192 for EGG				3,635)		
18	Sta. 160-180 for EGG - Runit, Eberiru, Engebi		4,410		)		
18	Tower stiffeners, increased size of members		126,180		)		
18	Roll-up doors, 75-ft. towers		29,400		)		
	Subtotal - Net Increase		159,990		3,635)	191,660	355,285
19	Stations 8 & 9 - NRL - Engebi & Eberiru				49,130)		
19	Steam cleaning shelter - 6.7 (NRL), Eniwetok				3,850)		
	Subtotal - Net Increase				52,980)	202,510	255,490
20	Increased cost - J-3 Stations 10, 11, 12, 14, 15, & 19		109,465			144,855	254,320
21	Two tent pads & frames for Med-Bio, Japtan				3,740)		
21	Pallets for insulating liner, Med-Bio, Japtan				14,740)		

	Subtotal - Net Increase			18,480)	83,840	102,320
26	Stations 144a and 144b, 145, 146, NRLK - Engebi & Eberiru			163,710)		
26	Station 135 - UCRL - Engebi			2,900)		
26	Station 131A - UCRL - Engebi			74,880)		
	Subtotal - Net Increase			241,490)	576,310	817,800
27	Hutment program 5.1 - OCSO - Parry			6,740)		
27	Stations 518, 519, 5141, 5151, 5161, 5171 - OCSO			810)		
	Subtotal - Net Increase			7,550)	180	7,730
29	Change in scope of Rad-Chem Stations 121A-121E			375,920)		
29	Increased Cost Rad-Chem Stations 120A-120E		38,600			
	Subtotal - Net Increase		38,600	375,920)	57,000	471,520
30	Stations 511, 512, 513, 5142, 5152, 5162, 5172, 5173, 5174 - NRDL			1,275	1,800	3,075
34	(New) Stations 5182, 5192 - AEC			330		330
	TOTAL CHANGE - - - - - - - - - -	$97,219	$587,105	$762,955	$ 739,520	
			$684,324	$1,502,475	$22,479,260	$24,666,059

Revised Total Estimated Cost including Camp Operation, Maintenance & Management and Support and Roll-up Services-$27,177,059

NOTE: The above costs are exclusive of fees.

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