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COMPLETION REPORT

OPERATION HARDTACK, PHASE I

U. S. ATOMIC ENERGY COMMISSION CONTRACT AT-(29-2)-20

ENIWETOK PROVING GROUND 1956 - 1958

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FOREWORD

The following report of Operation HARDTACK, Phase I, covers all aspects of engineering, construction, operation, and maintenance of the Eniwetok Proving Ground, Marshall Islands. This report has been prepared in accordance with the requirements of Contract No. AT(29-2)-20 as set forth in Paragraph 1, Page 10, Modification 55, of General Requirements.

The series of nuclear tests comprising Operation HARDTACK, Phase I, has advanced the development of weapons for defense against airborne and missile attack by a potential enemy. Another goal of the tests was the further development of nuclear weapons with reduced radioactive fallout.

The principal objectives of this report are to provide a complete and detailed account of the stewardship of Holmes and 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 will be of value to the Atomic Energy Commission, to Holmes and Narver, Inc., or to other participants in future projects of a similar nature.

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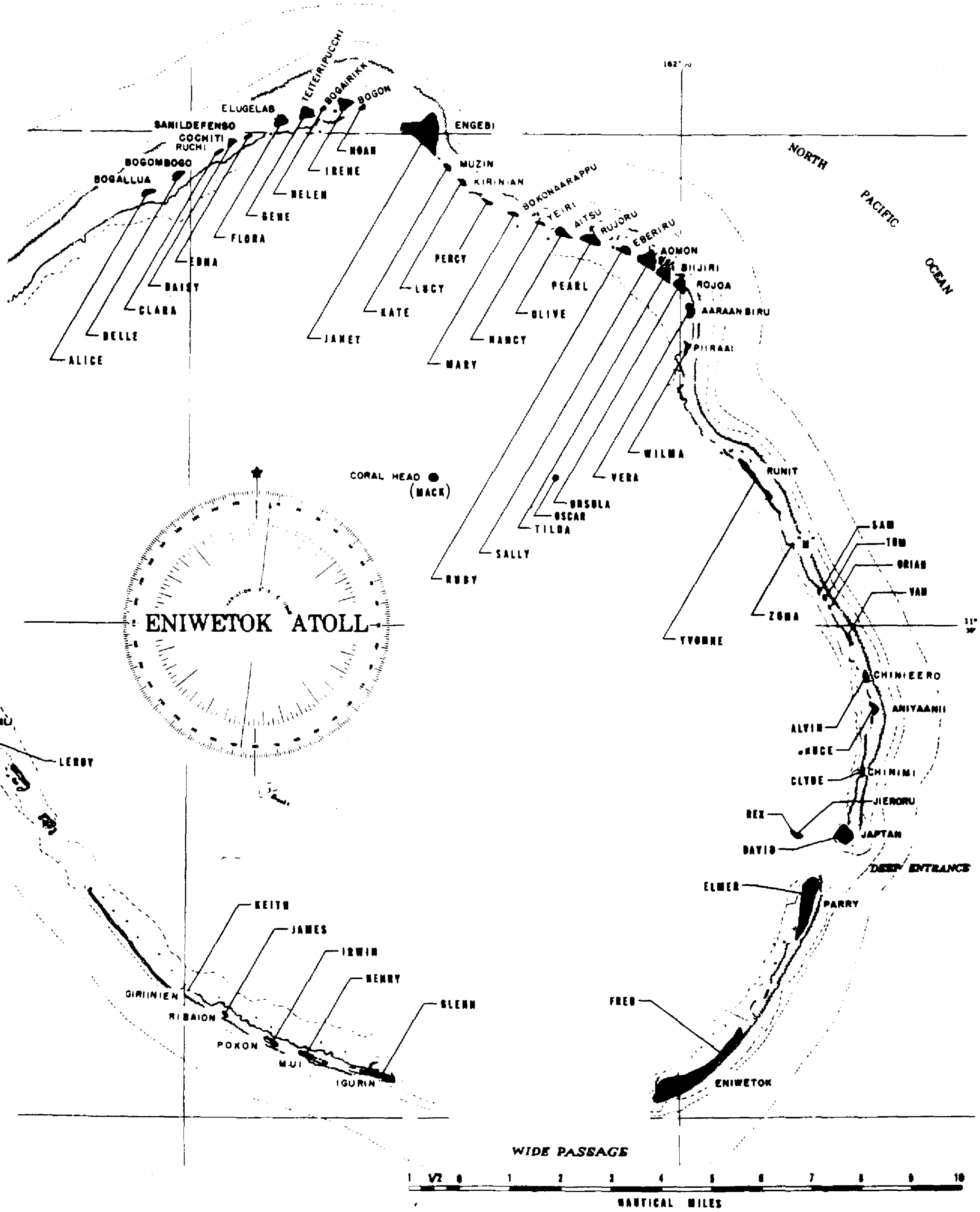
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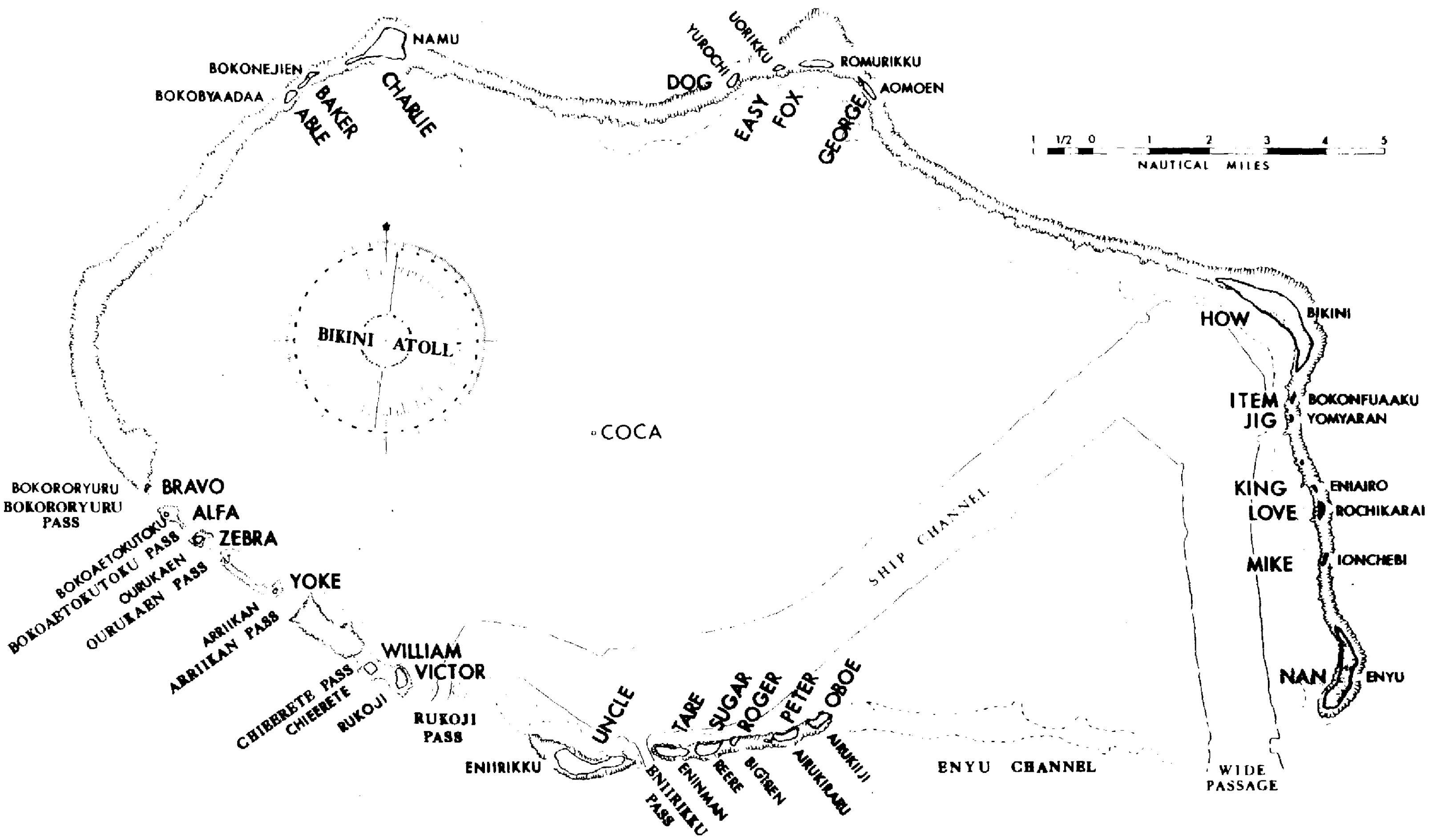
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CHAPTER I
INTRODUCTION

SECTION I
NARRATIVE SUMMARY

BACKGROUND.

Operation HARDTACK, Phase I, was the fifth consecutive test series to be conducted at EPG in which Holmes & Narver, Inc., participated as Architect-Engineer-Construction-Management Contractor for the Atomic Energy Commission. The Operation was by far the largest, both in terms of area and of over-all scope of operations required for the support of all elements of the Task Force. Although a considerable portion of the required services were routine, Operation HARDTACK demanded the utmost in technical and administrative know-how, ingenuity, and coordination to bring its operational efforts to a successful conclusion.

Two outstanding accomplishments during HARDTACK which called forth all experience gained on previous operations at EPG were the major installations on Site Yvonne for the CACTUS event and the relocation of the ABMA facilities from Bikini Atoll to Johnston Island.

Prior to December 1957, the scope of work at Site Yvonne was limited to a major modification of Station 1310 and the rehabilitation of several smaller stations; however, criteria were received in December 1957 for a major installation, including a Ground Zero Station, pipe arrays, major modifications to existing structures, and the construction of a number of new Scientific Stations, which were to be completed in sufficient time for a test event on 1 May 1958. When this requirement became known, an all-out effort was exerted and through the combined forces of Home Office and Jobsite Engineering, logistics, and Construction, it was possible to complete construction and to advance the required ready date.

When facilities were practically completed for the ABMA program on Site How on Bikini Atoll, a change in plans shifted operations 1745 miles eastward to Johnston Island. A set of duplicate facilities was necessary there, requiring the dismantling and re-erecting of a service tower and various rocket launchers, removing and re-installing User equipment, and transporting a mountain of supplies, materials, and equipment to the new site. In a like manner, this project was completed and made available to the Using agencies well in advance of the required dates.

Of the 37 HARDTACK test events for which preparations were made, 4 were Ground Zero Stations, 2 were underwater, 1 was a balloon event, 2 were high altitude missiles, and 28 were afloat stations: 23 barges and 5 LCU hulls. Two barge events were cancelled after completion of construction. As indicated, the zero stations used in the Operation were predominantly afloat. This, in addition to unforseeable support requirements for the underwater events, required the increased use of marine craft and services which at times taxed the Contractor's capabilities to the limit, but in the final analysis all requirements were adequately filled.

Experience gained from Operation REDWING indicated that radical changes and improvements, both organizational and administrative, would be necessary in order to provide for more efficient conduct of operations for future test series the size of REDWING or larger. Chiefly among these changes was the re-organization of certain Jobsite Divisions; the major change was the creation of the Communications Division, placing all Communications operations and maintenance responsibilities under one Division Head. Other changes included the elimination of the Administrative Division, and the transfer of Air and Land Transportation, Security, Guard, Safety, and Rad-safety functions to the Industrial Relations Division; the transfer of marine, power, and distillation maintenance functions from the Service Operations Division to the Construction Division; the addition of a Construction Manager, and the appointment of General Superintendents as heads of construction and maintenance functions in the Construction and Maintenance Division. An Assistant Resident Manager was designated as Executive Division Head, to whom was assigned the office services and administrative functions. Material take-off functions were transferred from the Engineering Division to the Supply Division. In addition to the divisional changes, other functions within divisions were given departmental status in keeping with added duties and responsibilities. As in REDWING, Bikini Atoll was supervised by an Assistant Resident Manager responsible for the conduct of operations connected with that atoll.

Along with this re-organization, a revamping and streamlining of policies and procedures were

(Neg. No. W-1009-11)

Figure No. 1-1. Fred Runway — Looking Northeast.

indicated, and measures were immediately put into effect to accomplish this prior to another Operation. A Class "A" Print Shop was authorized on 3 January 1958 and was in full operation by early April. A Photographic Laboratory was constructed in the new H&N Administration Building and was completely equipped to provide full coverage of all phases of the Operation, including support to the Class "A" Print Shop.

SPHERE OF OPERATIONS.

The sphere of operations for HARDTACK was expanded to include not only Johnston Island, but also new construction on Truk, Rongelap, Ponape, and Nauru Atolls, 660, 280, 370, and 770 nautical miles respectively from Eniwetok Atoll. In all, the off-atoll sites included Weather Stations at Utirik, Kusaie, Kapingamarangi, Wotho, and Ujelang. Construction and service activities encompassed 33 islands in Eniwetok Atoll and 20 islands in Bikini Atoll. The complexity and magnitude of the program called for the closest coordination of effort between Jobsite and Home Office to accomplish H&N's mission in HARDTACK, and presented a challenge which was accepted and accomplished with a minimum of time lost. No delay of test events was occasioned through the inability of H&N to meet the readiness dates requested by other elements of the Task Force.

CHRONOLOGICAL REVIEW.

Upon the completion of Operation REDWING in August 1956, Scientific Stations and other structures were rolled up, secured, operated on a minimum scale, or abandoned to place EPG on a stand-by status. Also during this period all property and equipment returned as excess from off-island sites were processed and stored against future needs. Items were completely dismantled, sandblasted, painted, re-assembled, and treated with preservative material as indicated in each case. Routine maintenance measures were performed on special and critical items of re-usable equipment which could be maintained more economically outside of a mothball status. Periodic inspections were also performed on all mothballed facilities to ensure that preservative

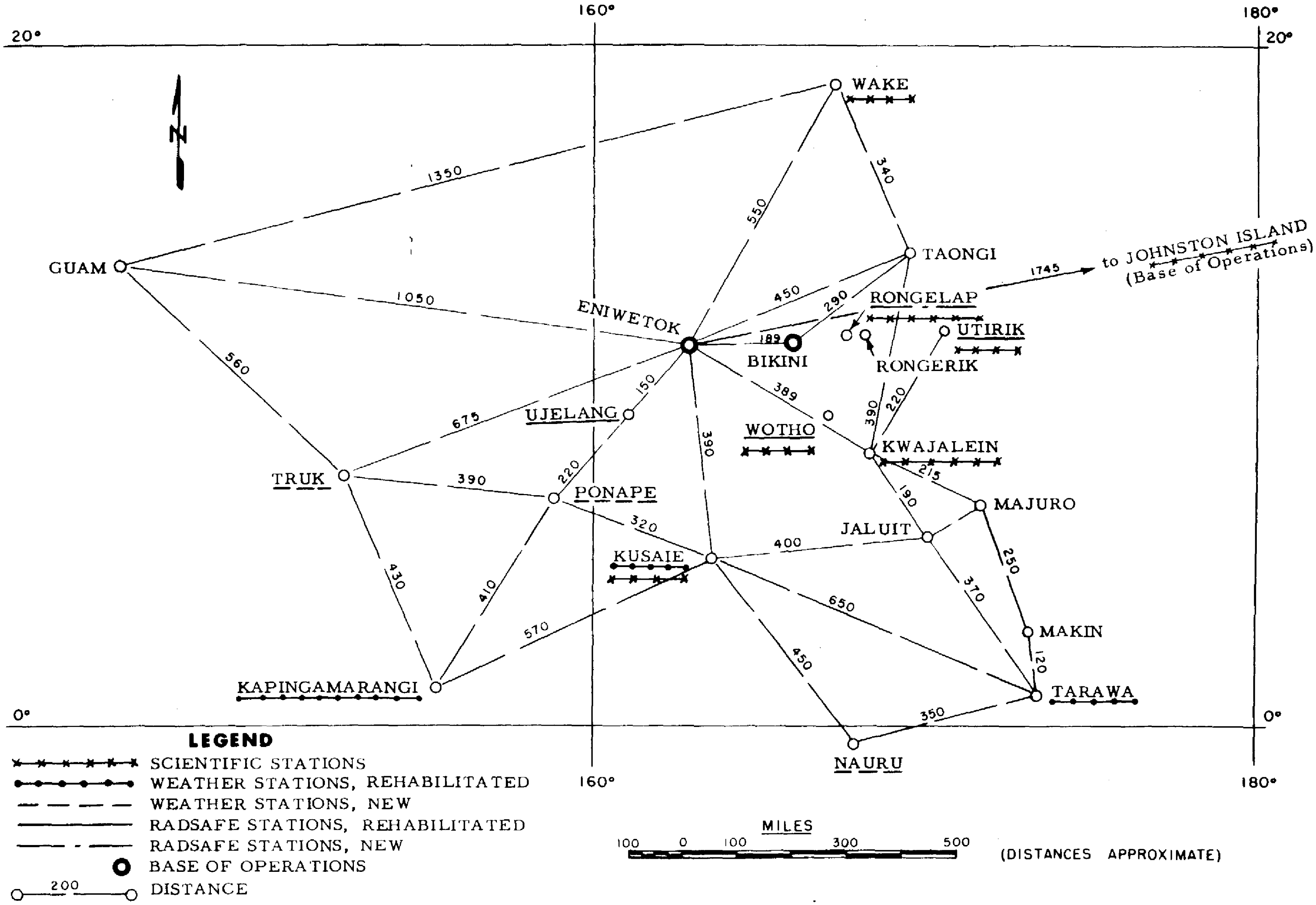

Chart No. 1-1. Sphere of Operations.

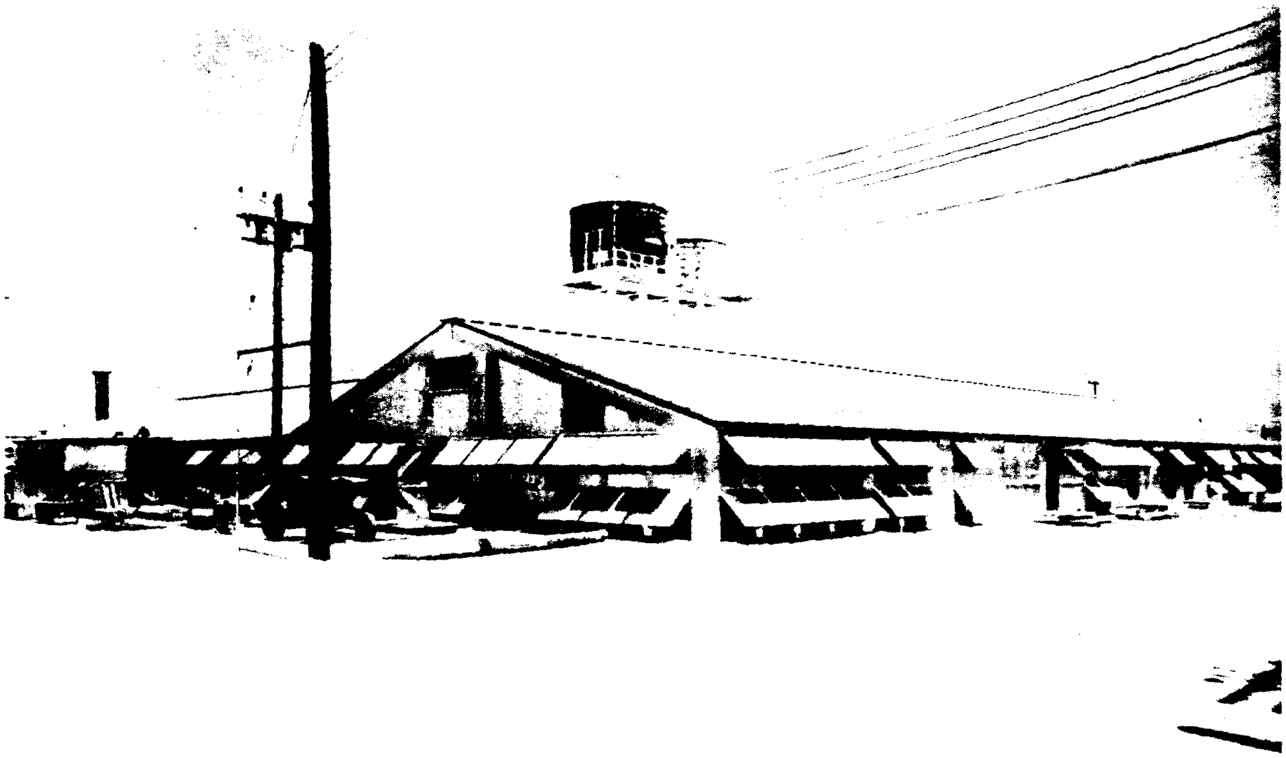

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Figure No. 1-2. H&N Administration Building — Elmer.

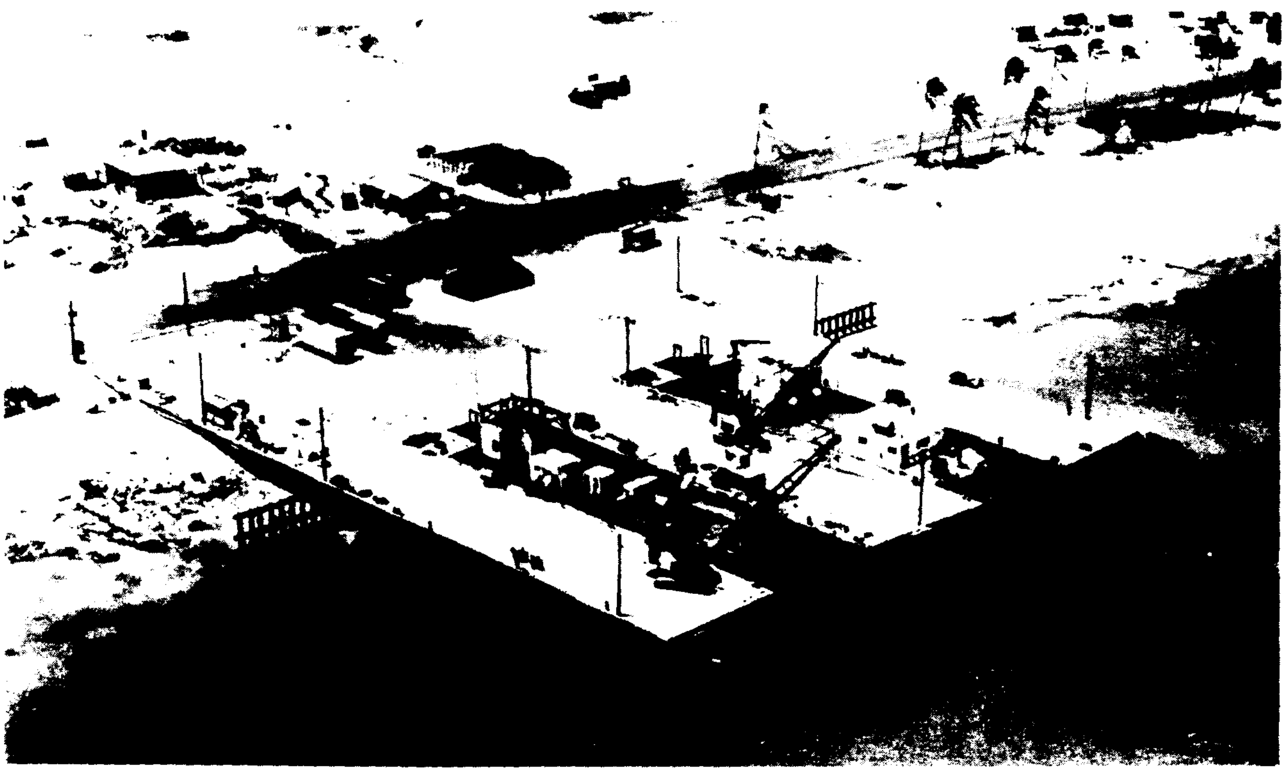

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Figure No. 1-3. Barge Slip — Nan.

measures were adequate and had not deteriorated.

Early in 1957 reconnaissance trips were made to various off-atoll sites to determine the feasibility of these sites for proposed weather and rad-safety facilities. Shortly thereafter, criteria were firmed up for temporary camp requirements and Engineering prepared design drawings for specific needs of each Weather and Rad-safety Station. The main base camp at Nan in Bikini Atoll was activated during the first week of June 1957, and rehabilitation and new construction work were started immediately. Operating from Nan, off-island camps were constructed on Sites How and Oboe; drawings were released during June 1957 for these camps, and construction was virtually completed by late October. In February 1958 a small support camp was authorized on Site George, which was completed by mid-April.

From Elmer on Eniwetok Atoll the off-island camps at Janet and Yvonne were constructed; drawings were released during June 1957, and construction was virtually completed by early November. Drawings were released on the Weather and Rad-safety Stations from September 1957 to February 1958, and construction and transportation schedules were established for their accomplishment. By 1 April 1958 these facilities were ready for use in support of the test series, remaining only to be manned.

The air field rehabilitation program on Site Fred was an extensive project which had been in progress since January 1957; runway extension and various modifications and additions were started by November 1957. This project is discussed in Chapter II, Section 5. Also started late in 1957 were the fire protection systems and pump houses on Elmer and Fred.

Operational requirements for simultaneous timing and firing signal systems and separation of signal and telephone cables necessitated a comprehensive rehabilitation and extension program to submarine cable plants at both Bikini and Eniwetok. The accomplishment of this requirement necessitated the examination and testing of 2,112,800 feet of existing cables and the installation of 1¼ million feet of 16-pair and 26-pair submarine cable.

A new type of submarine cable terminating vault was designed and constructed to accomplish a separation of the communication and signal cables at the landings. Where existing submarine cable terminating vaults were rehabilitated, a second vault was installed for the signal cable. A total of 21 cable landings were accom-

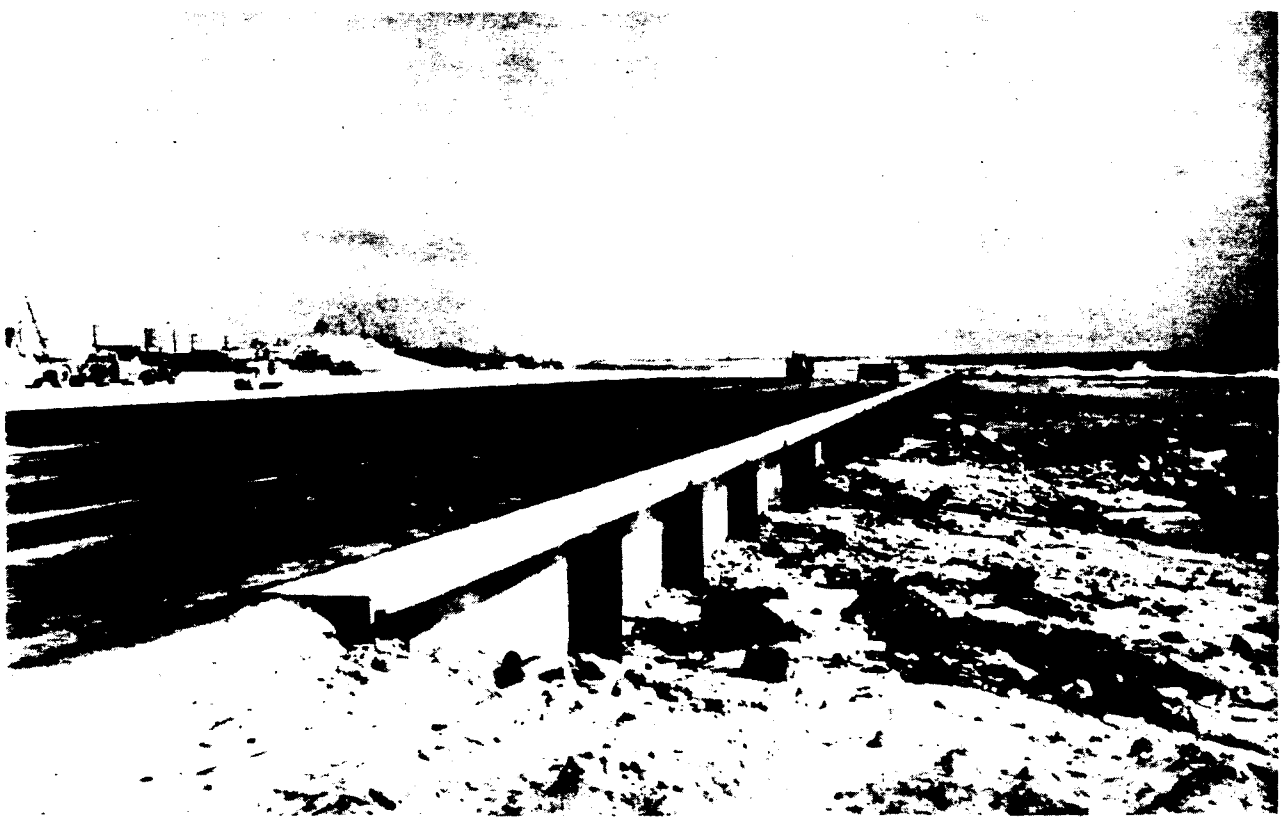

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Figure No. 1-4. Seawall at Eastern Extension of Fred Airstrip.

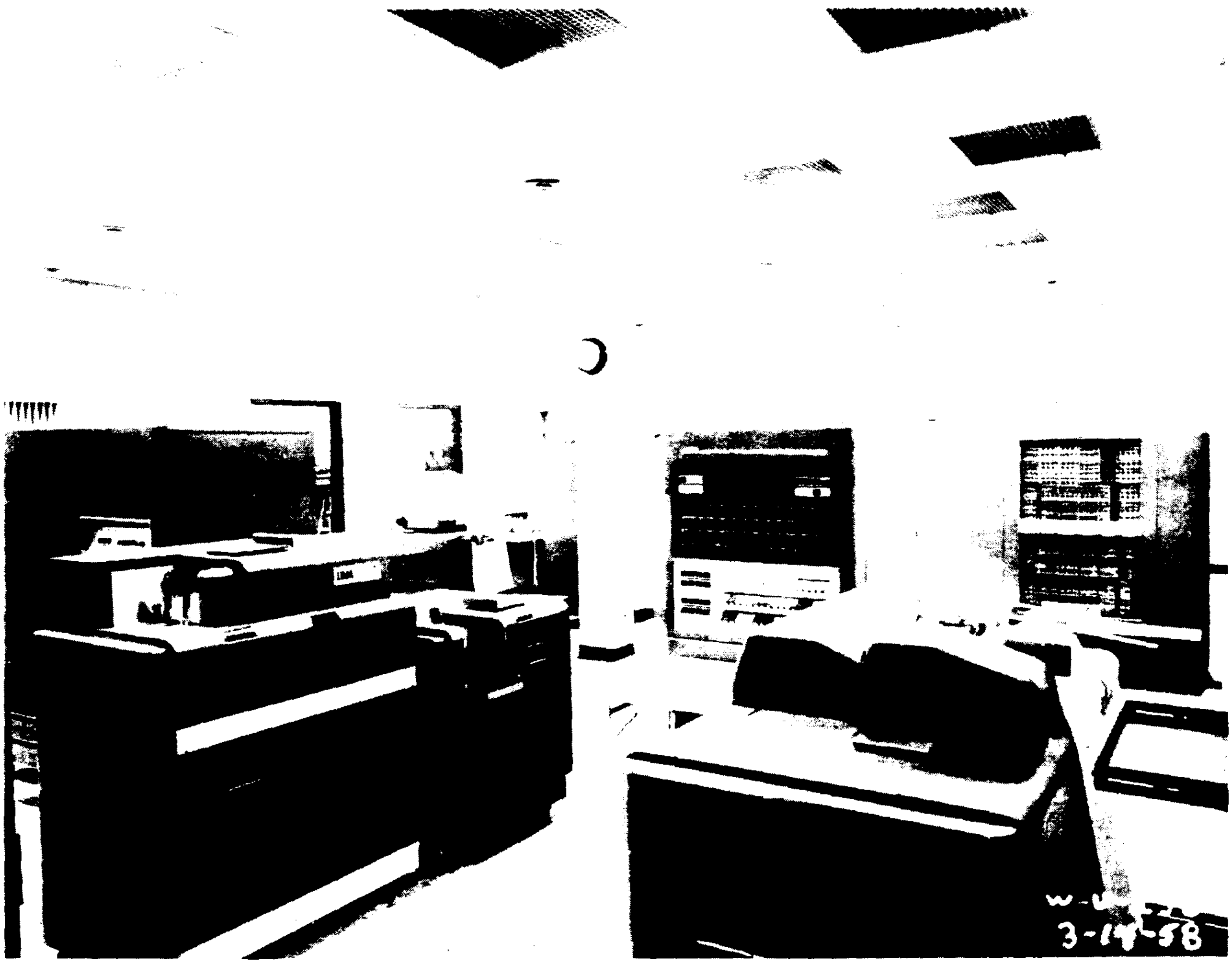

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Figure No. 1-5. IBM Equipment Installation — Building 453 — Elmer.

plished by utilizing the existing vaults or constructing the new type.

Under the supervision of the newly-created Communications Division, communications facilities at EPG were greatly expanded in preparation for the forthcoming Operation. The Tropospheric Scatter System and the Automatic Dial Exchange System provided automatic dialing service within Eniwetok Atoll and directly to the switchboard on Site Nan in Bikini Atoll. A military microwave system, a voice circuit to Kwajalein, a carrier system, and a commercial VHF System were also put into operation, thereby providing the more adequate and efficient communications facilities demanded by HARDTACK requirements. The use of radio interference detection equipment provided better control and radio discipline of radio circuits than was possible during REDWING.

By far the most complex building constructed under the PAC program for HARDTACK was the IBM Building, an all-concrete structure with suspended ceilings and, in one room, a removable floor set on stringers on concrete pedestals. This building, which contained an air-conditioning system to provide both overhead and under-floor circulation, was started in October 1957 and was available for occupancy on 10 February 1958. The largest new Scientific Station construction project was Station 1312 on Janet, started in September 1957 and completed in April 1958. Besides the buildings and other facilities contained in the over-all program, 788 Scientific Stations were required, of which 80 were considered of major size.

Concurrent with construction planning, personnel requisitions were prepared and recruiting was intensified to provide the personnel to Jobsite in the amounts necessary to accomplish H&N's mission. A peak of 3158 contract employees at Jobsite was reached on 9 April 1958. With the arrival of other elements of the Task Force

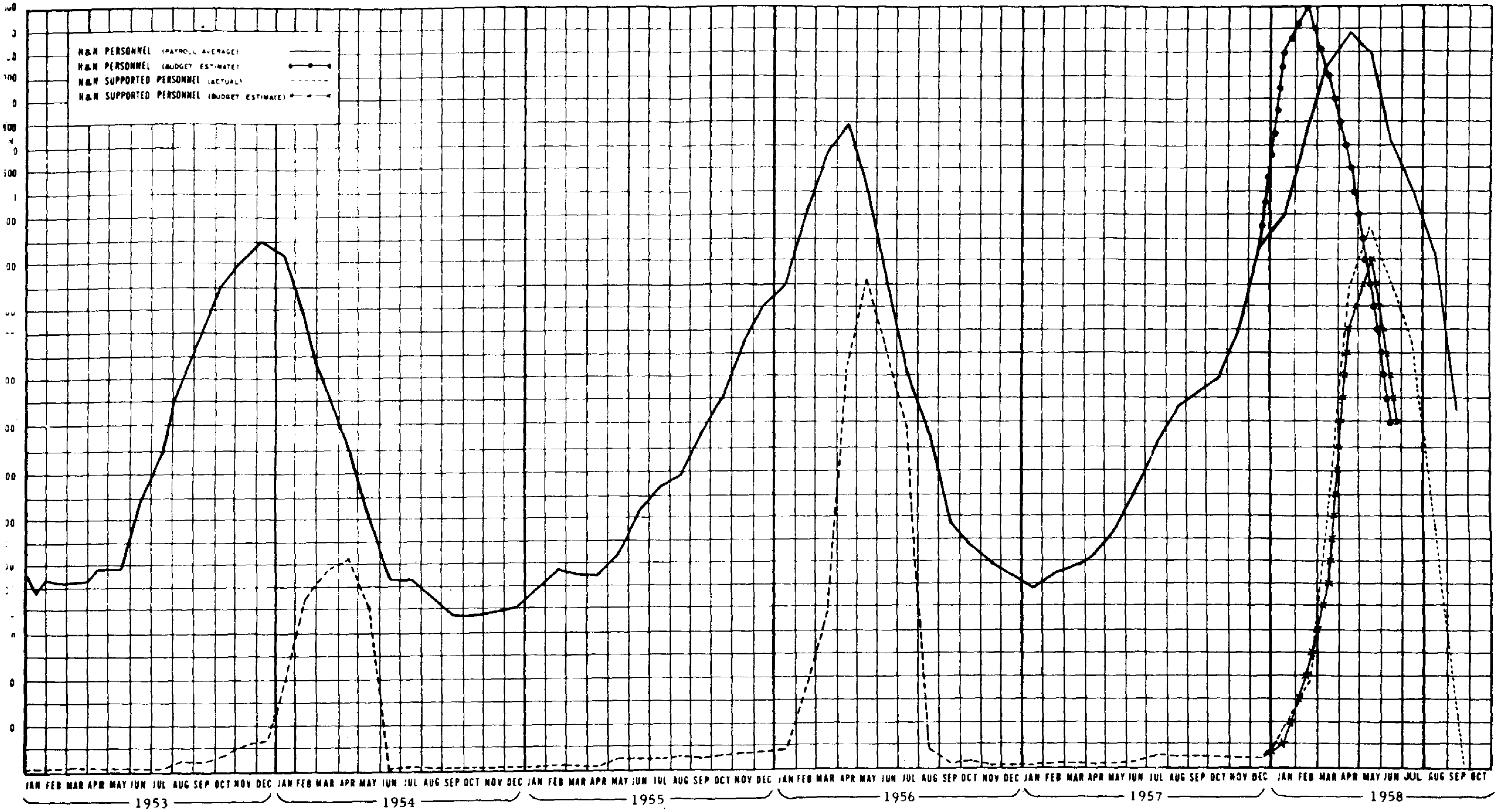

Chart No. 1-2. Composite Jobsite Personnel — EPG.

at EPG, the total population supported by H&N reached a peak of 5280 on 22 April 1958.

Early in 1958 a Technical Facilities Coordination Group of TDY personnel from Home Office Engineering arrived at Jobsite to assist in expediting the scientific program. This group consisted of Project Engineers and other engineering personnel who were constantly in touch with User groups and were familiar with their requirements. The mission of this group was to gather all design requirements of the Users and coordinate their accomplishment through the field engineering design forces.

At this same time, ships and planes were unloading men, equipment, and supplies into the main camp at Elmer in enormous proportions; warehouses and open storage areas in all camps were utilizing all available space, and the lagoons at Eniwetok and Bikini Atolls were receiving additional craft daily. In an attempt to expedite the support program, the supply facilities at Nan were revamped to provide full accounting for all materials at Bikini, and Supply Coordinators were assigned at all off-island camps for more effective control of materials needed at these locations.In order to realize maximum utilization of the craft on hand, air and marine transportation systems and schedules were established, and facilities were expanded to provide transportation for the large influx of Task Force personnel.

By mid-January 1958 a major portion of the Barge Station requirements were known, and construction was in full swing to meet readiness dates for their use. Because of changes in criteria some revisions were necessary, mainly in the Pinex-type Barges. A significant facet of Operation HARDTACK was the large-scale use of Pinex Barges as Ground Zero Stations. The construction of these barges is explained in detail in Chapter IV, Section 2, Marine Operations. Although faced with additional barge and LCU station requirements late in the program, afloat stations were completed on schedule. New barge assembly facilities were constructed at Nan and were utilized to the fullest for final assembly and device loading for the UCRL program. The barge construction program presented numerous difficulties due to shortages of certain materials which prevented continuous construction effort on any one barge. This situation necessitated considerable movement between assembly areas and moorings in the lagoon.

The major Ground Zero Stations, #20 on Yvonne and #21 on Gene, were readied in time for the CACTUS and KOA events respectively, along with all satellite stations in connection with these and other events. Other stations were finished to the point where they could be quickly brought to completion for future events. The Scientific Station construction program for the CACTUS event was completed and in the readiness stage on D minus 1-Day, with the camp at Yvonne rolled up and evacuated at that time. After the Janet camp was rolled-up for the KOA event, further activities consisted of the support

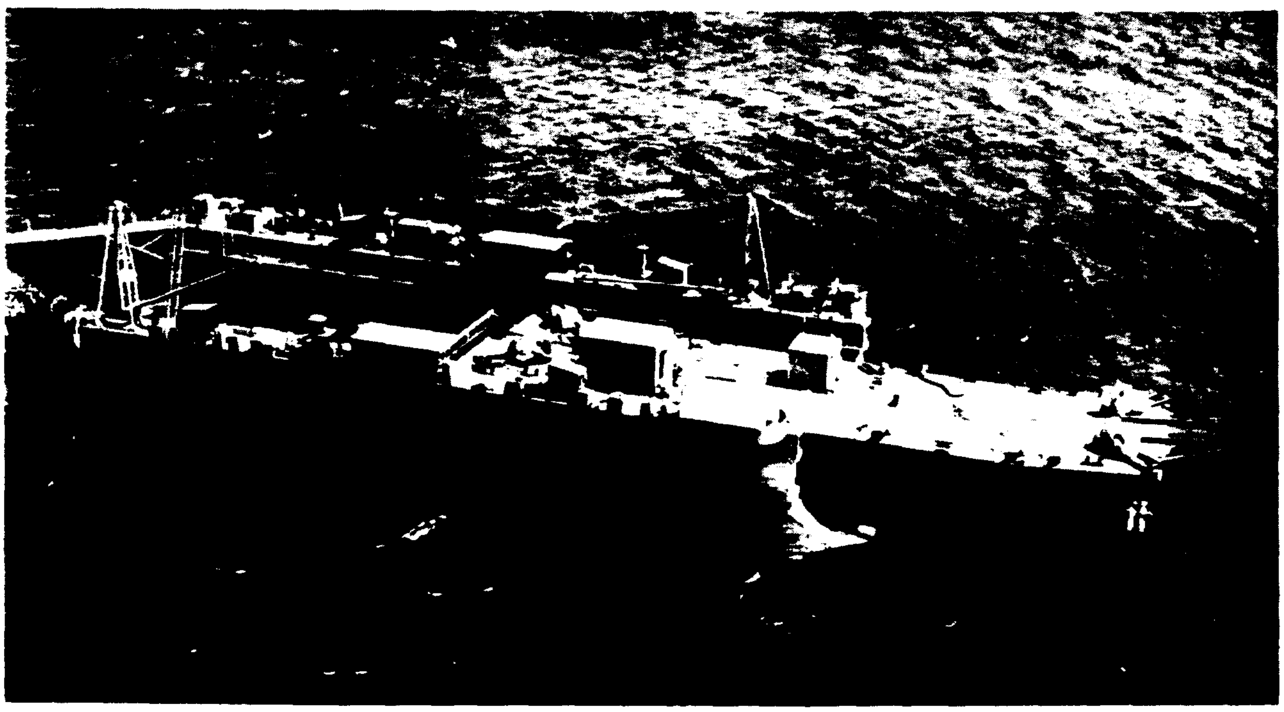

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Figure No. 1-6. Aerial of Pinex Barge in Drydock.

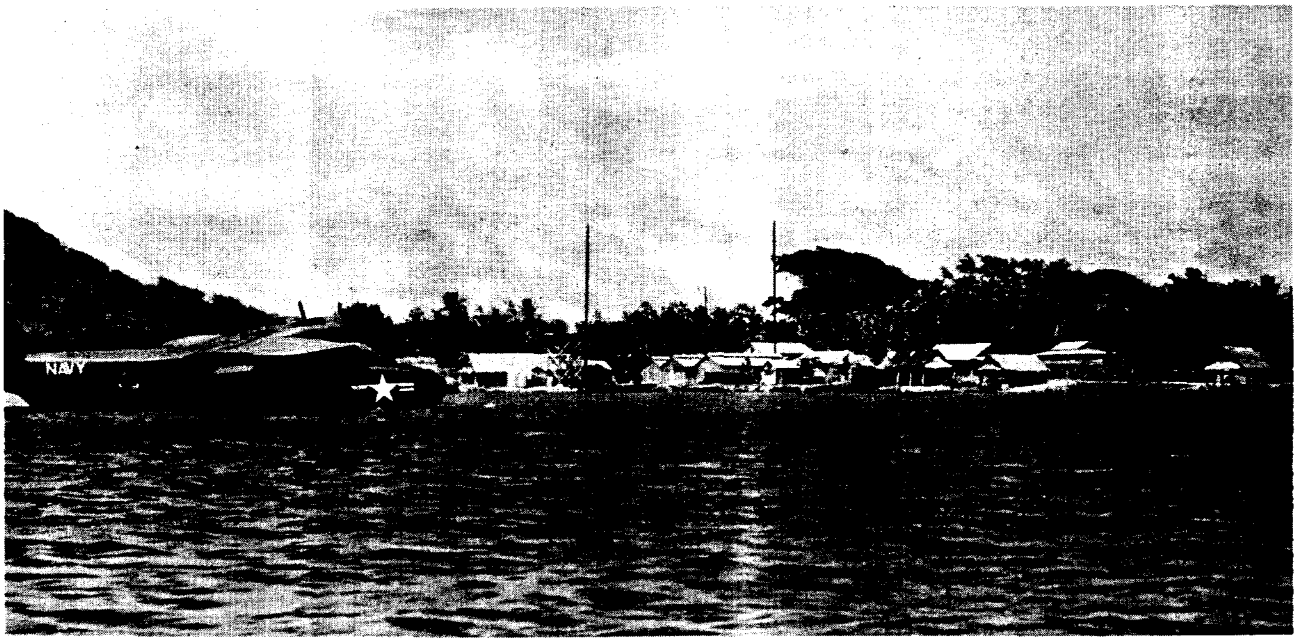

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Figure No. 1-7. Weather Station and Native Village at Kusaie.

of various missions into and out of all islands and areas where future event participation was required, completion of partially completed facilities and stations, and the operation of support facilities and services. Marine and air support was much in demand, especially during the days before and after events. At Bikini Atoll a similar program was effected with the exception that the camp at Oboe was maintained in a livable status throughout the tests at the atoll. It was necessary to evacuate personnel to sea for only two events at Bikini Atoll; at Eniwetok Atoll evacuations at sea were not necessitated. Although personnel remained ashore during the majority of test events, the capability for emergency evacuation at all sites was maintained throughout.

By 1 May 1958 processing of excess personnel had begun and continued throughout the duration of the Operation. A procedure was established to ensure adequate numbers of certain skills being retained to offset losses occurring through normal attrition and possible exposure to radiation, and to provide sufficient personnel for all support activities. This procedure proved effective when late in the Operation seven additional afloat stations and two Ground Zero Stations were added to the program and completed on schedule.

Equipment and property were returned from off-island sites and processed for storage as dictated by operational needs, and all salvageable property was removed from danger areas. As information was furnished regarding facilities excess to the Operation, these facilities were rolled up and secured to a stand-by status for the interim period. With the exception of Truk and Ponape, the Weather and Rad-safety Stations were rolled up by 15 August 1958 and crews, property, and equipment were returned to Elmer. At Bikini the roll-up and mothballing of camp facilities were completed, and the atoll was abandoned on 19 August 1958. After the last event on Johnston Island, the service tower was dismantled and stored at Johnston Island, other facilities were rolled up, and the final shipload of equipment and supplies departed for Eniwetok on 19 September 1958.

REPATRIATION OF RONGELAPESE.

One of the significant accomplishments following Operation REDWING was the repatriation of the Rongelap natives after an absence of three years from their home atoll. This humanely interesting episode started 1 March 1954, when a thermonuclear device, (the BRAVO event), was detonated in Bikini Atoll during Operation CASTLE. As a result of shifting winds, radioactive particles carried toward the atolls of Rongelap, Rongerik, and Utirik. Temporarily 82 Rongelapese were housed in emergency quarters on Ebeye Island in Kwajalein Atoll until a village could be constructed for them.

Holmes & Narver was directed by the AEC one month later to prepare plans and estimates for the construction of a village on Ejit Island in Majuro Atoll. The construction was completed, and in June 1954 most of the Rongelapese were moved to this village, where they remained until they could be returned to their native atoll.

The AEC, together with other Governmental agencies, planned for the return of the Rongelap natives as soon as it was considered that the residual radioactivity level was acceptable from a health point of view. At regular intervals, the Commission's representatives conducted radiological surveys. The data from these surveys were carefully evaluated, and on 16 June 1956 Holmes & Narver was authorized to prepare the necessary plans for rebuilding the native village on Rongelap Atoll, it having been determined that the residual radioactivity level had reached acceptable standards.

An extraordinarily important meeting was held 1 October 1956 in the office of the Comanding Officer, U.S. Naval Station, Kwajalein, at which time matters concerning planning, construction, air and ship support, and other pertinent subjects were discussed and finalized.

Exactly one month later, 15 construction requisitions were submitted to the Home Office for materials indicated in approved drawings. During November 1956 the tempo of logistic planning increased. It was determined that the Chief of Naval Operations would make available an LST through the Commander, MSTS. This vessel would be used to carry construction materials to Eniwetok Atoll from the United States, after which it would carry men and materials to Rongelap. It would remain at Rongelap to support the construction forces and provide quarters for the men working at that location.

While construction was still in progress, plans for implementing the return of the natives were being firmed. After conferences with the Eniwetok Branch Chief of the AEC, the High Commissioner of the Trust Territories, H&N, and other officials, Rongelap natives departed for their home atoll aboard the LST 618 on 27 June 1957, arriving 29 June, with their personal belongings, their pigs, chickens, dogs, and five H&N-constructed coffins bearing the remains of those who had died during their absence from Rongelap Atoll.

ABMA PROGRAM.

On 6 April 1958, when the Scientific Stations on Site How were practically completed, word was received regarding the anticipated relocation of the ABMA program to Johnston Island, approximately 1745 miles northeast of Bikini Atoll, which was to be used as the site for the two missile events. A reconnaissance party flew to Johnston Island on 7 April to determine the suitability of this site, and on 10 April it was decided to relocate the ABMA program there. At that time, towers and other facilities were disassembled for transshipment.

Numerous conferences were held at Elmer during the two-week period following 10 April. The purpose of these conferences was to establish participating programs and their requirements. It was decided to accomplish all Johnston Island engineering at Eniwetok for several reasons; among these was the fact that the Users were located at Eniwetok and also that there was an insufficient engineering staff at Johnston to accomplish rapid changes and designs for the ABMA program. On 17 April Home Office design and drafting personnel arrived at Eniwetok to expedite engineering changes and modifications.

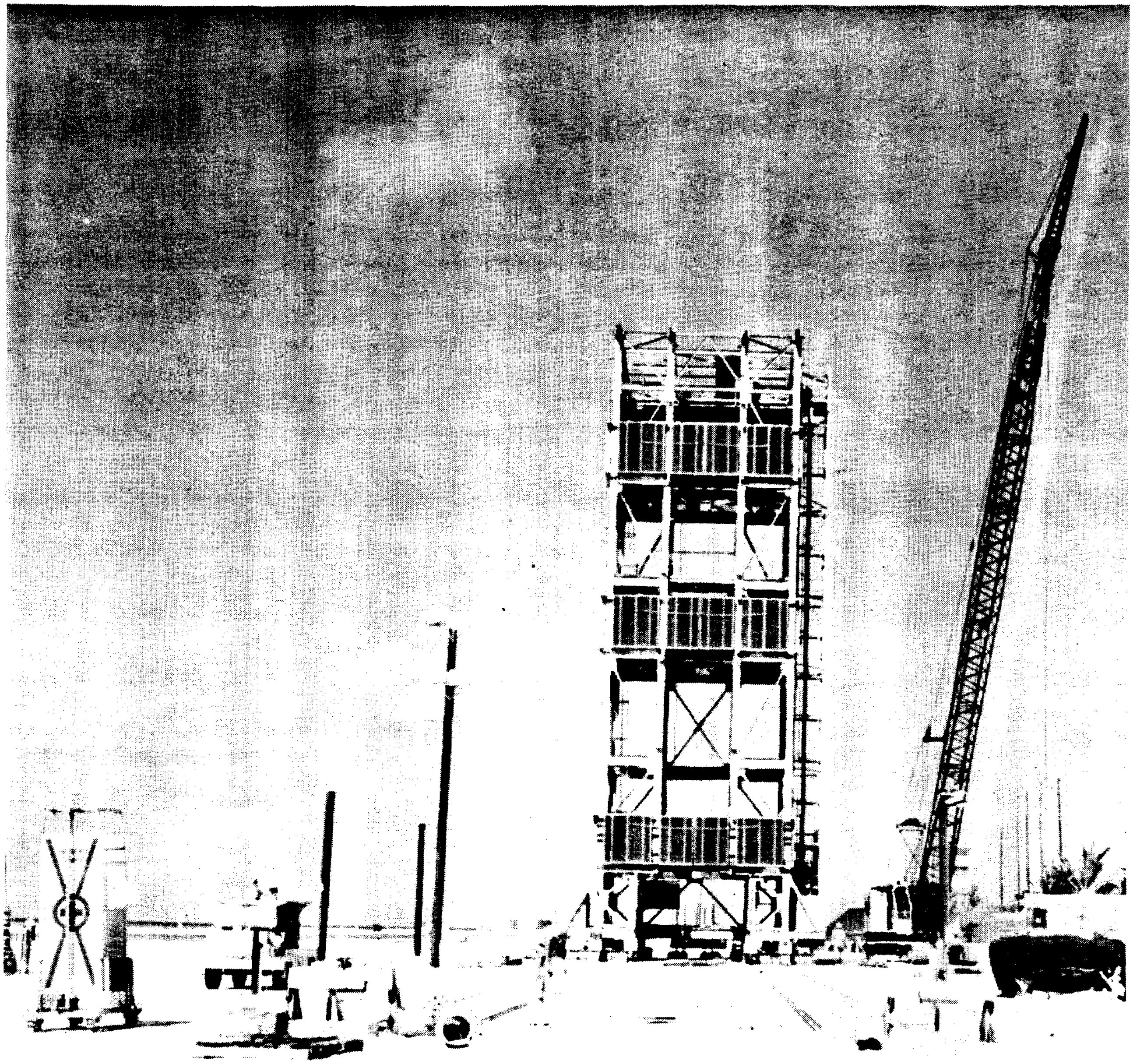
In the short span of two and one-half weeks all engineering work for the ABMA program was completed, and the Home Office engineering personnel returned to Los Angeles.

Nine survey personnel departed Eniwetok for Johnston Island on 20 April to make base line and location surveys, and the necessary Supervision journeyed to the site to make a reconnaissance. Also present on this assignment were one ABMA and two Sandia representatives. On the some date the USS COMSTOCK departed Eniwetok Atoll with 74.2 long tons of construction materials and 3 LCU-type craft, making a cargo total of 748.9 long tons.

After an inspection of the utilities at Johnston Island, it was disclosed that most were in a poor state of repair and that extensive maintenance would be required prior to housing the full complement of personnel for the two events scheduled at Johnston Island.

The consolidated messing facilities were taken over by H&N one week earlier than anticipated when it was found that Air Force Base Command facilities at Johnston Island were inadequate to feed an expected population of 1200. The Officers' Mess, the NCO Club, the Beach Club, the Structural Fire Protection System, the power generating facilities, the Post Exchange, and related service operations were assumed by H&N on the following listed dates:

H&N Mail	27 April
Mess Hall	1 May
Barber Shop	1 May
Sanitation	2 May
Janitorial Services	5 May
Post Operations	6 May
Camp Store	8 May
NCO Club	8 May
Power Plant	12 May
Beach Club	13 May
Snack Bar	12 July



(Neg. No. W-903-2)

Figure No. 1-8. Service Tower and Pad — Johnston Island — 90% Complete.

Of the difficulties encountered during the construction build-up, the logistic problem was one of major importance. In order to maintain the anticipated construction schedule, it was necessary to transship all existing equipment and materials from Site How to Johnston Island. Procurement of additional scientific equipment and materials from Honolulu and the mainland was also necessary, with shipments being made in most instances by MATS and commercial air freight to Honolulu for transshipment to Johnston Island. During the construction period, a total of 35,194 measurement tons (5580 long tons) was received at Johnston Island by surface craft and 2,193,955 pounds by air.

The entry of H&N into activities at Johnston Island posed additional problems from a security standpoint. The key factor was that any indication of AEC or JTF-7 interest in, or occupancy of, Johnston Island in relation to testing operations was initially classified as Secret. This made it extremely difficult to recruit personnel, as the bulk of new employees would arrive at Johnston Island on an uncleared basis and, in addition, any indication of Johnston Island as the destination of materials procured for the test program would have compromised classified information. The problem was resolved through conferences with the ALO Classification Division and Test Division officials which resulted in an early declassification of information pertaining to intended testing activities at Johnston Island. Based upon this declassification decision, permission was obtained from the CJTF-7, through the ALO Test Division Security Officer, to use employees on an uncleared or "GSR" basis indefinitely. This factor also eliminated the security problem in connection with the procurement and shipping of materials. Wherever possible, cleared employees were transferred from Eniwetok and Bikini Atolls to Johnston Island; however, a considerable portion of the personnel requirements were filled with new hires from Honolulu, on a "GSR" basis. H&N established a TG 7.5 Pass and Badge Office at Johnston Island to handle the control and issuance of security badges, and security requirements were handled in much the same manner as they were at Eniwetok and Bikini Atolls.

A 60-hour extended work week was necessitated during the construction phase to maintain an accelerated construction schedule. Scientific Station construction began on 2 May, and by 9 May the lower section of the service tower for Station J-6001 was set on its auxiliary pad and tower erection was in progress. On the same date the inside wall forms were set for Station J-6002, and half of the re-inforcing steel bar was in place. All major Scientific Stations were under construction by 1 June, and work continued at an accelerated pace until the completion of all Scientific Stations on 7 July.

It was determined rather late in the planning stages that a 500-kw generator was required to fulfill the island's power needs. This presented a tremendous problem, in view of the fact that generators of this capacity have a long procurement lead-time. To overcome this obstacle negotiations were concluded with the Navy at Davisville, R. I., for the loan of a 500-kw portable generator. Also, it was found necessary to borrow from the Navy at Pearl Harbor seven pieces of heavy equipment valued at about $200,000. As a result of these arrangements with the Navy, critical items were obtained without disturbing the logistic program at Eniwetok and Bikini Atolls. No costs were incurred other than transportation and rehabilitation upon the return of the equipment.

WEATHER AND RAD-SAFETY STATIONS.

A successful test series requires that the Scientific Users keep constantly aware of the changing weather and radiological conditions; therefore, it was considered essential to establish new, and rehabilitate existing, Weather and Rad-safety Stations at various atolls forming a ring around the EPG. These atolls presented a diversity of climates, topography, marine and aircraft landing conditions, and ownership. Although it was the responsibility of the military services to operate these stations, H&N was contractually obligated to survey the sites and construct the necessary support structures. Construction efforts with respect to the off-atoll weather and rad-safety sites are covered in Chapter II, Section 4, Expendable Construction. In many instances, it was necessary to accomplish this assignment under adverse conditions seldom encountered in a normal construction project.

Early in 1957 H&N was notified by the Assistant Director, Test Division, AEC, ALOO, that JTF-7 was planning to use the following sites for weather and rad-safety purposes during Operation HARDTACK:

WEATHER	RAD-SAFETY	U.S. WEATHER BUREAU
Tarawa	Wotho	Truk
Kusaie	Ujelang	Ponape
Kapingamarangi	Rongelap	
Nauru		
Rongerik		
Utirik		

An interesting aspect of this program was the land lease terms that were entered into between a negotiating team, composed of representatives of the AEC, the Trust Territories, and H&N, and the owners of the various atolls. In most of the atolls these arrangements were concluded with the native chiefs; however, in several instances the negotiating team dealt with Cau-

(Neg. No. W-689-2)

Figure No. 1-9. Chapel Constructed on Rongelap.

(Neg. No. W-989-4)

Figure No. 1-10. Moving Equipment Through Deep Sand — Rongelap.

(Neg. No. W-870-8)

Figure No. 1-11. Weather Station — Nauru.

casian individuals who owned Kusaie Atoll, and with representatives of other governments, as in the cases of Tarawa and Nauru.

At the end of Operation HARDTACK, all Weather and Rad-safety Stations were rolled up, with the exceptions of Truk and Ponape which were constructed for the U.S. Weather Bureau.

OTHER HIGHLIGHTS.

In keeping with the increased operational scope at Bikini Atoll during Operation HARDTACK, several significent facilities were established at Site Nan. These facilities were the Communications Building, No. 204, the UCRL Assembly Building, No. 279, and the Barge Assembly Facilities, No. 281. The Communications Building was required to house inter-atoll and intra-atoll radio communications equipment. The UCRL Assembly Building provided the User with the capability of assembling the test devices scheduled for detonation in the Bikini Atoll and the three-fingered barge slip and assembly area proved of tremendous value in outfitting and loading devices onto the shot barges.

When the need for additional water surface craft existed at Jobsite, steps were taken to transfer LSM-444 to the AEC for duty at EPG. This vessel, which had been in reserve at San Diego, was inspected by a representative of H&N and was found to be in a good state of preservation. The interior had been kept completely sealed and dehumidified and the underwater hull had been protected by cathodic treatment. Until such time as the LSM-444 was operational at Jobsite, the Navy made available an LST to the AEC. After final acceptance trials were successfully completed, the LSM-444 departed from San Diego under tow for the EPG on 14 November 1957. The vessel was later named ALOTO and was christened at Jobsite on 30 December 1957.

Early in 1958 the Director of Public Health Service, Marshall Islands, reported 46 cases of poliomyelitis on Majuro Atoll, the Headquarters of the United Nations Trust Territories in the Marshall Islands. This was a mild paralytic type with no cerebral respiratory involvement and affected persons with an age spread of 2 to 46 years. To prevent the spread of polio, H&N instituted a policy of inoculating all H&N contractual and TDY personnel at Jobsite. At the same time, a similar program of influenza inoculations was begun. Those persons refusing inoculations were required to sign waivers absolving AEC and H&N from responsibility in the event either disease was contracted. These two programs were rigorously administered and kept the number of influenza cases to a minimum and precluded the outbreak of polio.

Disaster struck late in 1957 when two typhoons, "Lola" and "Mamie," passed near Eniwetok and Bikini Atolls causing total damage of about $132,500. No personnel casualties were suffered; however, considerable damage was done to the LST pier on Site Nan and Building 67 on Site Fred, as a result of "Lola." "Mamie"

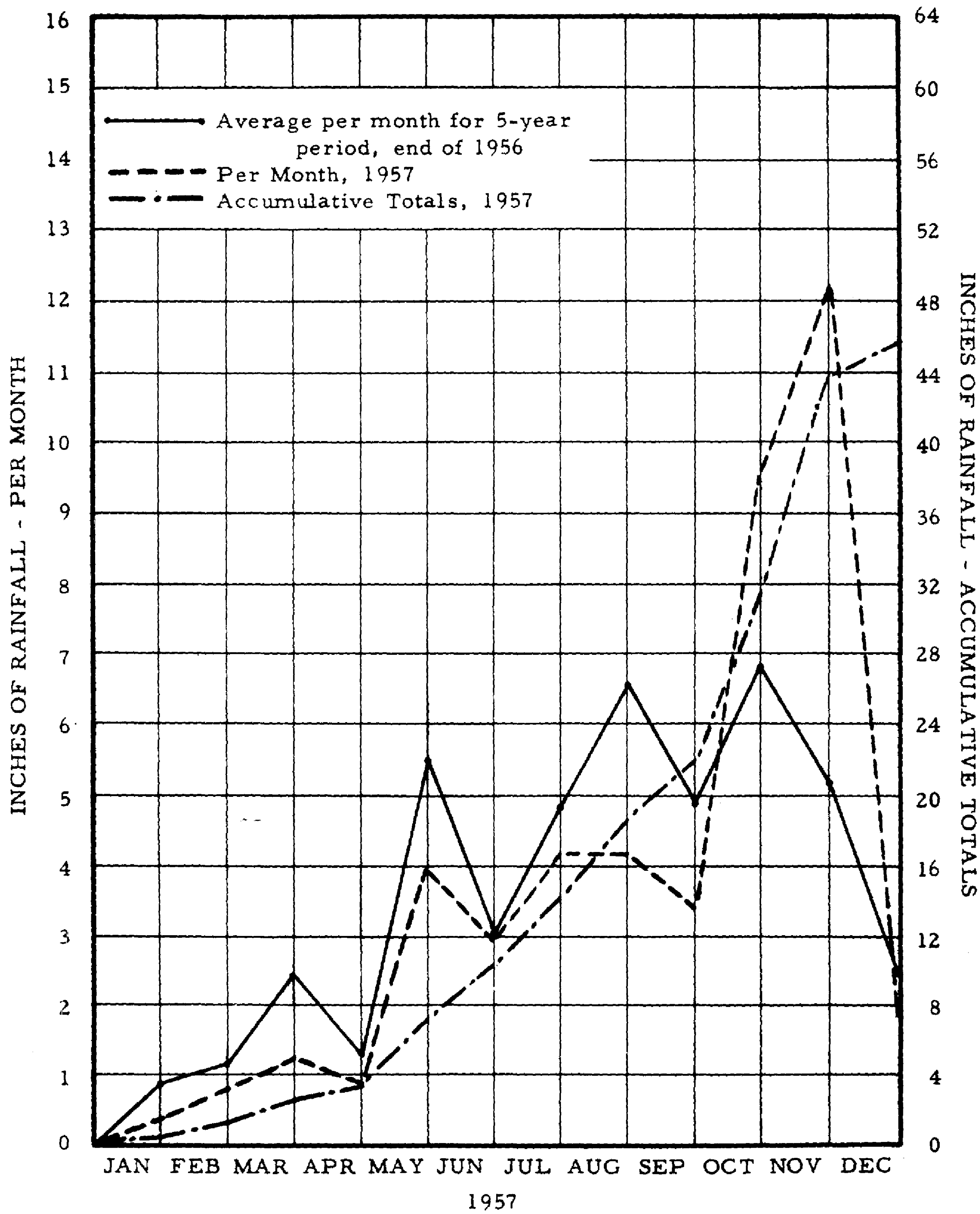


Chart No. 1-3. Rainfall — Eniwetok Atoll.

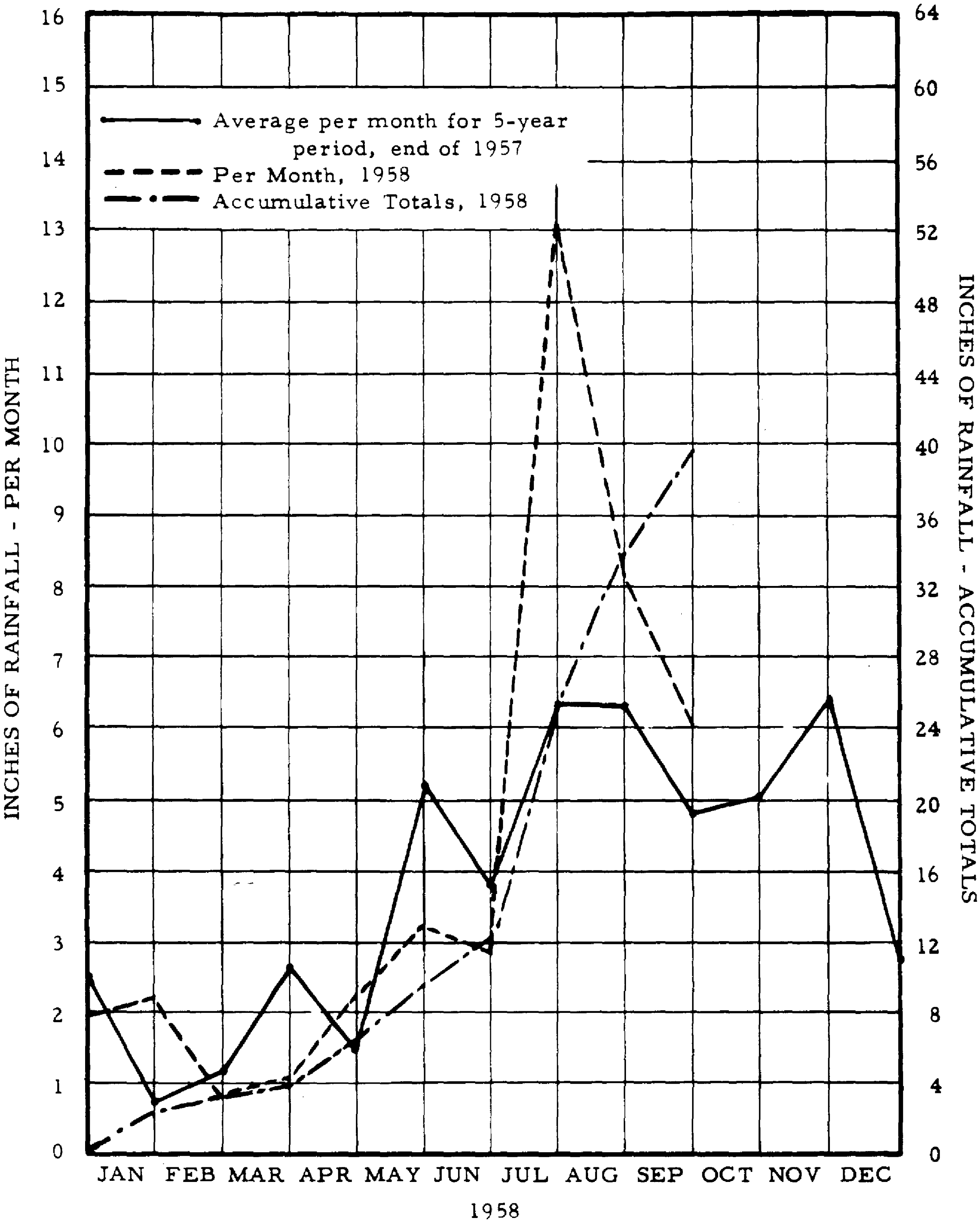


Chart No. 1-4. Rainfall — Eniwetok Atoll.

caused considerable damage to the personnel pier on Site Janet. On 10 January 1958 another typhoon, "Ophelia," struck, with its full force felt about 300 miles southwest of Eniwetok Atoll. Damage at Eniwetok Atoll was determined to be about $20,000. Again there were no personnel casualties; construction schedules experienced minimum interruptions. Jobsite personnel coordinated a mercy flight to Majuro, Jaluit, and Namorik Atolls to offer assistance to the natives who felt the brunt of the typhoon.

On 15 September 1958 Operation HARDTACK, Phase I, was officially concluded, and the CJTF-7 returned jurisdiction of the EPG to the AEC.

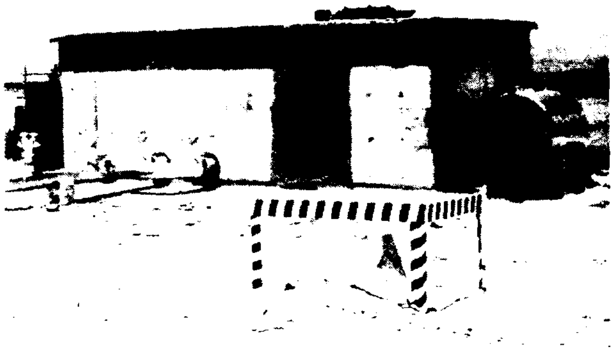


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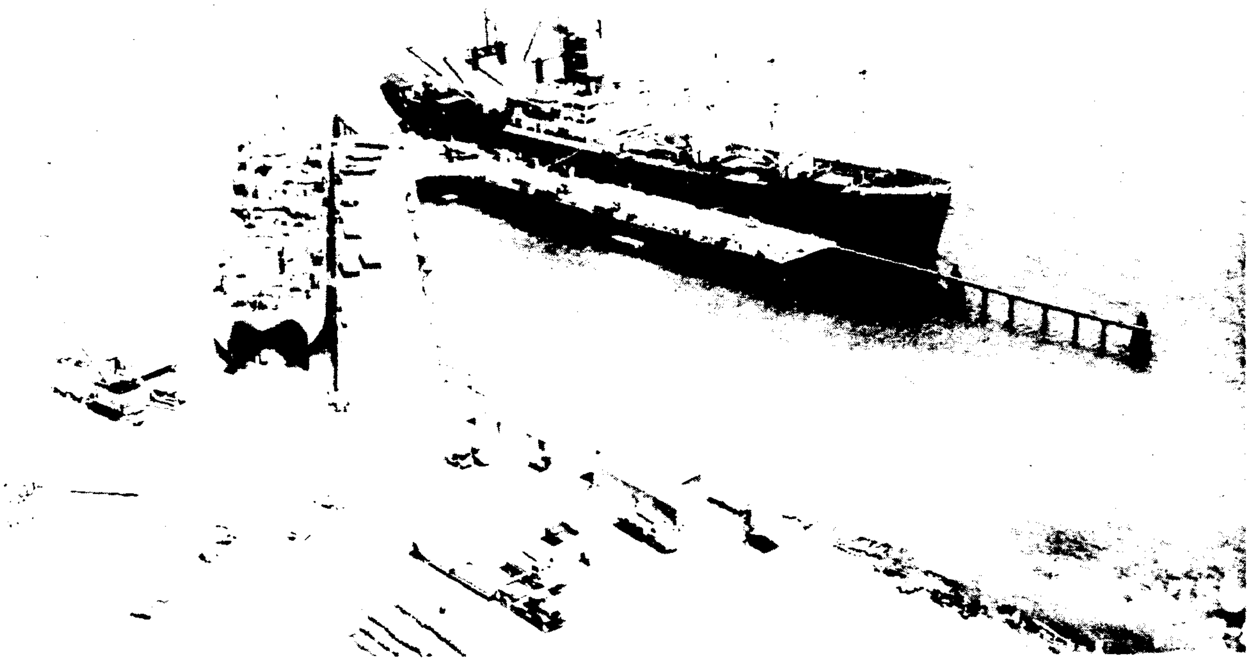
Figure No. 1-12. Pumphouse for Fire Protection System — Fred.



(Neg. No. W-756-3)

Figure No. 1-13. Working a Reefer Ship and LST at Deep Water Pier — Elmer.

SECTION 2
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS.

1. The abundance of experience available from key Management and Engineering personnel who had participated in past Operations exerted a significant influence in meeting the challenge of a highly diversified program made more difficult by constantly changing criteria throughout the design stage.
2. The inter-atoll Tropospheric Scatter System proved excellent in reliability, voice quality, and traffic handling capabilities. Without any additional equipment, ample facilities remain for additional circuits. The VHF networks and the UHF ship-shore circuits, using military equipment, operated successfully and were adequate as installed. The HF ship-to-shore circuit and the television station operation were satisfactory. The Elmer dial exchange operation was adequate and remarkably trouble free. The smaller 70-line telephone exchanges proved satisfactory, operating without difficulty even close to the test detonations.
3. Evacuations during Operation HARDTACK were conducted in an efficient manner. Few situations arose that required augmentation to the established plan. In no instance did these additions to the plan cause an interruption to the evacuation program.

RECOMMENDATIONS.

It is recommended that:

1. The growing utilization of Advance Material Estimates in the future be accomplished in two ways:
   A. The number of types and sizes of basic stockpile items must be reduced to a minimum; e. g., various specifications for steel pipe may be combined into one specification which will cover the maximum number of design requirements.
   B. Requirements for various items of equipment must be analyzed to ascertain the possibility of using one or more standard sizes and types of equipment, multiples of which will satisfy the requirements of many facilities.
2. Future operational plans provide for centralized inter-island air-lift operational control for Eniwetok Atoll at Site Elmer. This would aid immeasurably in planning and coordinating daily aircraft requirements and movements.
3. Marine channels be cleared into all islands that contain major scientific installations.
4. As a part of the JTF-7 Operations Plan, a firm aircraft capability for the support of off-atoll locations be included.
5. PAC appropriations be received at the beginning of the fiscal year for optimum performance of procurement activity. The elongated peaks of the construction programs would be eliminated if PAC procurement and construction were effected in non-operational years.
6. Every effort be made to provide an additional 1000-man mess hall on Elmer in view of the fact that 3 and 4-seatings per meal have resulted in an uneconomical operation.
7. For future operations, realistic billet forecasts and personnel forecasts from each element of the Task Force be made a requirement at least four months in advance of the actual need.
8. Consideration should be given toward more stringent controls on the sale of beer and liquor to personnel of all Task Groups.
9. Consideration should also be given to the installation of a Snack Bar at Site Nan. This would aid considerably to the morale at this site and would provide a long-needed facility for the convenience of personnel.
10. Commissaries be established at EPG to sell foodstuffs for parties and special occasions to Task Force personnel during operational periods.
11. The Contractor assume responsibility for camp operations on Site Fred, including but not limited to housing, messing, and laundry.
12. Water should be furnished to transient ships at a nominal cost and only in emergencies.
13. The support of all off-atoll weather and rad-safety sites be assumed by H&N, particularly the power generation and distillation plant operations.

14. Additional water taxis and 600-horsepower tugs be furnished at Bikini Atoll to support adequately a full-scale operation at that location.
15. To increase area coverage and provide service range comparable to the excellent Bikini VHF system, a 300-foot tower similar to the Building 204 tower at Nan be installed adjacent to Building 488 at Elmer.
16. Increase the existing 3 Communications Channels between Eniwetok and Honolulu consisting presently of 1 Voice, 1 Teletype and 1 Order wire, to provide an additional Voice Circuit for a new total of 4 Communications Channels of commercial grade service, which would include 2 Voice, 1 Teletype, and 1 Order wire.
17. A truck-mounted interference detection unit be engineered and purchased to provide equipment which incorporates the latest developments. The interference detection unit used during HARDTACK, while doing a competent job, operated with makeshift equipment.
18. The present manual telephone equipment at Nan be converted to automatic dial. An automatic dial exchange at Nan would eliminate the traffic bottleneck and provide efficient telephone service to all parts of the EPG.
19. An addition to Building 224, Elmer, be erected to provide adequate space for the Communications Center. Also an effort should be made to obtain automatic off-line cryptographic equipment to replace the manual system presently in operation.
20. Either personnel be employed and administered by the agency under whose supervision they work, or personnel required to fulfill User requirements be furnished by the Contractor on the basis of individual support. This policy will eliminate the friction and misunderstanding resulting from differences in the policies and procedures of various organizations of the Task Force.

(Neg. No. W-V-314-10)

Figure No. 1-14. PBX — Nan.

SECTION 3
CONTRACT HISTORY

Contract AT(29-2)-20 was modified 14 times during Operation HARDTACK. Other changes were made in the basic contract and Appendix B by the use of 25 approved Re-imbursement Authorizations. The contract as constituted for Operation HARDTACK, Phase I, was divided into three main jobs, as follows:

Job I - Engineering, Design, Inspection, Construction, and Procurement

Job II - Operation and Management of the EPG

Job III - Maintenance of the EPG

The various modifications to the contract made during Operation HARDTACK, Phase I, were as follows:

Modification 55, dated 29 June 1956, effective 1 July 1956, restated the entire contract with new Appendices A and B.

Modification 56, dated 7 September 1956, effective immediately, increased the "Obligated Funds" available for use under the contract.

Modification 57 was not applicable to this Operation.

Modification 58, dated 27 December 1956, effective immediately, deleted Part V of Appendix A, revised paragraph 2, Article IV, of the basic contract, and increased the "Obligated Funds."

Modification 59, dated 31 December 1956, effective 1 July 1956, revised Appendix A, firmed and enlarged the scope of work of Job I, and stated the estimated cost for the procurement of equipment for FY 1957 and the estimated cost of Jobs II and III for the six months ending 30 June 1957.

Modification 60, dated 24 June 1957, effective immediately, amended paragraph 2 of Article IV of the basic contract to increase the "Obligated Funds" available.

Modification 61, dated 1 August 1957, effective 1 July 1956, revised Appendix A by defining and increasing the scope of work under Job I and by stating the estimated costs for Jobs II and III for the 6-month period ending 31 December 1957 and the estimated costs for procurement of equipment for FY 1958.

Modification 62, dated 15 August 1957, effective immediately, amended paragraph 2 of Article IV increasing the "Obligated Funds" available.

Modification 63, dated 2 August 1957, effective immediately, amended and revised paragraph 5 of Article XXV to incorporate provisions and requirements for work performed under the contract within the scope of the Davis-Bacon Act.

Modification 64, dated 19 September 1957, effective immediately, amended paragraph 2 of Article IV to increase the "Obligated Funds" available.

Modification 65, dated 22 October 1957, effective immediately, increased the amount of work under Job I of Appendix A.

Modification 66, dated 26 December 1957, effective 1 July 1958, amended the contract to permit the Contractor to use Government-owned property in the performance of work in common service departments where the cost is allowable as an indirect item.

Modification 67, dated 17 February 1958, effective 1 July 1956, revised Appendix A increasing the scope of work under Job I, stating the amount of Government-furnished material to be supplied and used by the Contractor in the performance of Job I and the estimated costs of Jobs II and III for the 6-month period ending 30 June 1958.

Modification 68, dated 10 February 1958, effective immediately, amended paragraph 2 of Article IV to increase the "Obligated Funds" available.

Modification 69, dated 22 April 1958, effective immediately, amended paragraph 2 of Article IV to increase the "Obligated Funds" available.

Modification 70, dated 20 June 1958, effective immediately, amended paragraph 2 of Article IV to increase the "Obligated Funds" available.

Modification 71, dated 9 August 1958, effective 1 July 1956, increased and defined the scope of work under Job, I, stated the amount of Government-furnished material to be supplied and used by the Contractor in the performance of Job I, and the estimated cost of the performance for Jobs II and III during the 3-month period ending 30 September 1958.

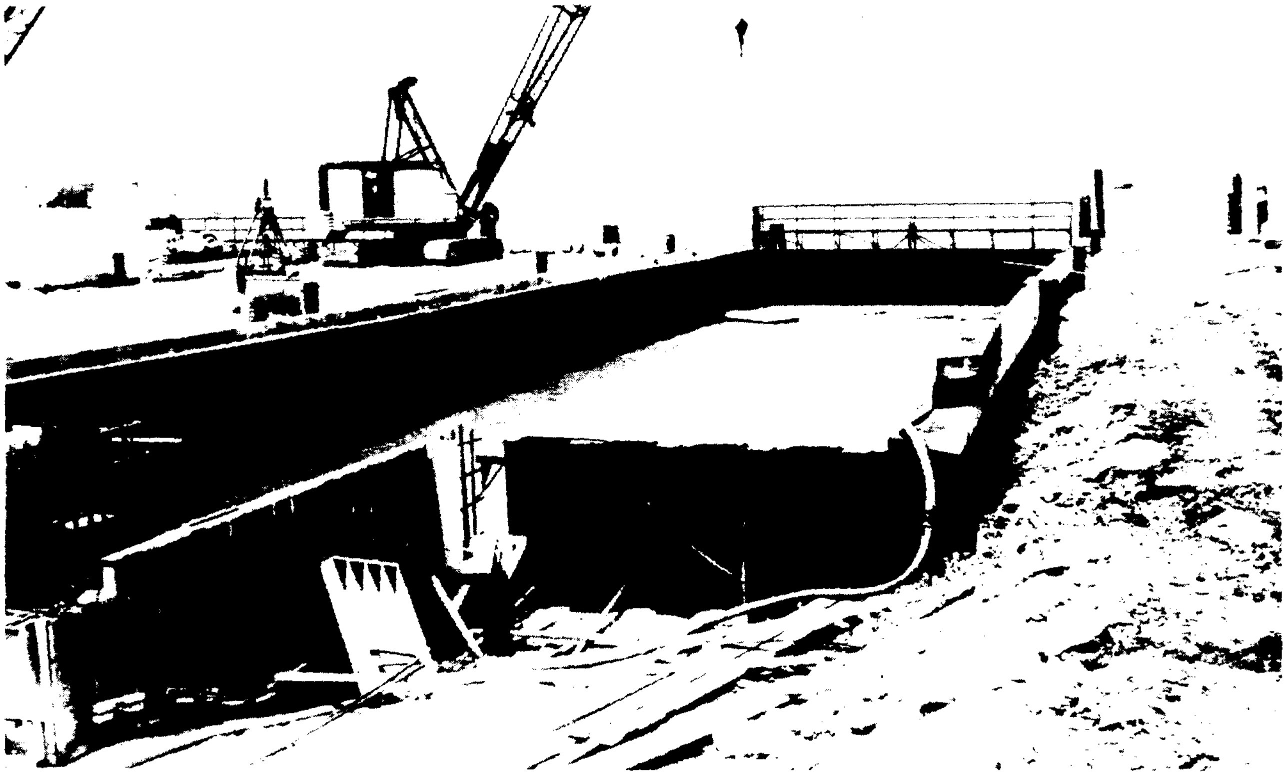
Modification 72, dated 30 September 1958, effective 1 July 1956, revised and increased the scope of work under Job I and stated the estimated cost of performance for Jobs II and III during the 3-month period ending 31 December 1958.

(Neg. No. W-V-296-4)

Figure No. 1-15. Aerial of Elmer — Deep Water Pier in Foreground.

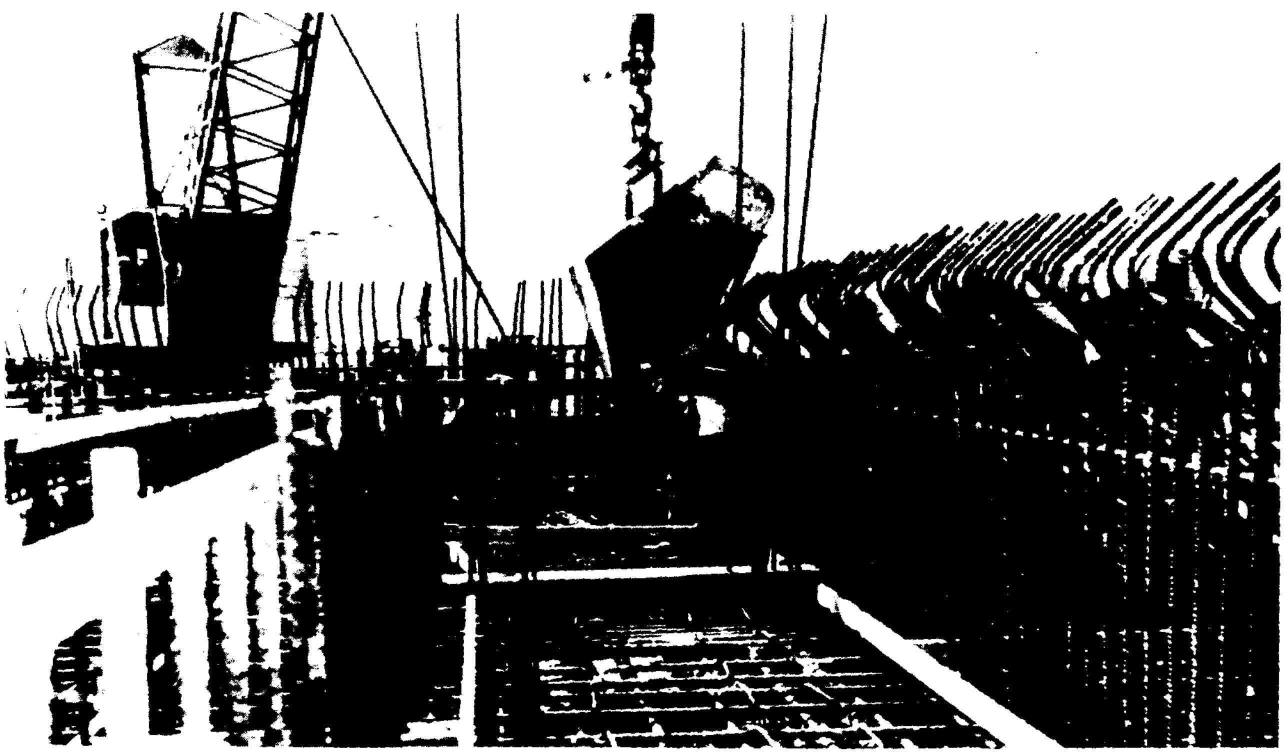
SECTION 4
PARTICIPATING AGENCIES

ABMA	Army Ballistic Missile Agency
AFCRC	Air Force Cambridge Research Center
AFSWC	Air Force Special Weapons Center
BRL	Ballistic Research Laboratories (Aberdeen Proving Ground, USA)
BuAer	Bureau of Aeronautics, U.S. Navy
CWL	Chemical Warfare Laboratory (USA)
DMA	Division of Military Application, AEC
DOD	Department of Defense
DOFL	Diamond Ordnance Fuze Laboratory
DTMB	David Taylor Model Basin, U.S. Navy
EG&G	Edgerton, Germeshausen and Grier, Inc.
LASL	Los Alamos Scientific Laboratory
MDL	Missile Development Laboratory
NASWF	Naval Air Special Weapons Facilities
NAVCEL	Naval Civil Engineering Laboratory
NEL	Naval Electronics Laboratory
NML	Naval Materiel Laboratory
NOL	Naval Ordnance Laboratory
NRDL	Naval Radiological Defense Laboratory
NRL	Naval Research Laboratory
ONR	Office of Naval Research
R/W	Ramo-Wooldridge Corporation
SC	Sandia Corporation
SCEL	Signal Corps Engineering Laboratory
SIO	Scripps Institution of Oceanography
SRI	Stanford Research Institute
UCRL	University of California Radiation Laboratory
WADC	Wright Air Development Center



(Neg. No. W-877-7)

Figure No. 1-16. Barge Slip at Nan Showing Gate in Place, 75% Complete.



(Neg. No. W-V-94-4)

Figure No. 1-17. Pouring Concrete at Station 1312 — 30% Complete.

CHAPTER II
ENGINEERING AND CONSTRUCTION

SECTION I
ENGINEERING

HOME OFFICE ENGINEERING.

General

The Engineering Department in the Home Office was under the general supervision of the Engineering Manager. His responsibilities included coordinating engineering liaison and Client contract functions; assisting in the determination and establishment of the Home Office Engineering organizational and manpower requirements; and ascertaining that Engineering work progressed satisfactorily in conformance with H&N Engineering standards. The Assistant Engineering Manager and the Chief Project Engineer-Blast Study assisted the Engineering Manager. Under the immediate supervision of the Assistant Engineering Manager were the Chief Project Engineer-Engineering, Chief Project Engineer-Communications. and Chief Production Engineer.

The Assistant Engineering Manager represented the Engineering Manager during his absences, and aided in the administration of policies and procedures of the Engineering Department. He coordinated the activities within the Engineering Department, as well as with other departments of the Project.

The Chief Project - Engineer-Engineering, assisted by a staff of Project Engineers, was responsible for coordinating the activities within the Project Group in developing User criteria, in assuring conformance of engineering design with User criteria, and scheduling completed design compatible with construction completion and User occupancy dates. The Project Group also maintained a close coordination with the Resident Engineer at Jobsite by means of teletypes and advance issuance of engineering drawings to relay information of a nature that would affect construction problems and schedules.

The Chief Project Engineer-Communications was responsible for the achievement of all radio, television, and teletype systems designs, for the design requirements of permanent telephone systems on Sites Elmer, Fred, and David, and for all off-island telephone exchanges and instruments.

The Chief Production Engineer was responsible for the execution of engineering design and drafting on a controlled schedule. He supervised the Civil, Electrical, Mechanical, Structural, Checking, Specifications, and Coordination Sections, which consisted of Engineers, Designers, and Draftsmen under the supervision of Section Chiefs. Additional support was given by a stenographic group under the direction of the Chief Clerk, who was responsible for maintenance of office procedures, supervision of preparation of all correspondence, maintenance of correspondence files, security of correspondence, and the provision of secretarial services. A Materials Coordination Engineer provided liaison between the Engineering Department and the Construction and Planning Department.

The Chief Project Engineer-Blast Study was responsible for the performance of a group of structural specialists engaged in the study of effects of nuclear blasts on AEC structures. The purpose of the studies was to improve the structural design of AEC test structures by establishing criteria on which to base such designs with uniformity. The ultimate goal is to provide data to simplify design and to effect maximum economy in materials, methods, and construction time for blast-resistant structures.

Home Office Engineering personnel engaged in Operation HARDTACK varied from an average of 10 persons from September to December 1956 to an average of 20 persons for the first five months of 1957. The number rose sharply to 90 in June 1957 and increased to a peak of 113 in December 1957. From September 1956 through September 1958, the Department applied a total time of 270,492 man-hours, or 1593 man-months.

As a result of past experience and in anticipation of the scope of work for Operation HARDTACK, the basic organization of the Engineering Department was retained. However, several organizational and procedural changes were incorporated to ensure more accurate and better coordinated engineering design and drawings in less time than during previous Operations.

A change introduced for Operation HARDTACK was the assignment of a Home Office

Project Engineer for each of the laboratories, UCRL, LASL, DOD, Sandia, ABMA, and for the PAC construction program. Their function was to process all of the necessary engineering design and planning requirements of the Users from initial criteria through release of approved plans for construction use. The Project Engineers assigned in residence at laboratories and agencies acted in a liaison capacity to expedite new and changed criteria.

During Operation HARDTACK, the Engineering Department provided design information to the Construction and Planning Department to enable that department to initiate procurement with as much lead-time as possible for satisfactory scheduling of shipping of critical materials and equipment to Jobsite.

DRAWINGS ISSUED (FINAL)

REDWING

	Home Office	Jobsite
Scientific	1041	268
PAC	306	570
Totals	1347	838

HARDTACK

	Home Office	Jobsite
Scientific	1640	699
PAC	384	449
Totals	2024	1148

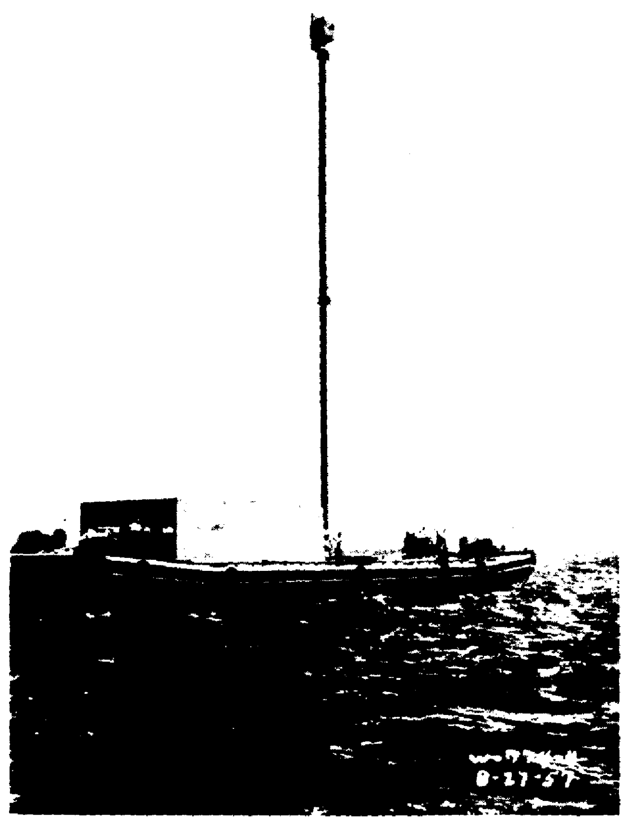
Design

The Home Office design program covered the 16-month period from September 1956 through January 1958, during which criteria were received, designs were completed, and construction drawings and specifications were issued to cover approximately $20,000,000 worth of scientific and support construction for the FY 1958 program. Some design work continued in the Home Office after 1 February 1958, but at that time all original drawings were sent to Jobsite, and a design staff from the Home Office moved to the field to reinforce Jobsite engineering capability.

The major features of HARDTACK involved a vastly improved and highly specialized radio and telephone communications system, expansion of electric power and other utilities, unusual designs for four different types of all-steel barges, major modifications and extensions to an airfield, including a unique type of sea wall, and highly specialized, air-conditioned buildings to house critical scientific equipment.

All Scientific Users cooperated to the utmost in advising H&N Project Engineers of new criteria or changing requirements. Maximum use was made of repetitive designs, such as barracks, office and laboratory buildings, and structural barge features.

The program as designed in the Home Office was under two broad classifications: namely, the Plant Acquisition and Construction (PAC) features of a generally permanent nature, and the Scientific or expendable construction. Civil, structural, mechanical, electrical, and communications designs were based on the best engineering practice consistent with the intended use. For example, a PAC building would be designed generally in accord with the Pacific Coast Uniform Building Code, whereas a camera observation structure intended for only one-time use would be designed to minimum standards for stability or weather resistance. Conversely, a PAC-type office for operating or maintenance activities would have only the ventilation necessary for personnel, while an expendable instrument shelter might be air-conditioned and dehumidified to ensure accuracy and protection of delicate scientific instruments.



(Neg. No. W-744-11)

Figure No. 2-1. Barge Mock-up Used for Barge Motion Studies.

(Neg. No. W-V-296-2)

Figure No. 2-2. Four 2-story Barracks — Elmer.

Home Office Engineering action included preparation of final design drawings for FY 1957 and FY 1958 PAC construction projects located on Sites Fred and Elmer. In general, the FY 1957 design program provided plans for several new buildings and facilities for Non-scientific Users, initial phases of a salt water fire protection pipeline system at both Sites Fred and Elmer, a Communications Center Building and a 600-dial Telephone Exchange at Site Elmer. Design engineering required for the several buildings was limited almost entirely to conventional foundations for prefabricated steel and aluminum buildings, and some dehumidification design. The new fire protection systems and the dial telephone exchange required more meticulous design planning.

The FY 1958 PAC design program represented at least four times the valuation of planning required for the FY 1957 PAC schedule. The program included the design of several new buildings and modifications to existing buildings for both Scientific and Non-scientific Users, modifications and additions to the power, sewer, and fresh water systems, airfield additions, telephone and radio communications facilities, and planning for a new Generator and Distillation Plant at Site Fred.

Outstanding PAC design projects completed at EPG, from the standpoint of size and design, were the Airstrip Extension and Parking Aprons, Site Fred; POL Farm Expansion, Site Fred; Fire Protection System, Phase I, at Sites Fred and Elmer; IBM Building No. 453, Site Elmer; and Multi-story Barracks, Site Elmer.

Difficult engineering design prepared for expendable construction was in keeping with the unusual nature of several new facilities. Outstanding among these design projects were the ABMA Program Missile Service Tower and Firing Pad, Station 6001, at Site How, which was subsequently moved to Johnston Island; Pinex-type Barge Zero Stations; barge facilities at Site Nan; Tower Station 2250 at Site Sugar; and modifications and additions to the Submarine Signal Cable System.

The entire ABMA missile facility at EPG required extensive design of test facilities, cleared areas, roads, and encampments and occupied all of How Island on Bikini Atoll. Relocation of the ABMA Program to Johnston Island required further modification of prepared design drawings for adaptation to the new location.

The Service Tower, Station 6001, as first designed for Site How was a 90-foot-high, corrugated metal-covered, steel-frame structure, 24 feet square in plan, and was mounted on steel wheels for mobility on tracks. When this tower was later constructed at Johnston Island, the roof structure, sliding door, and tower siding were omitted and the foundation was redesigned to minimize procurement and construction time. The basic design problems were to provide a structure meeting the User's several detail requirements: stability in motion in a 30-mph wind; resistance to a wind pressure of 30 pounds per square foot when in fixed anchored position; provision for a system to move the standing structure to and from the firing and parking pad; ability to enclose the standing missile on all sides; and stability in resisting overpressures from the first events in Bikini Lagoon with the metal siding removed. The problem when first confronted seemed overwhelming and of doubtful feasibility because of the great size of the structure. Design was not particularly difficult from the engineering standpoint, but problems arose as a result of the unusual details for hinged platforms at tower work levels, tower tie-down anchors at the parking and firing pads, concrete counter-weights at the lower platform level, and the towing system rigging and winch.

Pinex-type Barge Zero Stations were an entirely new type of barge modification development. The general configuration of the deck structure details, underwater collimating pipe, and access caisson were as suggested by the Users. The main design problems were in selecting design and details for an adequate and feasible bracing system support of a long, large-diameter, steel pipe below the bottom of the hull, the vertical removable steel caisson for access to the underwater lower end of the collimating pipe, and a multitude of details for underwater connections and water-tight joints.

The barge facilities at Site Nan were more in the order of an unusual facility rather than a difficult design, once the over-all general planning concept was determined. The design objective was to provide two quiet-water, barge-mooring slips for outfitting shot barges. The gate construction to prevent water level surge in the two basins was the basic problem. The underwater gate sill construction initially suggested an obstacle, but this was surmounted by planning to drive steel sheet-piling, cut-off walls topped with a level steel section. This was later revised during the construction period to provide a prefabricated sheet-pile, cut-off wall section lowered into an underwater excavation, backfilled and tied off by wire rope.

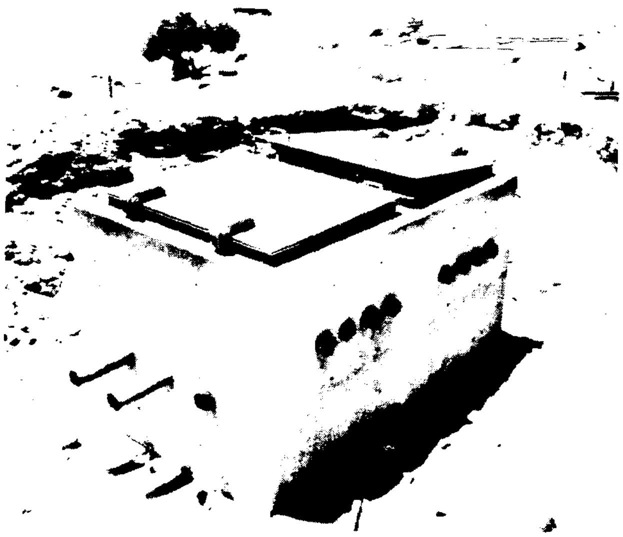
Station 2250 at Site Sugar was the first requirement for a non-expendable, blast-resistant, steel, guyed tower structure at EPG. Essentially, the station tower was a 150-foot tower guyed at the top level and made up of 25-foot segments of a standard 300-foot shot tower developed for EPG. An unusual aspect of Station 2250 was that it was supported at its base on the roof level of the Room D addition to existing Station 2200; this was also the first time at EPG for the erection of a significant steel tower upon a Scientific Station structure roof.

The IBM Building, No. 453, designed to house a model 707 IBM computer system, was the first fireproof re-inforced concrete office building to be constructed at EPG. The structure was

(Neg. No. W-V-243-5)

Figure No. 2-3. Caisson Installation on Pinex Type Barge.

designed to resist 0.75 psi side-on and 1.5 psi reflected overpressures without temporary shoring or bracing. Dependable air-conditioning and power supply were the most important design feature considerations to ensure protection of the electronic components of the computer from corrosive action and equipment shut-down due to power failure.



(Neg. No. W-V-241-7)

Figure No. 2-4. Typical Submarine Cable Vault — 50% Complete.

The Multi-story Barracks, Buildings Nos. 456, 457, 459, and 460 constructed at Site Elmer, were the first two-story (128-man) barracks buildings to be built at EPG. An extensive design and cost study was prepared to determine the most feasible and economical design. The results of the study and later investigations determined the selection of a final design having precast concrete first-story frame bents, precast flat slab second floor, all-aluminum second-story bents, and corrugated aluminum roofing and siding. This was the first use of precast concrete as an element of permanent building construction at EPG.

The Airstrip Extension and Warm-up Apron at Site Fred was the largest FY 1958 PAC construction project. Design problems included determination of asphaltic concrete and unre-inforced portland cement concrete pavement design sections, design of a 855-foot-long concrete sea-wall, and new airfield lighting systems. The sea-wall problem was to provide a design that would permit construction during all tide stages on the ocean reef and was resolved by using precast concrete wall sections between vertical steel H-piles.

Operational requirements of the submarine cable telephone and signal systems at Eniwetok and Bikini Atolls, together with a complete examination of all existing cables made at Jobsite, provided design criteria for the analysis of each system to determine the extent of rehabilitation and new installations necessary to bring the systems up to the stipulated HARDTACK capability. The new criteria included desirability of separating the communication and signal systems, both in cables and at land terminals, for safety and maintenance reasons. In addition, new signal requirements included the stipulation that an adequate number of pairs be provided to accomplish the simultaneous firing of three separate events at each atoll, with a minimum of 50 per cent of the allocated pairs as back-up.

Continuity and insulation-resistant tests were conducted on 2,112,800 feet of existing cables, as follows:

5 pr. #14	549,800 feet
5 pr. #19	122,400 feet
16 pr. #19	1,417,100 feet
51 pr. #19	23,500 feet
Total	2,112,800 feet

Based on the results of these tests and the known operational requirements, an engineering analysis was made and a report was submitted to the AEC containing proposals for modifications and additions to the existing cable plants. Permission to use approximately 400,000 feet of 16 pair #19-gauge submarine cable in warehouse stock at Jobsite, and authority to procure an additional 1,000,000 feet of 26 pair #19-gauge submarine cable were requested. Upon approval, purchase specifications for the 26-pair #19-gauge submarine cable were prepared and procurement was initiated.

Two types of submarine cable terminating vaults were designed, predicated on anticipated overpressures at the individual sites. Each vault contained two separate compartments, with terminating facilities in one for the telephone pairs and in the other for signal pairs. To ensure operation of the communications and signal systems immediately after each event, the vaults were designed as a below-grade structure with a waterproof hinged roof. Waterproof terminal boxes were positioned just below the covers in a horizontal configuration, mounted on hinged frames to allow their movement to an upright position above grade when the covers were open. This facilitated the connecting and checking

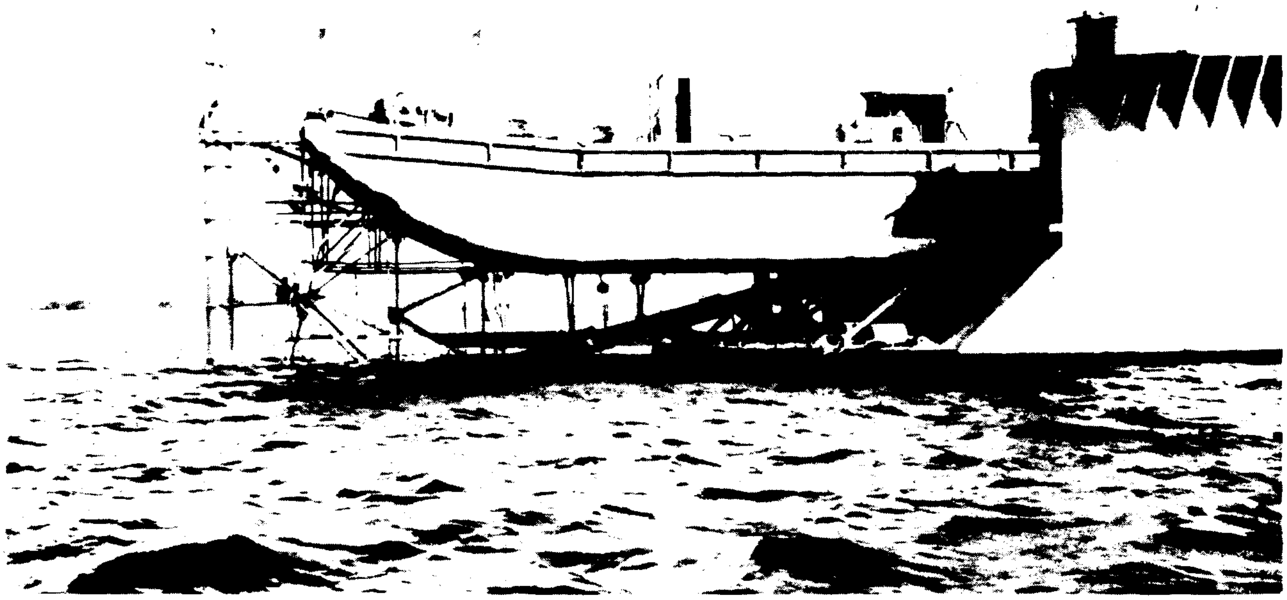


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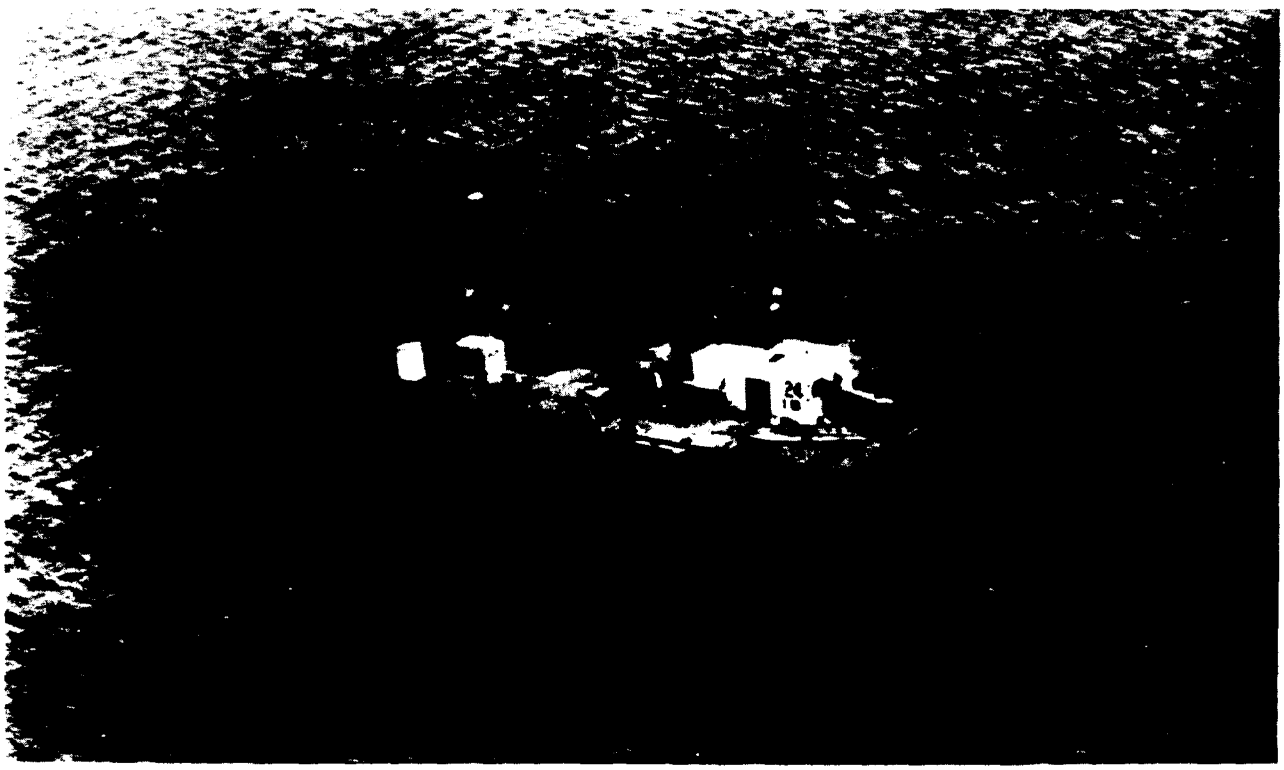
Figure No. 2-5. Barge Station 34 in Drydock.



(Neg. No. W-V-337-11)

Figure No. 2-6. LCU Station 24 Positioned Off Yvonne.

of cable pairs and reduced the size requirements for the vaults.

Comparison of Engineering Design with Previous Operations

A new method for the design of non-expendable, blast-resistant structures was adopted for Operation HARDTACK. Prior to Operation HARDTACK, non-expendable structures were designed on the basis of allowable stresses for wind load: i. e., for allowable static load stresses increased by one-third. The new method applied principles as outlined in the ASCE publication, "An Engineering Approach to Blast-Resistant Design." The system was basically an "ultimate design" method using considerably higher allowable stresses than for wind load. The net effect of the new design method was to reduce re-inforcing steel sectional areas and wall and slab thickness. By reason of this effect and the lack of experimental field data, a factor of safety of two was usually applied, but depending on the nature of the structure size and the test evaluation importance for some extremely high psi loading, the factor of safety was reduced in some cases to as low as 1.5. It is anticipated that Operation HARDTACK post-shot damage inspection reports will supply valuable information to the Design Engineers to alleviate questionable design considerations and will lead to more certain and economical blast-resistant design method standards.

The scope of engineering design for Operation HARDTACK was more extensive in quantity and variety than for past Operations. This is attested in part by the greater number of drawings prepared. PAC Construction design requirements resulted in the preparation of design drawings for the construction of many more categories of permanent base facilities, several of which were extraordinarily large and unusual. The design program for Scientific and Expendable Construction required less complex engineering analysis and planning than the PAC program. In addition, experience gained from previous Operations and the systematic use of the new blast load design method contributed to the more effective and expeditious scientific design. The fact that the extent of the design detail and the number of design drawings were greater can be attributed to the greater number of test-shots for Operation HARDTACK as compared to REDWING; preparations for participation of the ABMA missile project at Site How which was subsequently moved to Johnston Island; and the considerable number of facilities developed at Site Nan.

Operation HARDTACK notably excluded steel tower zero stations but generally supplanted this shot vehicle with modified U. S. Army BC-type Deck Cargo Barges and LCU hulls. The development of Shot Barge plans for LASL and UCRL required considerable plan details and detail design for four barge types. New or modified major Scientific Stations designed of re-inforced concrete surpassed the extent of overall detail design requirements for other recent Operations because of the greater number of new stations designed in this category. The development of re-inforced concrete structures at Eniwetok Atoll was predominant on Sites Yvonne, Gene, Helen, Irene, and Janet and at Bikini Atoll on Sites Peter, Sugar, Tare, How, Dog, Charlie, and George.

Liaison With Jobsite

The principal liaison between Home Office and Jobsite Engineering was accomplished by Engineering Work Orders and Contract Authorizations. The Engineering Work Order copies to Jobsite were not only a direct means of conveying detailed information pertaining to the scope of design planning performed by Home Office Engineering but in some cases assigned engineering action to be accomplished by Jobsite Engineering. The Contract Authorization documents were mainly to authorize Jobsite camp maintenance and operations and miscellaneous construction projects for which action was requested of Jobsite Engineering by the AEC Chief, Eniwetok Branch Office. They also served to keep Home Office Engineering informed of the scope of Jobsite Engineering action that might be correlated with Engineering Work Orders. The main line of liaison of correspondence was teletype messages. This medium was used extensively by the Chief Project Engineer and the Resident Engineer to expedite information requests, clarification of details, status of work, and plan changes. TDY visits were made by the Engineering personnel, as required, to correlate Home Office and Jobsite efforts.

Liaison With Users

Design criteria were obtained from the Users by means of letters, often with plan sketch descriptions of required new facilities or modifications to existing facilities. All criteria letters requiring design and engineering action were documented by the Project Engineers with the issuance of Engineering Work Orders for each facility project. The Project Engineers assigned to the various Users in a liaison capacity effectively expedited their respective design program from original criteria to issuance of final approved drawings by continuous contact with the various User representatives to discuss their design and engineering requirements. In this manner, new design planning was anticipated in advance of receipt of first criteria letters; status of current design projects became known; and design completion date requirements were planned. Action was then initiated for field tests or surveys, procurement of critical materials and equipment, and expeditious approval of preliminary plans.

Studies and Reports

The following reports and studies were prepared during Operation HARDTACK:

1. Study of Vehicular Causeway Between Parry and Eniwetok Islands
2. Proposed New Holmes & Narver Office Building, Site Elmer
3. Study of Multi-Story Barracks, Eniwetok Proving Ground
4. Recommendations for Disposal System of Wet Garbage, Eniwetok Proving Ground
5. Feasibility Report, Short Towers in Deep Water
6. Study for Improvements to Sewerage Systems on Sites Fred and Elmer
7. Feasibility Recommendations for Launching Ways, Site Nan
8. Study of Fall-out Protection at Sites Fred and Elmer
9. Recommendations for Changes and Expansion to POL Facilities, Eniwetok
10. Open Sea Vehicle
11. Recommendations for Modifications and Additions to the Submarine Signal Cable System, Eniwetok Proving Ground
12. Tower and Barge Study
13. Long Range Improvement Plan, 1959 Through 1962, Eniwetok Proving Ground (2 Vols.)
14. Study of Boarding Ramps for EPG
15. Automatic Sprinkler Systems for Eniwetok Proving Ground
16. Evaluation of Microwave Link Equipment vs. Submarine Cable for Telephone
17. Engineering Study of Proposed Four-Finger Barge Slip, Site Elmer
18. Water Supply Study - Assembly Area, Site Elmer
19. Telephone Cable Plant - Phase I, Site Elmer
20. Major Re-Usable Scientific Station Report, EPG
21. Engineering Analysis of Airfield Pavement, Site Fred
22. Standard Specifications for Eniwetok Proving Ground, 1 October 1957

Blast Study

The Blast Study Group participated in Operation HARDTACK as part of a general program for the development of information leading to the improvement of the design of AEC test structures. This objective was met 1) by obtaining reports of nuclear test results, laboratory test results, studies of nuclear weapons effects, and development of blast-resistant design procedures and design manuals; 2) by liaison with other agencies having related interests to obtain current information being developed by tests and investigations; and 3) by participating in nuclear tests when necessary to develop specific information for AEC needs after a careful check by liaison with other agencies to assure that such tests would not duplicate those of others. With the above objectives liaison was maintained with the following agencies: HQ/AFSWP, FC/AESWP, OCE, BuDocks, AFSWC, Sandia, WES, SIO, and BRL.

The observation of damage to test structures at both the Nevada Test Site and Eniwetok Proving Ground on a continuing basis is an important means of assessing the adequacy of design and the establishment of better design criteria. While the damage surveys have been conducted after each Operation to determine the condition of stations with respect to their use for the next Operation, such damage reports were not directed toward assessing the adequacy of design.

The purpose of the Blast Study Group in planning for participation in Operation HARDTACK was to select structures in advance which would be likely to suffer damage, then measure or obtain from others the overpressures and other effects to which they were subjected and observe the damage in relation to such exposure. It developed that Headquarters AFSWP, realizing that much useful information could be obtained from the observation of damage to structures exposed to blast as a result of the test operations, had planned a similar project. Accordingly a a joint AEC-AFSWP-sponsored project was established. Military participation was provided by the U. S. Waterways Experiment Station, Vicksburg, Mississippi, a laboratory of the Corps of Engineers, U. S. Army. The AEC participation was accomplished through H&N. The WES provided a Project Officer and an assistant, surveying equipment, and measurements of overpressures and accelerations of structures. H&N provided an Assistant Project Officer, information on structural design of stations, measurements of wave heights and inundations, and general support.

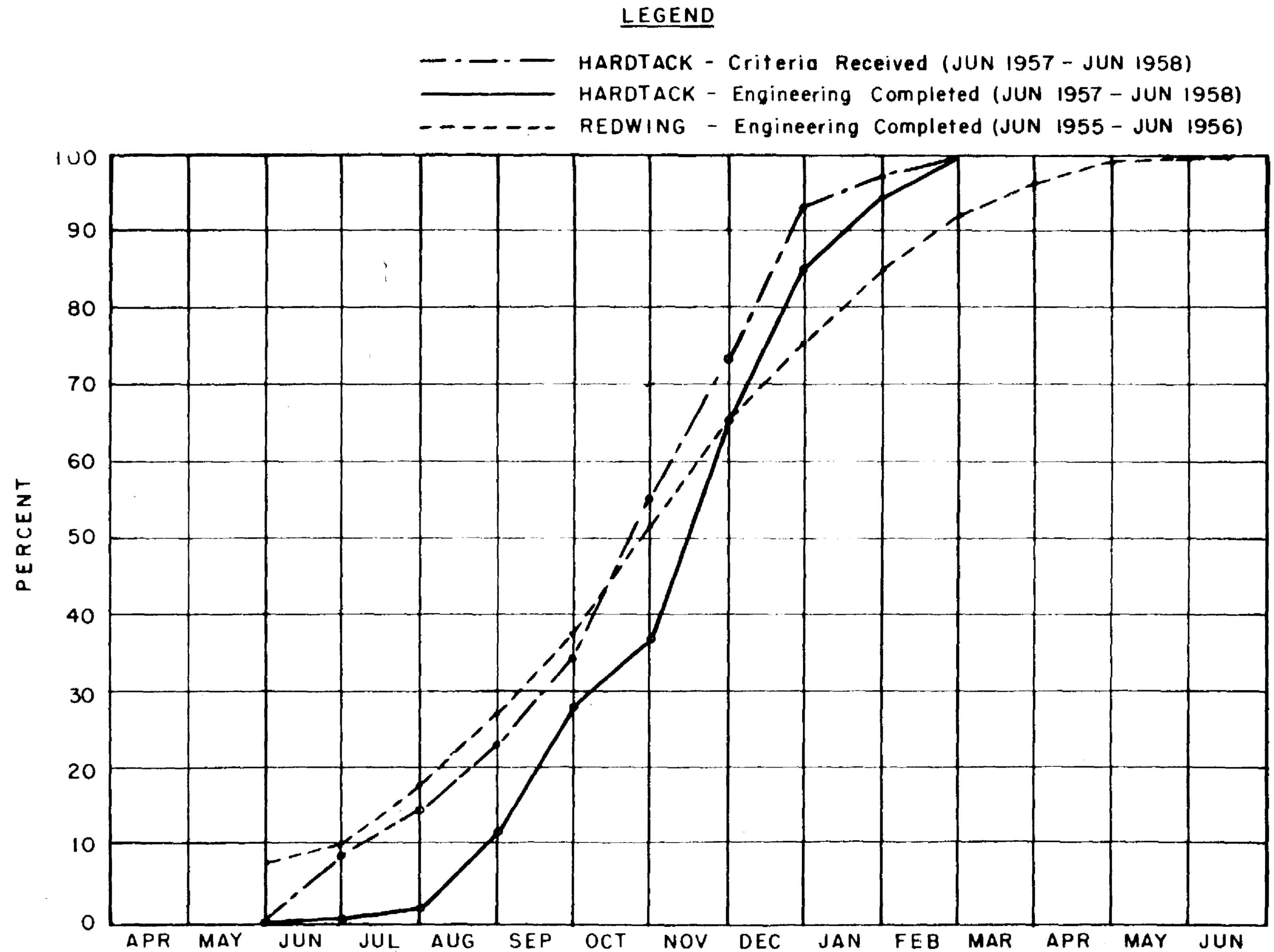


Chart No. 2-1. Engineering Progress — Expendable Test Facilities — HARDTACK vs. REDWING.

The military project was designated as Projec 3.7, Damage to Existing EPG Structures. The joint project objective was to record and evaluate damage from blast, thermal radiation, and water waves to selected AEC test structures, the military multi-story building on Site Janet left from Operation GREENHOUSE, and miscellaneous structures in camps. Self-recording gages were employed to measure air blast overpressures in the vicinity of structures of interest, to measure pressures on the front, top, and back of Station 1312 on Site Janet, and to measure accelerations of selected structures. Wave data were furnished by the Scripps Institution of Oceanography from measurements obtained in Project 50.1, which is mentioned later. Damage surveys were made for 10 events at Eniwetok Atoll on 37 structures, and at Bikini Atoll damage surveys were made for 10 events on 17 structures. Useful information was obtained which will be reported in ITR 1631 to be printed and distributed by the Technical Information Service Extension, Oak Ridge, Tennessee.

Predictions of waves to be expected on shore from nuclear explosions at Eniwetok and Bikini have been made in past Operations, but there had never been a systematic plan for checking the accuracy of such predictions. The information regarding anticipated wave heights and inundations is vital to the planning and design of test structures and dikes for protection of low areas. A request was therefore made to the Assistant Manager for Test Operations, ALO, for permission to arrange a contract with the Scripps Institution of Oceanography for making the predictions of wave heights and inundations, and for a measurement to check their validity. A part of this project had for its objective the measurement of wave heights near structures where wave damage was anticipated. This plan was approved by ALO, and as a matter of convenience, the investigation was included under an existing contract of the San Francisco Operations Office with the Scripps Institution of Oceanography. Technical supervision by the Blast Study Group was provided, and it was agreed that a Chief of Party and one surveyman from the EPG Survey Department would assist in this work which was designated Project 50.1.

The predictions of wave heights and inundation based largely on REDWING results were prepared and used by H&N for planning and design and were employed during the operational phase of HARDTACK for determination of protective measures. Wave measurements were made by 19 suitably located gauge stations on 8 events at Eniwetok Atoll. Wave heights were measured on Elmer for all events. At Bikini wave measurements were made by gauges at 19 stations on 2 events.

FIELD ENGINEERING.

The Resident Engineer had the responsibility of the Architect-Engineer service at the EPG, reporting directly to the Resident Manager. He was assisted in executing his duties by Assistant Resident Engineers and Department Heads. The Jobsite Engineering Division consisted of Design, Estimating and Analyses, Field Engineering and Surveys, Tests and Inspection, and Reports and Photography.

The main functions of the Jobsite Engineering Division were to process and issue Home Office-prepared drawings for construction; to revise Home Office drawings where necessary to meet Users' field changes or substituted materials; and to prepare design drawings for construction originating at Jobsite as authorized by the AEC/EBO, Home Office Engineering, or Jobsite Management.

Personnel levels within the Division were coincidental with the over-all construction activities. During the interim period, a low level of 31 was reached in December 1956. At the start of the build-up on 1 March 1957 there were 37 personnel assigned, increasing to 90 by 1 August 1957. At the start of the operational phase on 15 March 1958, there were 146 personnel assigned, but on 15 September 1958 this strength figure was reduced to 62.

During build-up and operational periods one Assistant Resident Engineer was stationed at Bikini Atoll, where he acted as field liaison representative reporting directly to the Resident Engineer and was charged with the responsibility for the proper functioning of the field engineering forces at that atoll. These functions included inspection of all construction; interpretation of plans and specifications; job progress records and reports; topographic, hydrographic, and construction control surveys; preparation of basic data for "as-builts"; as well as coordination of engineering problems with local AEC and User representatives. Two Assistant Resident Engineers at Eniwetok accomplished the administrative work load of the division at Eniwetok Atoll. In addition, an Acting Assistant Resident Engineer was assigned to Johnston Island at the beginning of the build-up phase at that location to administer Engineering responsibilities paralleling those at Bikini Atoll.

A position of Technical Facilities Coordinator, directly responsible to the Resident Manager, was created at Jobsite to execute new and revised engineering design requirements, and to provide on-the-spot liaison between the Users and the Jobsite Engineering Division involving last-minute revisions and additional requirements. Headed by the Home Office Assistant Engineering Manager, Project Engineers, Design Engineers, and Design and Senior Draftsmen from the Home Office were sent to EPG in January 1958 to support this position. This main group stayed in force at Jobsite until late April 1958, at which time the position of Technical Facilities Coordinator was sustained by a Home Office Project Engineer until early June.

The Technical Facilities Group proved very effective in the expeditious processing of User requirements and changes initiated at Jobsite and aided immeasurably in the over-all construction effort.

Field Engineering Design Department

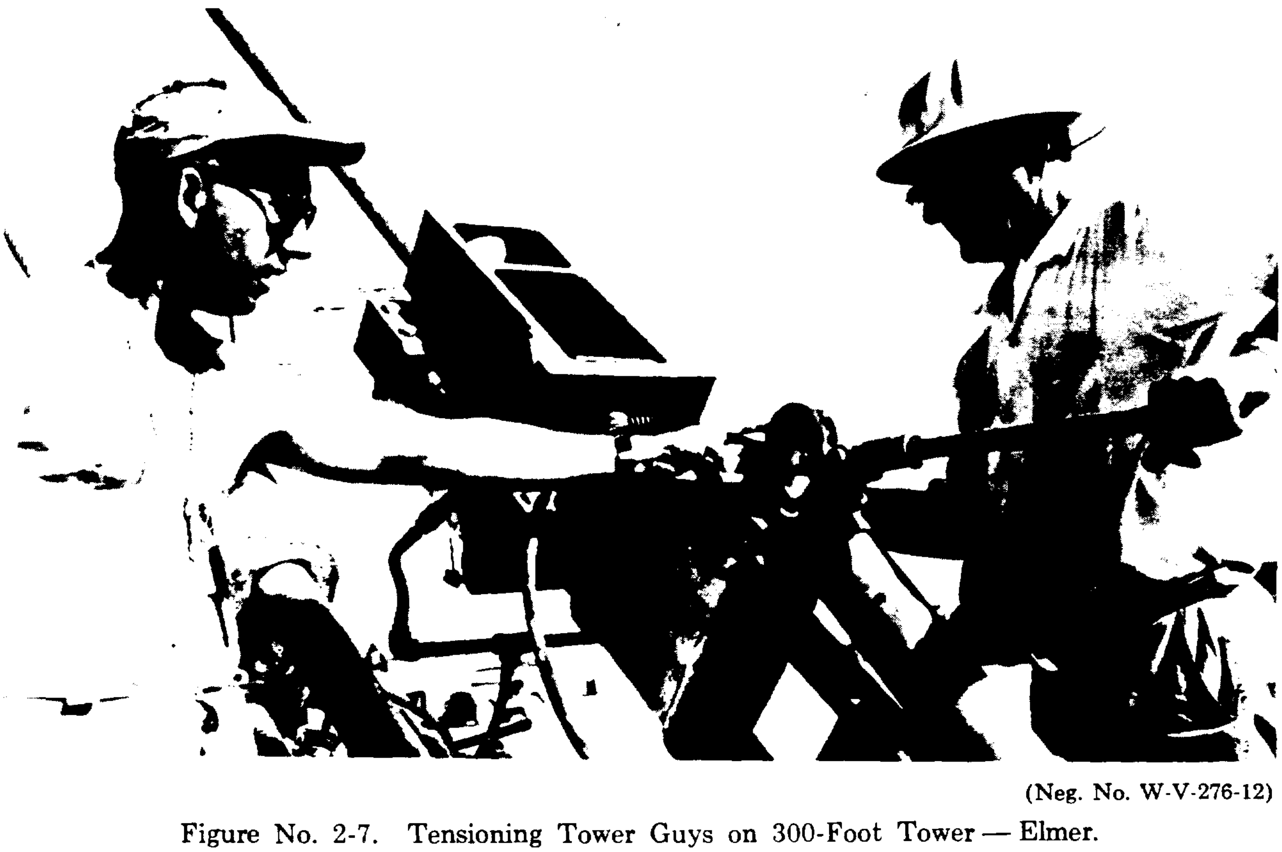
During the build-up phase in mid-1957, the Design Department had 27 personnel assigned and this level was maintained through the operational phase. This strength was supplemented by eight draftsmen on TDY from the Home Office in support of criteria furnished to the Design Department through the Technical Facilities Coordinating Group. The early build-up was necessary to expedite temporary camp design drawings in time for use by construction forces. The Department was responsible for processing, interpreting, and revising Home Office drawings to meet field conditions. In addition, the Department prepared design drawings requested by AEC or H&N management for temporary camps, Weather and Rad-safety Stations, and Scientific Stations when criteria were received late in the Operation, or for other miscellaneous items as required by the Home Office.

Plot plans and design drawings for off-island camp construction were started early in 1957. The adoption of standard buildings and details developed and proved satisfactory in prior Operations aided in expediting completion of design.

Whenever possible the approval of major changes in scientific facilities was cleared through the Chief Project Engineer at Home Office, but as the construction work load increased and time for completion decreased, it was necessary to accomplish changes to scientific construction and notify the Home Office later by forwarding revised drawings approved by both AEC and the User. On construction originating in the field and not related to scientific construction, the Resident Engineer and the AEC Branch Chief approved the drawings and original estimates. In all cases, revised drawings and field drawings were forwarded to the Home Office by reproducibles for their records.

Test and Inspection Department

During the build-up phase in mid-1957, the Test and Inspection Department had 18 personnel assigned, increasing to 26 in mid-February 1958, just prior to the start of the operational phase.



(Neg. No. W-V-276-12)

Figure No. 2-7. Tensioning Tower Guys on 300-Foot Tower — Elmer.

(Neg. No. W-V-246-8)

Figure No. 2-8. Compression Test on Concrete Cylinder.

The Materials Testing Laboratory on Elmer was responsible for testing aggregate, cement, concrete, soils, and other materials requiring control in construction; for testing materials required in support of any special studies the Department was required to make; for surveillance of aggregate stockpiling; and for assistance to Field Inspectors during concrete placing. To provide adequate and effective coverage and ensure adherence to specifications. field laboratories were established at Site Nan for Bikini Atoll and at Johnston Island. These field laboratories operated directly under the supervision of the Test Laboratory Engineer at Elmer.

Aggregates for concrete mixes were composed of crushed coral rock and fine coral beach sands. Variations in the physical qualities of coral rock required the preparation of 41 mix designs at Eniwetok Atoll, 17 at Bikini Atoll, and 6 at Johnston Island. The mix designs for Johnston were made at Elmer, using sample ingredients shipped from there. For the aggregate shipped from Hawaii for use at Johnston Island, the on-site field laboratory determined the specific gravity, and the design mix furnished from Elmer was adjusted accordingly. In order to maintain the highest quality concrete, all aggregates were thoroughly tested before approval for use in concrete.

Concrete cylinders were packed in wet sawdust for 48 hours, the time required for shipment to the test laboratory at Elmer. A total of 1483 test cylinders were taken from 32,500 cubic yards of concrete. The average compression strength of all test cylinders for the required strength of 2000 psi, 2500 psi, and 3000 psi was 2500 psi, 2700 psi, and 3700 psi respectively. No significant variation was noticeable between atolls.

Inspection of all construction at EPG was the responsibility of the Chief Inspector at Elmer until construction started on Bikini Atoll. At that time another Chief Inspector was assigned at Nan and assumed responsibility for all construction at the atoll. Similarly, when construction got under way at Johnston Island, a Chief Inspector and inspection force were organized at that location to assume responsibility for all inspection functions. The inspection of construction of Weather and Rad-safety Stations was the responsibility of the Chief Inspector at Elmer. Supplementing the Inspectors, certain Engineering Specialists were assigned specific inspection duties; i.e., an Assistant Engineer was selected to inspect all barge-type construction.

(Neg. No. W-V-246-6)

Figure No. 2-9. Shear Test Equipment, Test Lab — Elmer.

(Neg. No. W-V-46-12)

Figure No. 2-10. Concrete Slump Test for Bldg. 430 — Elmer.

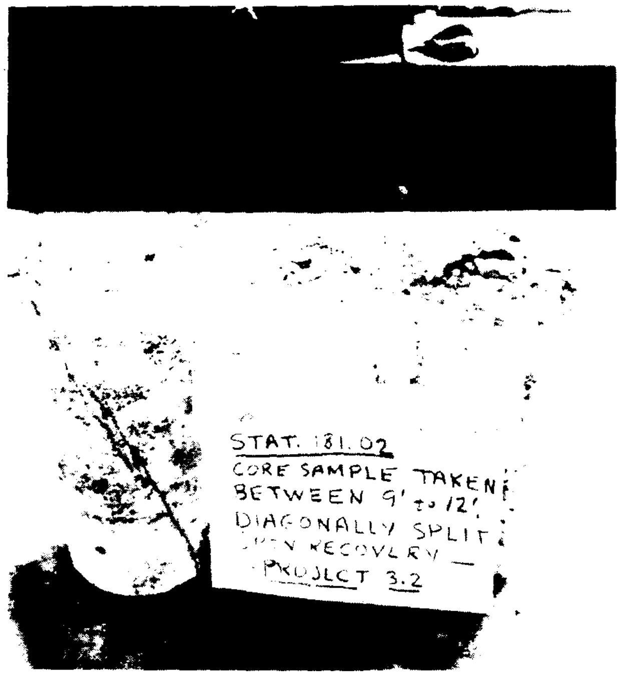


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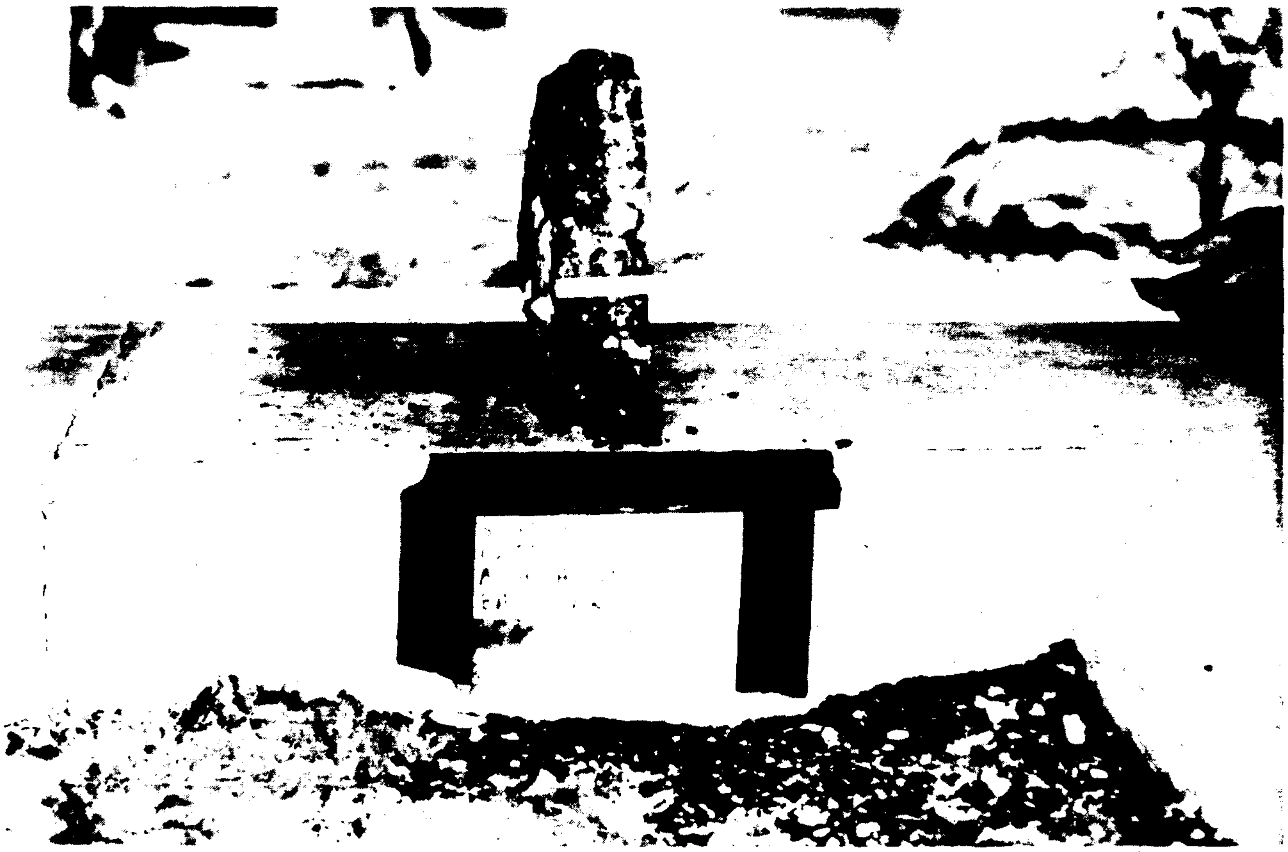
Figure No. 2-11. Core Samples for Ground Motion Studies.



(Neg. No. W-849-2)

Figure No. 2-12. Asphalt Pavement Check — Fred Airstrip.

On large-scale concrete placement operations, the Chief Inspector and Test Laboratory personnel aided the Site Inspector in the surveillance of all phases of the pour. These personnel continuously observed and recorded batching, mixing, transporting, placing, finishing, and curing of the concrete. In this manner, the Site Inspector was free of detailed observations and was able to maintain liaison with the Area Superintendent on other work.

In addition to field inspection duties, the Chief Inspectors and Engineering Specialists reviewed all Work Orders and field design drawings and expeditiously provided the Site Inspectors with interpretations of construction requirements, drawings, and revisions to criteria design.

QUANTITY	TYPE OF TESTS
1606	Standard Method of Test for Compression Strength of Molded Concrete Cylinder, ASTM C-39.
380	Standard Method of Test for Sieve Analysis of Coarse and Fine Aggregates, ASTM C-136.
234	Standard Method of Test for Specific Gravity of Fine Coarse Aggregates, ASTM C-127 and C-128.
22	Standard Method of Test for Unit Weight of Aggregates, ASTM C-29.
408	Standard Methods of Test for the Field Determination of Density of Soil In-place, AASHO T-147.
82	Standard Method of Test for Flexural Strength of Concrete Beams, ASTM C-78.
69	Standard Method of Test for the Compaction and Density of Soil, AASHL T-99.
69	Standard Method of Test for Bitumen Content of Paving Mixtures by Centrifuge, AASHO T-164.
23	Standard Method of Test for Water in Bituminous Material, AASHO T-55.
11	Standard Method of Test for Soundness of Aggregates, ASTM C-88.
27	Standard Method of Test for Normal Consistency of Hydraulic Cement, AASHO T-129.
12	Standard Method of Test for Time of Setting of Hydraulic Cement by Vicat Needle, AASHO T-131.
25	Standard Method of Test for Cemen Mortar Cubes, AASHO T-106.
52	Direct Shear Test of Beach Fines.
20	Asphalt Pavement Density Determination.
40	In-place CBR Tests.
3080	TOTAL

Table No. 2-1. Tests Performed by Test Laboratory.

SURVEY.

Survey activities were directed by a Department Head located at Elmer and assisted by Assistant Department Heads, supervising field survey and office work at Eniwetok and Bikini Atolls. During Operation HARDTACK, an Assistant Department Head was also located at Johnston Island. The organization of the Survey Department consisted of field parties, normally four men each, supporting office personnel, including Computers and Draftsmen, and Supervisors for each location. Personnel increased from 8 on 31 December 1956 to a peak of 73 on 11 March 1958.

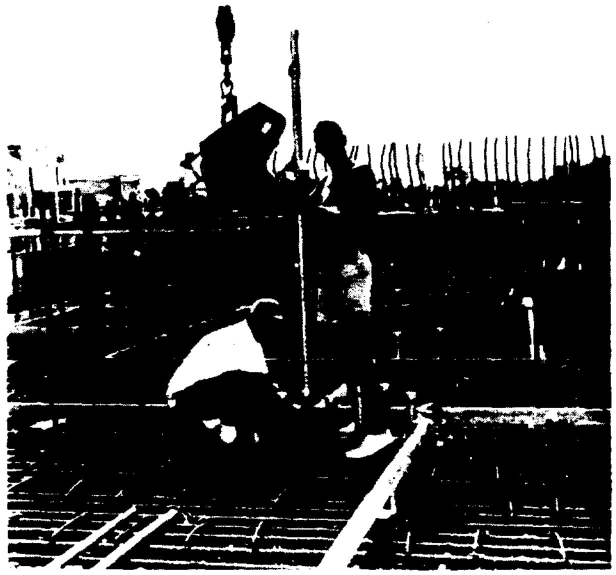
Surveying activities during the interim and build-up phases included topography at Rongelap, Truk, and Ponape; boundary surveys at Rongelap, Nauru, Tarawa, Truk, Ponape, Utirik, Ujelang, and Kusaie; an entrance channel reconnaissance at Taongi; and "as-built" and construction surveys for rehabilitation of Rongelap Village.

During the operational period, surveying activities were concentrated on PAC construction at Elmer, David, and Fred, Scientific Station and barge location, horizontal and vertical control, topographic mapping and plane table surveys, hydrographic mapping, Microbarograph Stations, barge and hull motion studies, tide studies, and rainfall and temperature data collection.

The transfer of the ABMA program to Johnston Island resulted in a requirement to determine precise measurements impractical to obtain by conventional methods. To obtain this information, a Tellurometer system was purchased. Later developments cancelled the requirement for these measurements. However, the Tellurometer system was utilized at Eniketok and Bikini Atolls. The Tellurometer system determines distances by measuring the travel time of high frequency radio waves and is capable of accuracies of the order of 1 part in 100,000, or better. The range of the system is stated to be from 500 feet to 35 miles. The capabilities of the Tellurometer system are such that many of the precise surveys, now performed by triangulation requiring night operations, can be accomplished in the daytime. Also, this system is not affected by high winds, rain squalls, or light refraction.

Horizontal Control — Eniwetok Atoll

The 1957 expansion survey established new second order stations on Sites Yvonne, Sally, and Gene and third order stations on Sites Glenn, Henry, James, and Keith. The triangle closure to include Station Lantana on Site Glenn exceeded the allowable closure limits; however, the triangulation towers were damaged by a storm before they were completely rechecked. An evaluation of the tentative results indicated the values to be within a tolerance of one part in 5000. Therefore, it was decided to defer reobservation of the triangulation towers until more precise values were required for the station.



(Neg. No. W-V-94-3)

Figure No. 2-13. Elevation Check at Station 1312 — Janet.

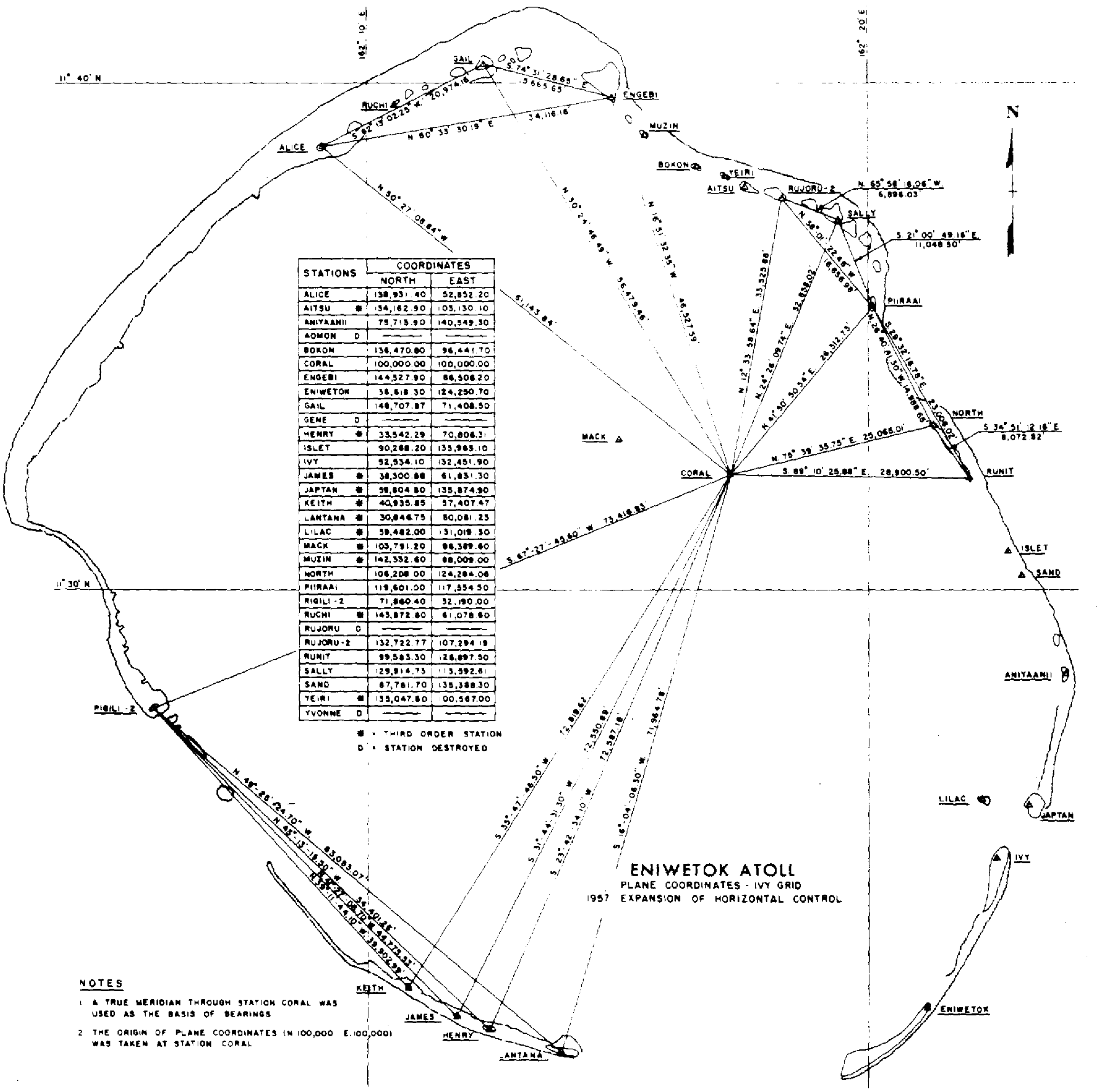
Horizontal Control — Bikini Atoll

A requirement was received to determine the relationship of two sites to within a tolerance of one part in 25,000. An evaluation of the Bikini network was made to determine if this requirement could be met without extensive additional triangulation to first order specifications. This evaluation indicated that if the full capacity of the net were obtained by an adjustment by the method of least squares, the net, while not to first order specifications, should be well within the required tolerances.

An adjustment was applied by the method of least squares which indicated that the probable error in a direction, as computed from the adjustment, was 0.81 second. Only minor corrections were made to directions and distances as determined by the side equation adjustment.

The 1953 Station Charlie on Site Charlie was recovered in 1957 and its distance relation measured to Station Chuck. Based on the adjusted values for these stations, a discrepancy of 0.15 foot was found between the computed and the measured distances.

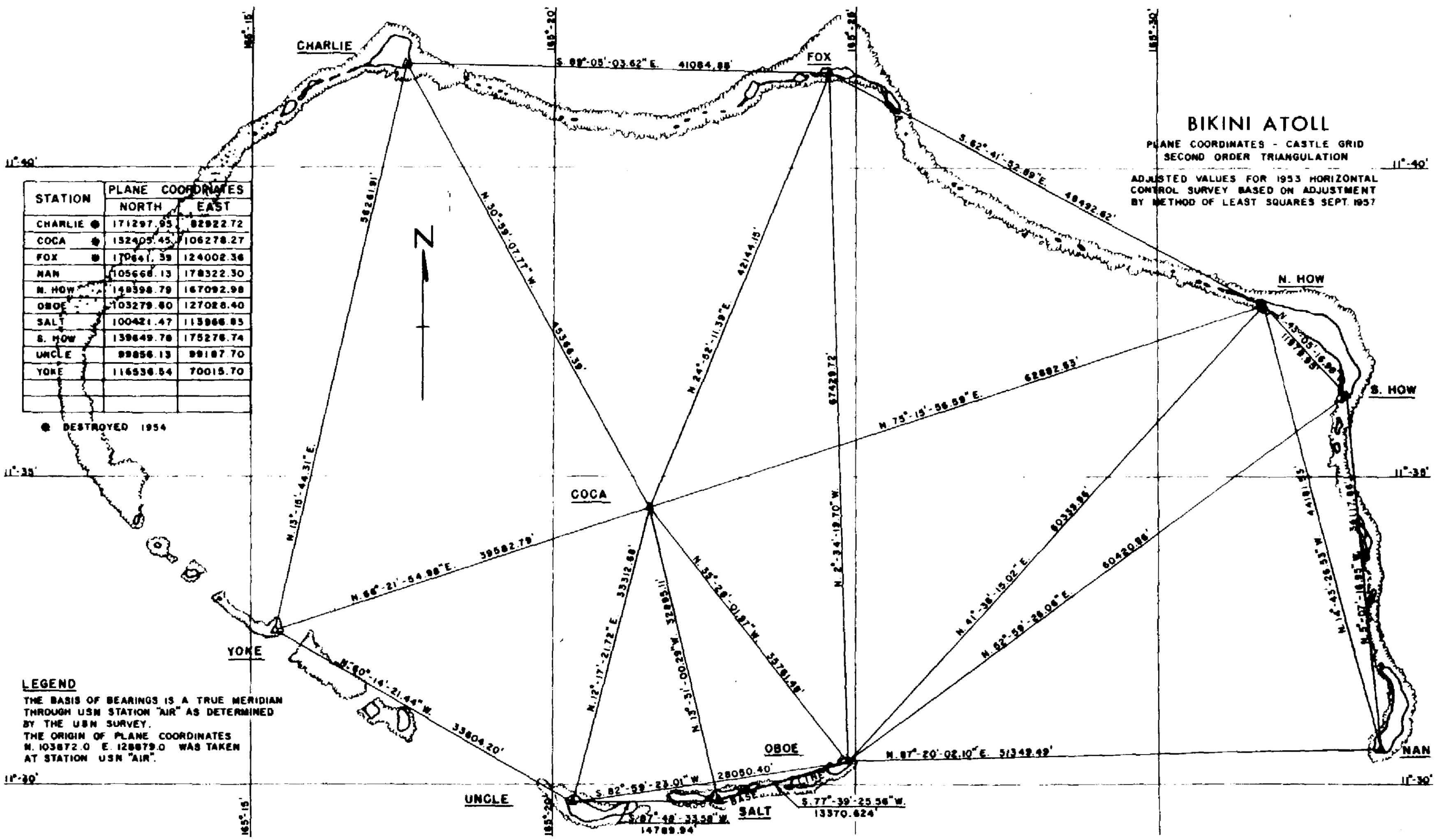
A check survey of two large quadrangles was completed in 1957 based on the fixed locations of Station Yoke, Oboe, Nan, and N. How,



STATIONS		COORDINATES	
		NORTH	EAST
ALICE		138,931.40	52,852.20
AITSU	*	134,162.90	103,130.10
ANITAANI		75,715.90	140,549.30
AOMON	D	———	———
BOKON		136,470.80	96,441.70
CORAL		100,000.00	100,000.00
ENGEBI		144,527.90	86,508.20
ENIWETOK		38,618.30	124,250.70
GAIL		148,707.87	71,408.50
GENE	D	———	———
HENRY	*	33,542.29	70,806.31
ISLET		90,288.20	135,965.10
IVY		92,534.10	132,451.90
JAMES	*	38,300.88	61,831.30
JAPTAN	*	59,804.80	135,874.90
KEITH	*	40,935.85	57,407.47
LANTANA	*	30,846.75	60,081.23
LILAC	*	59,482.00	131,019.30
MACK	*	103,791.20	98,389.60
MUZIN	*	142,332.60	88,009.00
NORTH		106,208.00	124,284.06
PIIRAAI		119,601.00	117,554.50
RIGILI-2		71,860.40	52,190.00
RUCHI	*	145,872.80	61,078.80
RUJORU	D	———	———
RUJORU-2		132,722.77	107,294.19
RUNIT		99,583.30	128,897.50
SALLY		129,914.73	113,592.81
SAND		87,781.70	135,388.30
YEIRI	*	135,047.60	100,567.00
YVONNE	D	———	———

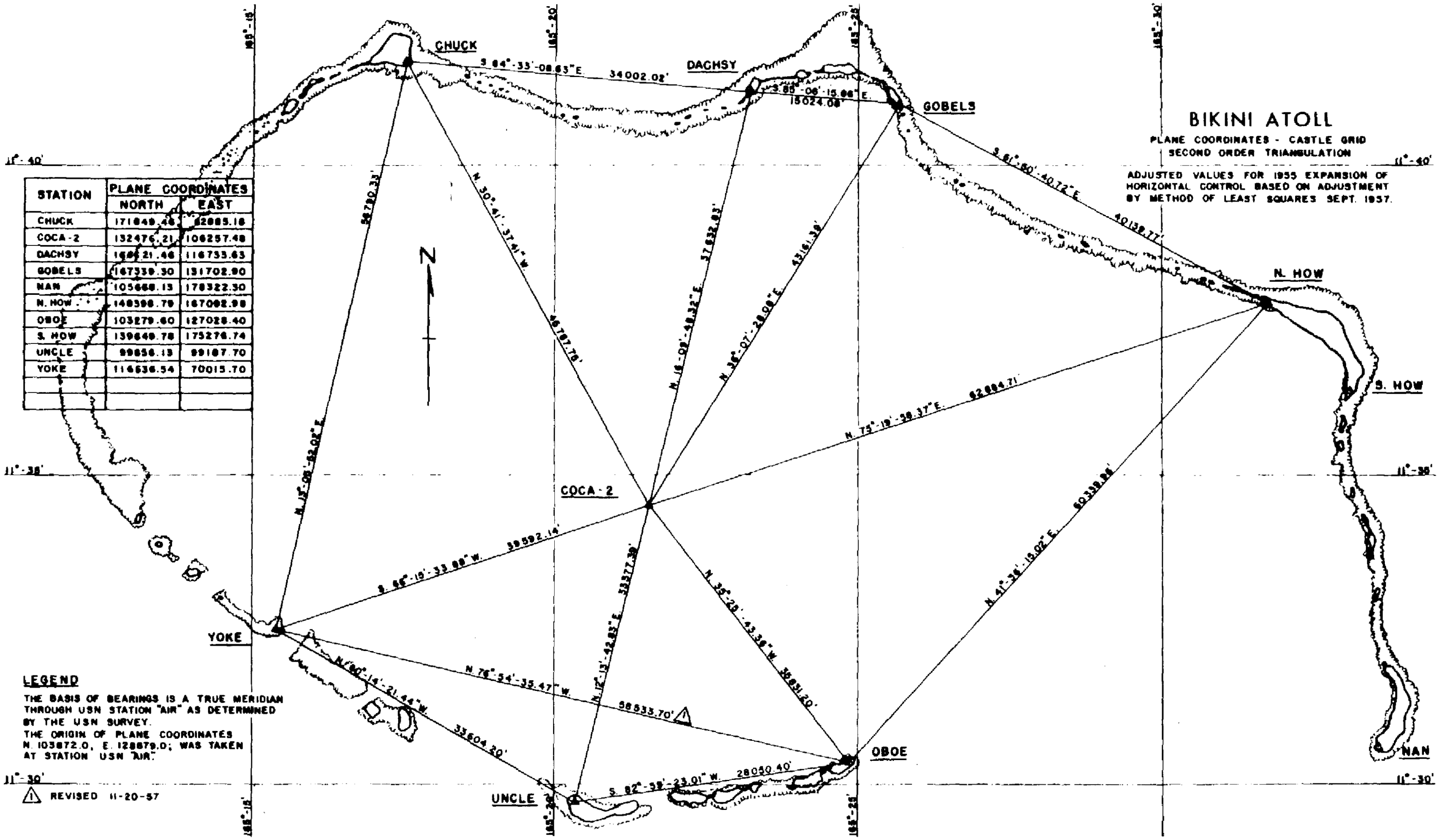
* = THIRD ORDER STATION
D = STATION DESTROYED

Figure No. 2-14. Horizontal Control — Eniwetok Atoll.



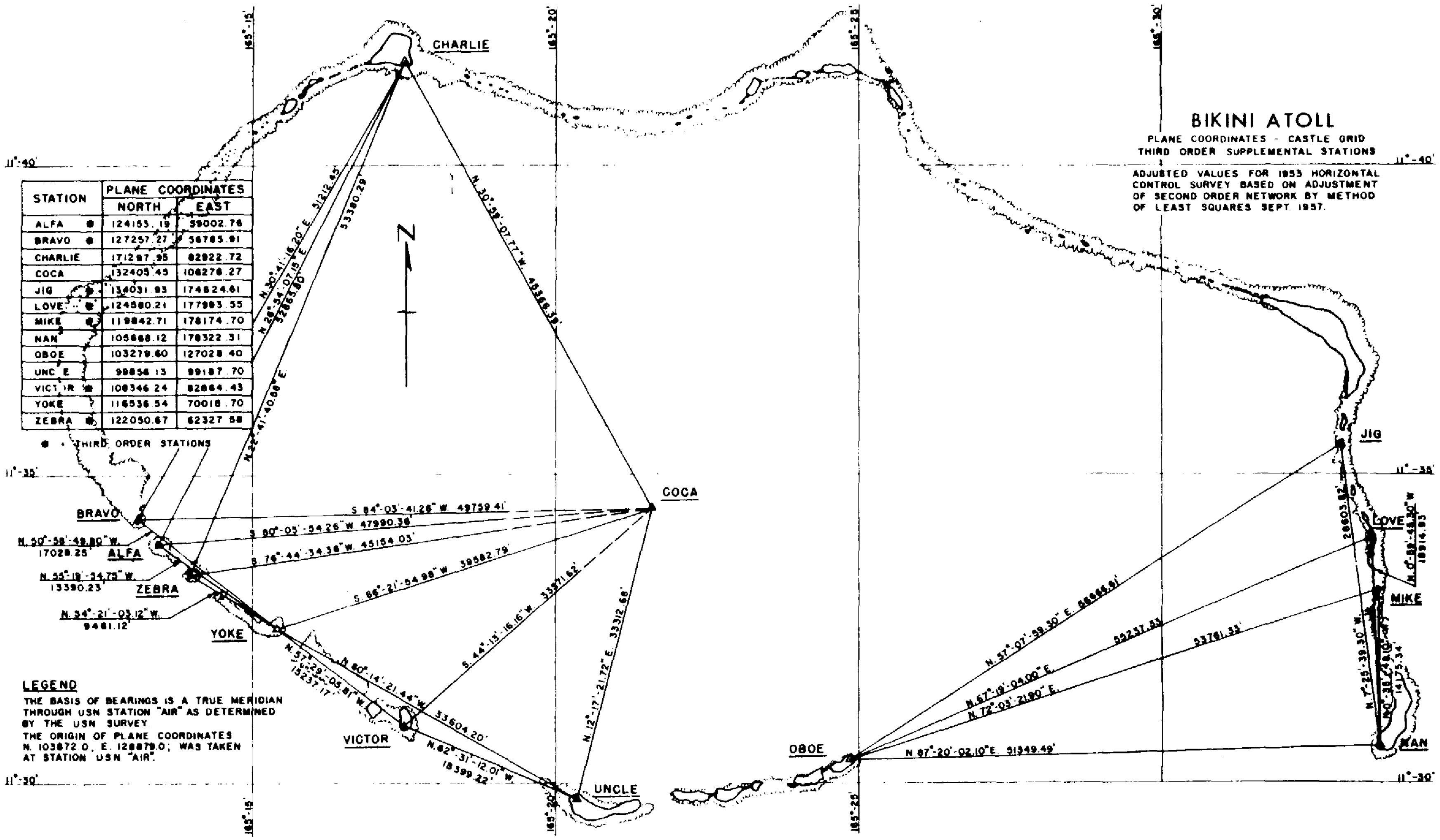
STATION	PLANE COORDINATES	
	NORTH	EAST
CHARLIE ●	171297.95	82922.72
COCA ●	132405.45	106278.27
FOX ●	170641.39	124002.36
NAN	105668.13	178322.30
N. HOW	148398.79	167092.98
OBOE	103279.80	127028.40
SALT	100421.47	113966.85
S. HOW	139649.78	175276.74
UNCLE	99856.13	99187.70
YOKE	116536.54	70015.70

Figure No. 2-15. Original Horizontal Control — Second Order Bikini Atoll.



STATION	PLANE COORDINATES	
	NORTH	EAST
CHUCK	171849.46	82885.18
COCA - 2	132476.21	106257.48
DACHSY	16[illegible]21.46	116733.63
GOBELS	167339.30	131702.90
NAN	105668.13	178322.30
N. HOW	148398.79	167082.98
OBOE	103279.60	127028.40
S. HOW	139649.78	175276.74
UNCLE	99856.13	99187.70
YOKE	116636.54	70015.70

Figure No. 2-16. Expanded Horizontal Control — Second Order Bikini Atoll.



STATION	PLANE COORDINATES NORTH	EAST
ALFA ●	124155.19	59002.76
BRAVO ●	127257.27	56785.91
CHARLIE	171297.95	82922.72
COCA	132405.45	106278.27
JIG ●	134031.93	174624.61
LOVE ●	124880.21	177993.55
MIKE ●	119842.71	178174.70
NAN	105668.12	178322.31
OBOE	103279.60	127028.40
UNCLE	99856.15	99187.70
VICTOR ●	108346.24	82864.43
YOKE	116536.54	70016.70
ZEBRA ●	122050.67	62327.68

● - THIRD ORDER STATIONS

Figure No. 2-17. Original Horizontal Control — Third Order Bikini Atoll.

including Stations Chuck and Gobels. A side equation adjustment was applied to the survey, and the relationship was obtained between these values of the stations and the values determined by the method of least squares. The discrepancy in coordinate values at Station Chuck was 0.56 foot in northings and 0.72 in eastings and at Station Gobels 0.10 foot in northings and 1.12 feet in eastings. The discrepancy in distances between Stations Gobels and N. How was determined as one part in 40,000.

Vertical Control

Prior to the next Operation, it will be necessary to obtain sufficient tide gauge recordings at each potential site over a period of time to establish time and height factors. A request for comparison of actual with predicted tides at Janet and Yvonne was received, after the two tide gauges at Jobsite were in use at Bikini; a 4-inch pipe, perforated on the lower portion and provided with a float, was installed on the personnel pier at each site. The tide level was recorded at intervals, and graphs were prepared showing the actual and predicted curves. Level circuits were run on each of the islands on which local control networks were installed, and elevations were determined for each control point. A closed level circuit was completed from How to Nan at Bikini Atoll. The difference in datum planes as indicated by the circuit was 0.07 feet.

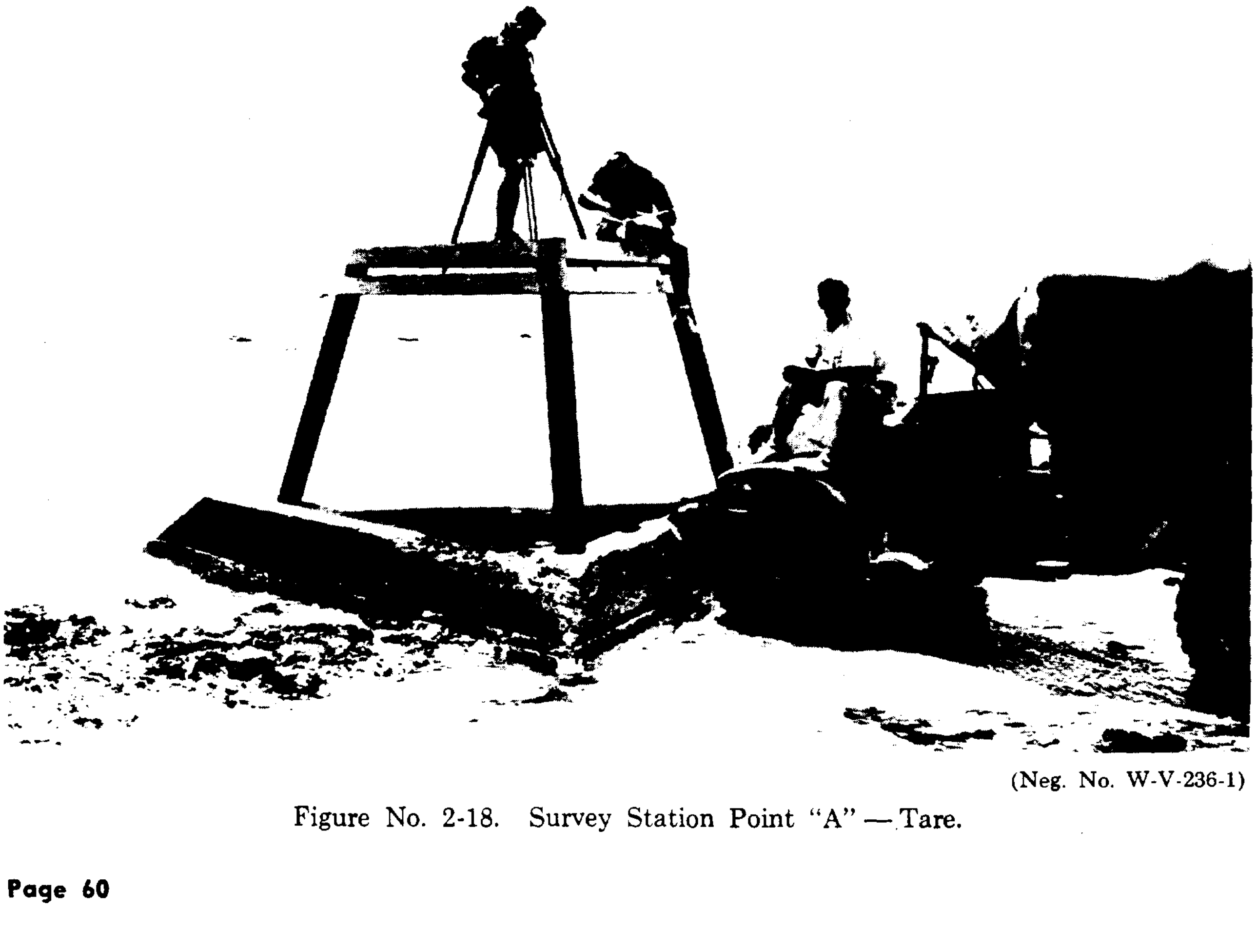
Scientific Station Location

The majority of the Scientific Stations were located from the local control lines. Two of the four Ground Zero points were tied directly to triangulation monuments, and the third Ground Zero point on Sugar, later changed to Yvonne, was located by use of the local control system.

The Scientific Stations related to the missile tests were located from a control system similar to those used for ground tests. Computations of horizontal and vertical angles to the burst points were made by Home Office Engineering.

Topographic Mapping

Topographic mapping surveys were completed and drawings prepared on the following sites: Gene and Ursula Complexes, Glenn, Henry,



(Neg. No. W-V-236-1)

Figure No. 2-18. Survey Station Point "A" — Tare.

Irwin, James, Janet, Kate, Keith, Leroy, Lucy, Pearl, Vera, Walt, Wilma, and Yvonne at Eniwetok Atoll; and Fox and Tare Complexes, Able, How, the ABMA area on How, Item, Jig, Nan, and Uncle at Bikini Atoll; perimeters only were accomplished on Able, How, and Uncle. Plane table surveys were completed on David, Elmer, and Fred on Eniwetok Atoll.

Hydrographic Mapping

Requirements for hydrographic mapping increased considerably over those of previous Operations. A second Raytheon fathometer was acquired to meet frequent simultaneous requests for both atolls. Crater surveys were required on a large number of barge station locations at Eniwetok Atoll. Support was furnished to the Navy hydrographers in charting the underwater shot areas, the wide passage at Eniwetok, the Camp Blandy area at Nan, and the Tare-Uncle channel areas.

Microbarograph Stations

Surveying was completed to install Microbarograph Stations at Fred, French Frigate Shoal, Kwajalein, Nan, Rongelap, Rongerik, Ujelang, Utirik, and Wotho. The REDWING sensing head at Rongerik was recovered and monumented but was not used for HARDTACK.

Barge and Hull Motion Studies

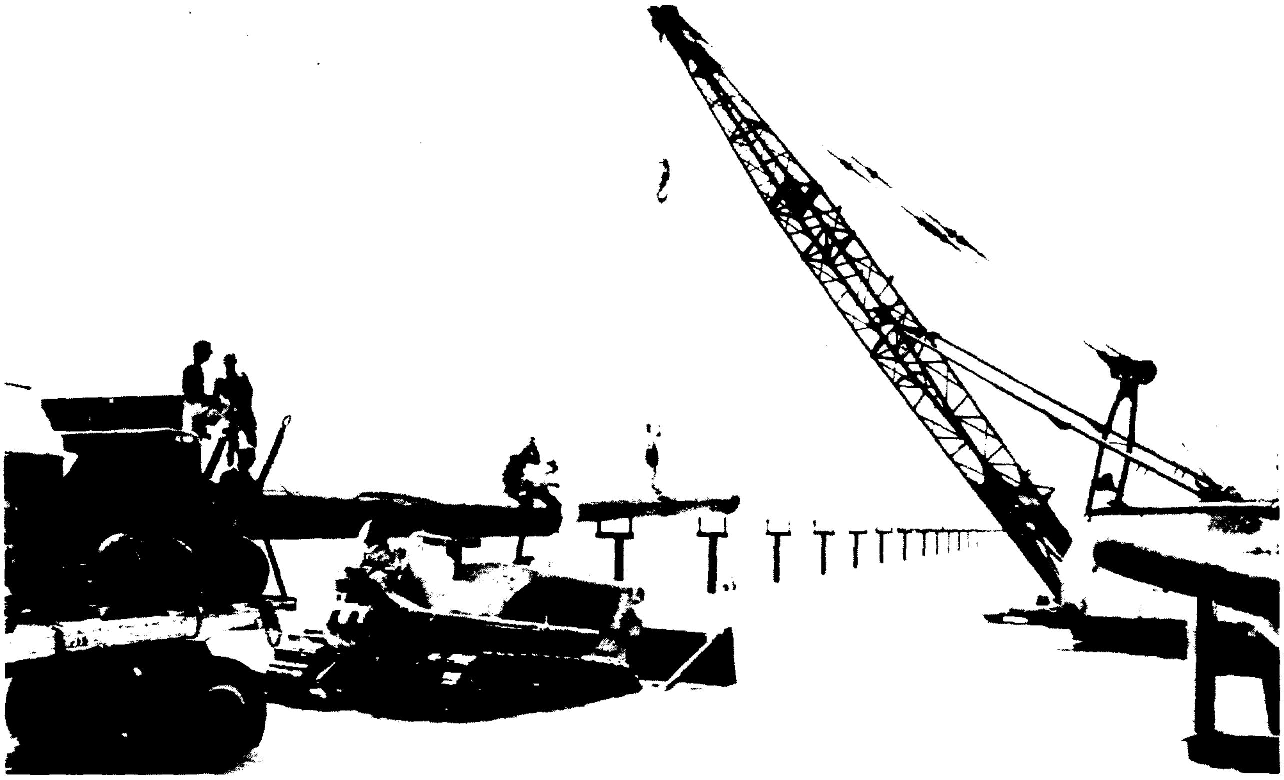
One barge and one hull motion study was made using the following method. A typical cab structure was installed on an Army BC-type barge or LCU hull, and a mast was installed at the center point of the barge or hull. This mast was 100 feet in height, fabricated with 16-inch pipe butt-welded at the joints, and a 4-inch cube of concrete was mounted at the top. The craft in both cases were moored off Yvonne, employing the same gear as used in mooring craft for barge shots. A series of observations were conducted to evaluate the motion of the craft during a variety of weather conditions. Observations were also made to assess the flexure of the craft structure due to wave and thermal action.

REPORTS AND PHOTOGRAPHY.

The Reports and Photography Section was responsible for gathering and compiling information necessary for preparing and publishing various weekly, monthly, and special reports; for editing, documenting, and publishing the Jobsite Monthly Narrative Report; and for providing photographic coverage of all H&N activities at EPG. In addition, this Section was responsibile for maintaining close liaison with all departments, to ensure complete, accurate, and current reports and photographic coverage of construction progress, post-shot damage, and damage from other causes.

Prior to HARDTACK the photographers performed their duties in the TG 7.1 Photographic Laboratory, but when plans were firmed up for the new H&N Administration Building, provisions were made to include a Photographic Laboratory for the exclusive use of H&N. With the installation of a print dryer on 9 May 1958, the laboratory went into full-scale production on a backlog of approximately 16,000 prints, which was substantially reduced by 19 July 1958.

During the interim and operational periods, two Photographers traveled to sites at both atolls and all Weather Stations. One major mission performed during the interim period was the photographic coverage of the Rongelapese Repatriation Program, which required a total of 1251 prints to the Home Office and 3808 prints to the AEC.



(Neg. No. W-V-207-12)

Figure No. 2-19. Pipeline Station 1212.02 — 40% Complete.

(Neg. No. W-859-11)

Figure No. 2-20. Western Extension of Fred Airstrip — 60% Complete.

SECTION 2
CONSTRUCTION

The Construction and Maintenance Division was responsible for the construction of all buildings, scientific structures, facilities, roads, and utility systems at EPG as authorized by approved Work Orders. It was also responsible for providing Jobsite mechanical and machine shop work for all departments and User agencies.

During construction periods a General Superintendent was assigned to Bikini Atoll, where he acted as the field liaison representative of the Division. Assisting him were Construction Superintendents assigned to various sites. In addition to construction responsibilities, these Superintendents were responsible for the over-all management of their sites and for observance of established safety and security rules and regulations.

The first construction project of any appreciable size in 1957 was the rehabilitation of airfield paving on Site Fred, which is covered in detail in Section 5 of this Chapter. Personnel strength started to increase in April 1957, with skilled workers requisitioned on the basis of a steadily increasing number of projects. A total of 429 men were assigned to the Construction and Maintenance Division by June 1957, of which 148 were assigned to the newly-opened Nan camp. Work started on a large concrete structure, Station 1312, on Site Janet on 9 September 1957, shortly before the opening of that camp in October; by January 1958 construction of many Scientific Stations was in progress, requiring 988 construction workers on the job. The personnel peak was reached during the week of 8 April 1958, with 1338 men assigned to the Division.

Even with this peak of construction personnel, the priority completion of a number of facilities in the PAC program, the existing heavy work load on the Scientific Stations, the late receipt at Jobsite of design changes, and certain material shortages resulted in the necessity for a strictly controlled overtime policy to meet certain of the construction schedules.

As facilities were completed, workers were either returned to their points-of-hire or transferred to other jobs requiring their skills. Roll-up of the tempory camps resulted in the further reduction of construction personnel. By 1 June 1958, the Division's personnel strength was reduced to 934 men, of which 163 were working on the Johnston Island project.At that time the program was enlarged and Work Orders were received for additional Scientific Stations on Eniwetok Atoll, including 7 additional scientific barges and LCU hulls.

Two typhoons in late 1957 caused damage to some structures on both Bikini and Eniwetok Atolls, but in general, climatic conditions had no adverse effects on the construction program; rainfall conformed to the averages of the past five years. Oceanic conditions and tides limited the working time on the reefs and on a number of occasions prevented the off-loading of materials and equipment.

Last minute changes in barge criteria often necessitated the removal, relocation, and even the deletion of certain installations, but in spite of these problems, the barges were delivered to the Using agencies as they were required. UCRL barges were delivered to Bikini by LSD or by Navy tow. One barge being towed to Bikini was damaged when heavy seas were encountered, and another was partially sunk while in tow; the latter was recovered, placed in drydock, and rehabilitated.

Prefabrication methods were used to the utmost for both wooden and concrete structures, including re-inforcing steel, which was cut and shaped at Elmer for all jobs. Concrete placement forms, building sections, barge device cabs, and helium tunnels were prefabricated at Elmer and at temporary camps for delivery to required locations. Submarine cable vaults, pump houses and sumps, small slabs, anchor blocks, etc., were poured at centralized locations and delivered where needed. Materials for the temporary campsites and Weather Stations were precut at either Elmer or Nan.

At the time construction was started on the temporary camps, there was a combined inventory of 59,864 cubic yards of aggregate of all sizes stockpiled at Elmer, Fred, and Nan. This quantity was supplemented by producing an additional 58,813 cubic yards from 21 July 1957 through 18 May 1958. At the end of that period, there was an inventory of 51,791 cubic yards of all sizes stockpiled, indicating that 66,886 cubic yards of aggregate were used at all locations through 18 May 1958. As camps were opened, primary and secondary crushers were installed at Elmer, Janet, Nan, and Oboe. Elmer produced all aggregate used on Yvonne, while the Janet plant served the other islands in the northern part of Eniwetok Atoll. Nan produced what aggregate was required at that site and the northern islands of Bikini Atoll, and the plant at Oboe supplied the needs of the Tare Complex and the other islands on the west side of Bikini Atoll.

PERIOD	ENIWETOK	BIKINI	OTHER ATOLLS	MONTHLY TOTAL	ACCUMU-LATIVE TOTAL
1957 JAN. 1 THRU JAN. 20	65	-	-	65	65
FEB. 20	238	-	-	238	303
MAR. 20	62	-	-	62	365
APR. 20	602	-	-	602	967
MAY 20	303	-	-	303	1,270
JUN 20	719	-	-	719	1,989
JUL 20	285	298	-	583	2,572
AUG 20	439	409	-	848	3,420
SEP 20	111	444	-	555	3,975
OCT 20	525	195	-	720	4,695
NOV 20	2,318	489	-	2,807	7,502
DEC 20	3,327	1,167	-	4,494	11,996
1958 JAN 20	10,842	915	-	11,757	23,753
FEB 20	3,615	1,549	-	5,164	28,917
MAR 20	2,660	1,386	-	4,046	32,963
APR 20	605	634		1,239	34,202
MAY 20	545	76	(JOHNSTON IS.) 697	1,318	35,520
JUN 20	389	346	623	1,358	36,878
JUL 20	116	84	6.5	206.5	37,084.5
AUG 20	83.5	35	22	140.5	37,225
SEP 20	51	-	4	55	37,280
OCT 20					
NOV 20					
DEC 20					

Table No. 2-2. Concrete Poured — All Atolls (in Cubic Yards).

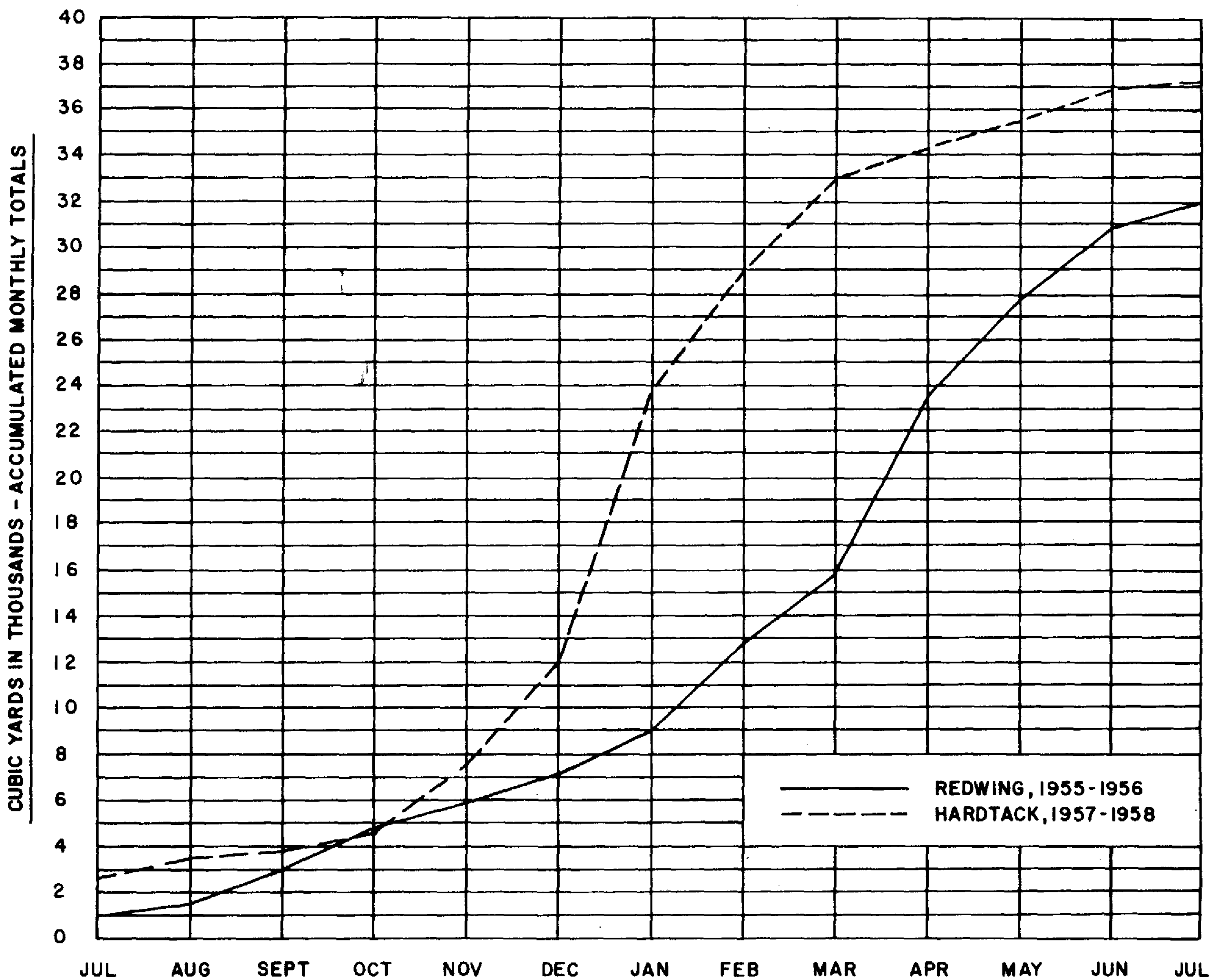


Chart No. 2-2. Accumulative Concrete Poured — HARDTACK vs. REDWING.

ZERO STATION	EVENT	SITE	DESCRIPTION	HULL NO.
1	FIG	Yvonne	Tent, 16 x 32-foot	—
2	DOGWOOD	Off Janet	LCU, 19 x 19-foot, raised cab	675
3	CEDAR	Off Charlie	Barge, UCRL Type Ia	6522
4	POPLAR	Off Baker	Barge, UCRL Type Ia	6509
5	SYCAMORE	Off Charlie	Barge, UCRL Type Ia	6512
6	FIR	Off Charlie	Barge, UCRL Type Ia	6510
7	ASPEN	Off Charlie	Barge, UCRL Type Ia	6511
8	MAPLE	Off Fox	Barge, UCRL Type Ia	6528
9	REDWOOD	Off Fox	Barge, UCRL Type Ia	6521
10	PINE	Off Janet	Barge, UCRL Type Ia	6095
11	NUTMEG	Off Tare	Barge, LASL Pinex Type II	6541
12	HICKORY	Off Tare	Barge, LASL Pinex Type II	6513
13	JUNIPER	Off Tare	Barge, LASL Pinex Type II	6517
15	QUINCE	Yvonne	Tent, 16 x 32-foot	—
16	OLIVE	Off Janet	LCU, 19 x 19-foot, raised cab	520
17	SCAEVOLA	Off Yvonne	Barge, UCRL Type Ia with no living quarters	6540
20	CACTUS	Yvonne	Steel cab — Ground	—
21	KOA	Gene	Steel tank — Ground	—
22	PISONIA	Off Yvonne	LCU, 15 x 21-foot, cab	1080
23	LINDEN	Off Yvonne	Barge, LASL Type I	6105
24	SEQUOIA	Off Yvonne	LCU, L-shaped cab and Pinex	1085
25	OAK	Alice Reef	LCU, 17 x 23-foot cab	1087
27	ELDER	Off Janet	Barge, LASL Type I	6519
28	YELLOWWOOD	Off Janet	Barge, LASL Type I	6525
29	ROSE	Off Yvonne	Barge, LASL Pinex Type III	6514
30	TOBACCO	Off Janet	Barge, LASL Pinex Type I	6520
32	MAGNOLIA	Off Yvonne	Barge, LASL Pinex Type II	6516
33	BUTTERNUT	Off Yvonne	Barge, LASL Type I with transportainer	6523
34	HOLLY	Off Yvonne	Barge, LASL Pinex Type II	6537
37	WALNUT	Off Janet	Barge, LASL Type I	6526
38	PINYON	Cancelled	Barge, United Nations	6518
39	PINYON PRIME	Cancelled	Barge, United Nations	6530
J-40	TEAK	Johnston Island	Missile; Redstone UHA	—
J-41	ORANGE	Johnston Island	Missile; Redstone VHA	—
42	YUCCA	Pacific Ocean north of Eniwetok Atoll	Balloon	—
43	UMBRELLA	Eniwetok Lagoon	Buoy; Underwater	—
44	WAHOO	Pacific Ocean southwest of Eniwetok Atoll	Buoy; Underwater	—

Table No. 2-3. Index of Zero Stations.

SECTION 3
SCIENTIFIC STATIONS

STATIONS:	1 and 15
SITE:	Yvonne
USER:	UCRL
PURPOSE:	Zero Stations
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	Sta. 1, 8-7-58/8-18-58; Sta. 15, 7-7-58/8-6-58

Each of these stations was a 16x32-foot tent constructed on a special fill material base. The tent frame was fabricated of light timber in three sections which bolted together to provide a quick method of dismantling and removal. For the tent foundation, a conical hole 8 feet deep by 32 feet in diameter at the surface was excavated, lined with polyethylene, and backfilled with soil provided by the User from the NTS. Power for each facility was supplied from three 5-kva, 4160/-120/208-volt transformers connected to the island distribution main and to a lighting panel, mounted on a plywood board independent of the tent frame. Receptacles on stakes around the walls of the tent and overhead lights on extension cords were plugged into recepacles below the lighting panel; this allowed the tent to be removed easily without disturbing the electrical work. A 26-pair signal cable was furnished to each station to provide timing signals and telephone circuits. User-furnished RG-8/U and ⅞ inch styroflex coax cables were run from the tent and spliced to the existing coax lines between REDWING Stations 1314 and 1311.05.

STATIONS:	2 and 16
SITE:	Station 2, off Charlie; Station 16, off Janet
USER:	UCRL
PURPOSE:	Zero Stations
PARTICIPATION:	2 and 16
DESIGN PSI:	None
CONSTRUCTION:	Sta. 2, 6-16-58/7-5-58; Sta. 16, 6-8-58/7-22-58

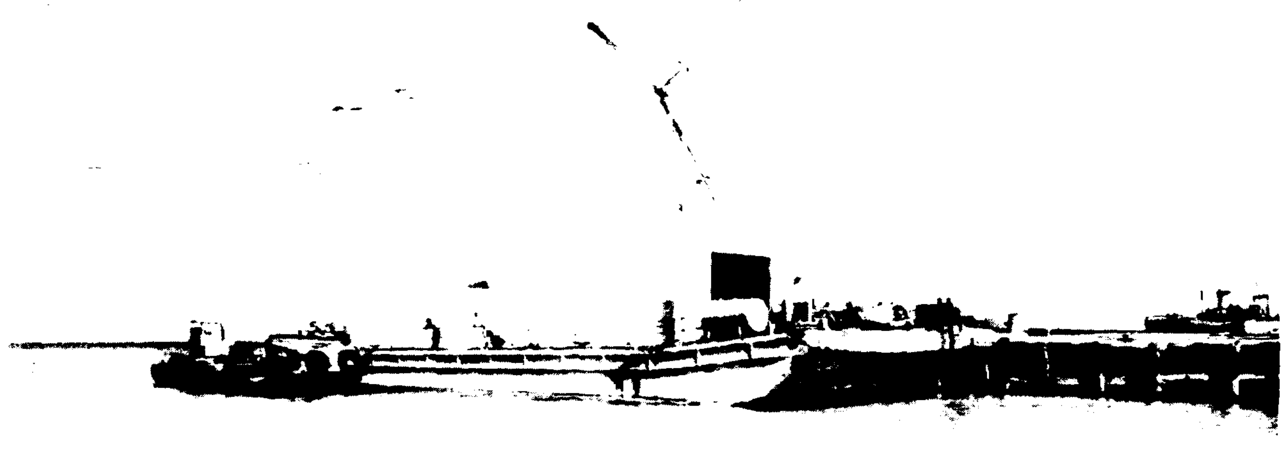
Each station was a modified LCU hull. The low deck between the port and starboard compartments was raised with steel framing to the level of the top of the compartments to form a steel plated area 32x36 feet. A new plate was placed over the existing one at the top level of this area. A timber cab, 19 feet square and 13 feet high, was placed on the port side of the raised area. Within the cab, a 1-ton monorail and hoist was utilized for positioning of User equipment and the device. A helium tunnel, identical to that furnished for Station 3, was provided for each station. One portion of the bulwark was removed, and another portion of the port and starboard bulwark was also removed for anchoring lines from the bow winches. A 4-point splayed anchoring system was used and winches were provided on the bow lines only. The living quarters kitchen compartments were rehabilitated to house 12 people. Power was supplied by two 20-kw engine generators operating in parallel for both scientific and utility use.

STATIONS:	3 through 10
SITE:	Stations 3, 5, 6, and 7, off Charlie; Station 4, off Baker; Stations 8 and 9, off Fox; Station 10, off Janet.
USER:	UCRL
PURPOSE:	Zero Stations
PARTICIPATION:	3 through 10
DESIGN PSI:	No overpressure; designed for 20 pounds, wind load only
CONSTRUCTION:	Sta. 3, 1-20-58/7-3-58 Sta. 4, 1-20-58/7-12-58 Sta. 5, 1-20-58/5-16-58 Sta. 6, 1-28-58/4-21-58 Sta. 7, 11-25-57/6-14-58 Sta. 8, 11-25-57/6-9-58 Sta. 9, 1-20-58/6-27-58 Sta. 10, 5-6-58/7-26-58

Barge Stations 3 through 10 were Zero Stations of similar design. These stations were modified U.S. Army-type BC barges, 120 feet long and 33 feet wide. Two wood frame structures were built on the deck. On the bow end, a 21-foot-square by 15-foot, 8-inch high Device Room was erected. This room had a 2-ton capacity bridge crane designed to handle materials within the cab. On the stern end living quarters were built to house the Users during the occupancy period. Barges were moored at their shot locations by means of a four-direction, winch-controlled anchorage system. A helium tunnel was added to Barges 3, 6, 7, 8, 9, and 10. This tunnel was of wood frame construction, 8-foot-square by 22-feet long, and was covered by a User-furnished plastic lining to make the structure gas-tight. Power was furnished by two 20-kw, 120/208-volt, 3-phase generators connected in such a way that either generator could furnish power to the instrument panel. The lighting panel was connected so that on a timing signal the load on this panel could be dropped.

STATIONS:	11, 12, 13, 29, 32, and 34
SITE:	Stations 11, 12, and 13, off Tare; Stations 29, 32, and 34, off Yvonne
USER:	UCRL for Stations 11, 12, and 13; LASL for Stations 29, 32, and 34
PURPOSE:	Zero Stations
PARTICIPATION:	11, 12, 13, 29, 32, and 34
DESIGN PSI:	0.75 psi
CONSTRUCTION:	Sta. 11, 1-25-58/5-9-58 Sta. 12, 1-11-58/6-28-58 Sta. 13, 1-11-58/7-22-58 Sta. 29, 1-30-58/5-27-58 Sta. 32, 2-20-58/4-18-58 Sta. 34, 1-15-58/5-12-58

These stations were constructed on U.S. Army-type BC barges 120 feet long and 33 feet wide. Each station consisted of a T-shaped cab cantilevered over the stern, a collimating pipe extending through the hull to a point at the bow approximately 20 feet under the water, a caisson for access to the underwater end of the pipe, a ready room for operating personnel, and a shelter to provide access to the pinhole. All super-structures on these barges were designed to survive equivalent overpressures from events at Site Janet while moored off Yvonne. Since design features of Stations 11, 12, and 13 were almost identical to Stations 29, 32, and 34, all were designed alike. The cab was of heavy timber construction, 17 feet 6 inches long, 18 feet wide, and 10 feet high, with two small sections cut from the corners to provide room for the anchoring winches. A removable hatch 9x13 feet was located over the cab roof opening and a 2-ton bridge crane just outside the cab was provided for leading and moving equipment in the cab. A large double door provided entrance to the cab. In the cabs of Stations 29, 32, and 34 a U-shaped concrete shield was constructed to collimate the line of sight to Station 1310. The shields varied, but in general they were 1 foot, 6 inches thick 9 feet high, and 10 feet long. Each shield had one or more block-outs for adjusting the collimating pipes. An angle iron frame was installed on the working point side of the shield for adjustment of a small 3x7-inch square lead defin-



(Neg. No. W-V-208-12)

Figure No. 2-21. Barge Station 3 — 65% Complete.

ing shield. In the cabs of Stations 11, 12, and 13, lead-paraffin shields were constructed of blocks of paraffin 12x12x18 inches and bricks of lead-paraffine. The material was supported by steel angle framework, with plywood lining of the configuration of the shield. The shield in the cab of Stations 12 and 13 was 8 feet high and 18 inches thick. The vertical portion was a wall 6 feet wide and the horizontal portion 6 feet wide and 7½ feet long set on the deck. The two portions formed an L-shaped shield in cross-section. The shield in the cab of Station 11 was 8 feet high and 20 inches thick. The vertical portion consisted of two walls intersecting to form an L-shape in plan 8x7½ feet, with the horizontal portion 8x7½ feet set on the deck. A 40-foot-high pipe mast for all the stations and a 20-foot-high pipe mast for Stations 29, 32, and 34 were installed outside each cab to mount User-furnished antennas for the 81 and 83 series stations.

For the Pinex experiment a clear line of sight was required between the working point in the cab and a detector 130 feet away and 20 feet under the water. To establish this line of sight and connect the detector it was necessary to cut a 2x12-foot hole in the barge deck; construct a pipeline through the compartment and under the barge; and provide a caisson for dry access to the lower end of the pipe to check pipe alignment and to connect the detector. The pipeline for this line of sight was rigidly welded to main members in the compartments and suspended from bolted pipe bracing attached to the barge bottom. The pipeline for Stations 11, 12, 13, 32, and 34 consisted of two concentric pipes beginning at a point approximately 47 feet from the working point. The inner pipe was composed of 33 feet of 5-inch extra strong pipe and 50 feet of 12-inch Schedule 80 pipe. The outer pipe was 24-inch extra strong pipe. For Station 29 a single pipeline was used. This pipeline started at the same location but consisted of 34 feet of 24-inch extra strong pipe, 10 feet of 12-inch extra strong pipe, 7 feet of 6-inch extra strong pipe, an air gap of 5 feet, 7 feet of 6-inch extra strong pipe, and 20 feet of 12-inch extra strong pipe.

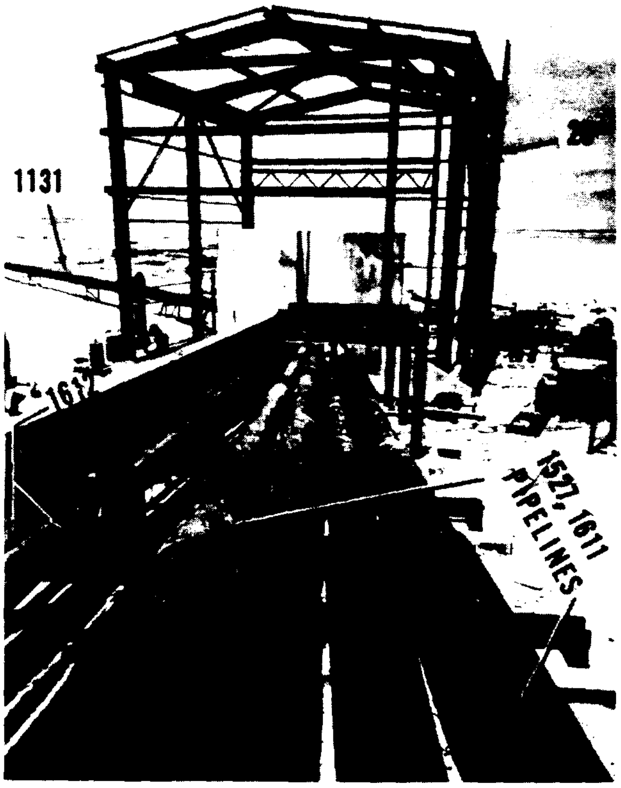
Station 11 was provided with an additional shield which was located close to the pinhole access shelter. It was mounted on a 4-foot-high wood platform and was contained in a timber frame. Lead bricks stacked in thicknesses varying from 2 to 6 inches provided the shield. The configuration of the shield was L-shaped with one leg 7 feet long and the other leg 3 feet long. The sides, top, and bottom of the shield formed a tunnel 9 inches wide and 16 inches high. A ready room 14x10x8½ feet high was built of timber and located on the starboard side between the cab and the hatch shelter. In the design of this facility it was required to determine if any flexing of the barge occurred along the long axis as a result of wave and wind action while anchored in a typical four-point mooring. Studies were conducted at Jobsite to measure this flexing, and it was determined wave and wind action had little or no effect but that deck temperature which was a function of weather could cause deflections as large as 1 inch between ends of the barge. Since LASL required a tight alignment tolerance and the barges were to be used at dawn, it was necessary to do all final alignment of the pipeline after 2000 hours and before sunrise.

A 16-pair and a 26-pair submarine signal cable were run to Stations 29, 32, and 34 from the timing station on Site Yvonne. These cables were terminated in a cabinet on a rack on the stern end of the barge. From this cabinet, cables were run to the cab where other cabinets were installed.

Stations 11 and 12 had deck sprinkler systems for washdown of possible fall-out from the events at Site Charlie. A 325-gpm pump drew sea water through a 4-inch suction hose line on the side of the barge and pumped to sprinkler heads throughout the deck area.

STATION:	17
SITE:	Off Yvonne
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	17
DESIGN PSI:	None
CONSTRUCTION:	6-16-58/7-25-58

The bow end of a U.S. Army-type BC Barge, 120 feet long by 33 feet wide, supported this station. The timber structure was divided into a device room, 21 feet square in plan by 15 feet, 8 inches high and a cab 12 feet long, 7 feet wide by 7 feet high on the roof above the device room. The device room had a personnel door and two shutters on each side, a 4x7-foot door on the bow end, and two 6x6-foot hatch openings on the roof. The roof cab had two shutters and a 4x7-foot door and was painted red. Six 4x6-inch columns 20 feet high were installed along the port side of the barge. Positioning of this barge was accomplished using a four-anchor mooring connected to two winches and two double bitts. Power for this station was supplied from one 20-kw generator.



(Neg. No. W-V-240-10)

Figure No. 2-22. Pipelines 1527, 1611 and 1612 Leading into Station 20.

STATION:	20
SITE:	Yvonne
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	20
DESIGN PSI:	None
CONSTRUCTION:	1-4-58/4-25-58

Located at the north end of Site Yvonne, this station was a 33-foot, 4-inch-wide by 35-foot, 4-inch-long steel-framed building with black corrugated protected metal roofing and siding. The building consisted of three welded steel rigid frames, with a double-pitched roof rising to the ridge line at 30 feet 5 inches. Roofing and siding sheeting were supported on steel channel purlins and girts. The foundation consisted of reinforced concrete pedestal footings. The floor was a 6-inch-thick reinforced concrete slab on the ground with a combined, deepened footing section around the perimeter. A 5-ton suspended monorail type girder crane was provided to operate within the building length. Maximum clear hook height was 21 feet.

A large opening in the southeast wall was provided to permit entry of the Program 12, 13, 15, and 16 lines of sight. This opening was closed with a plywood wall, after the lines of sight had been established. One large roll-up door on the northwest side permitted entry of heavy equipment. A steel ladder provided access to the roof for installation and adjustment of telemetering and radio antennas. To speed the time of design and procurement for this structure, a cab identical with that of Station 24 in Operation REDWING was selected. Two concrete baffles were located on the floor in the structure to collimate and shield the various lines of sight. One baffle 13½ feet high, encompassed an arc of 120° in the southeast end of the cab, providing 2 feet of concrete and 5½ feet of sand shielding. The baffle was slotted to permit installation of a 4½x3x2-foot iron shield and LASL-furnished sand and paraffin shields. The second baffle was placed on the line of sight to Station 1220.02; it was 2 feet thick, 4¼ feet wide, and 6½ feet high.

Power to this station was provided by a 75-kva, 4160/120-208-volt, 3-phase transformer located southeast of the station. Primary power to this transformer was supplied through an oil fuse cutout from the 4160-volt, 3-phase, 3-wire, 60-cycle island distribution system. This transformer also provided power to Stations 322.01, 1130, 1210.01, 1216, 1218, 1523.01-.04, 1527/1611, 1612, and to five trailer receptacles. Power distribution for utility and scientific purposes within Station 20 was made through an 18-circuit lighting panel. The bridge crane was supplied power through two 5-kva, 120/440-volt dry-type transformers connected to the lighting panel.

Timing signals were provided by one 51-pair cable terminating in a 53-pair terminal cabinet in the cab. This cabinet also furnished signals for the telemetering antennas, Stations 81.20 and 83.20, located on the structure roof.

Three telephones were used in Station 20: one line was connected to the Site Yvonne exchange; one line was connected to the Site Elmer operator; and a direct line went to Station 71, Site Elmer, for calibration of equipment. The hot-line to Station 71 terminated at Station 20 through an EE-8 set with a headset on a Supervisor's extension cord. Three field phone circuits were used to align mirrors and pipes and to calibrate instruments.

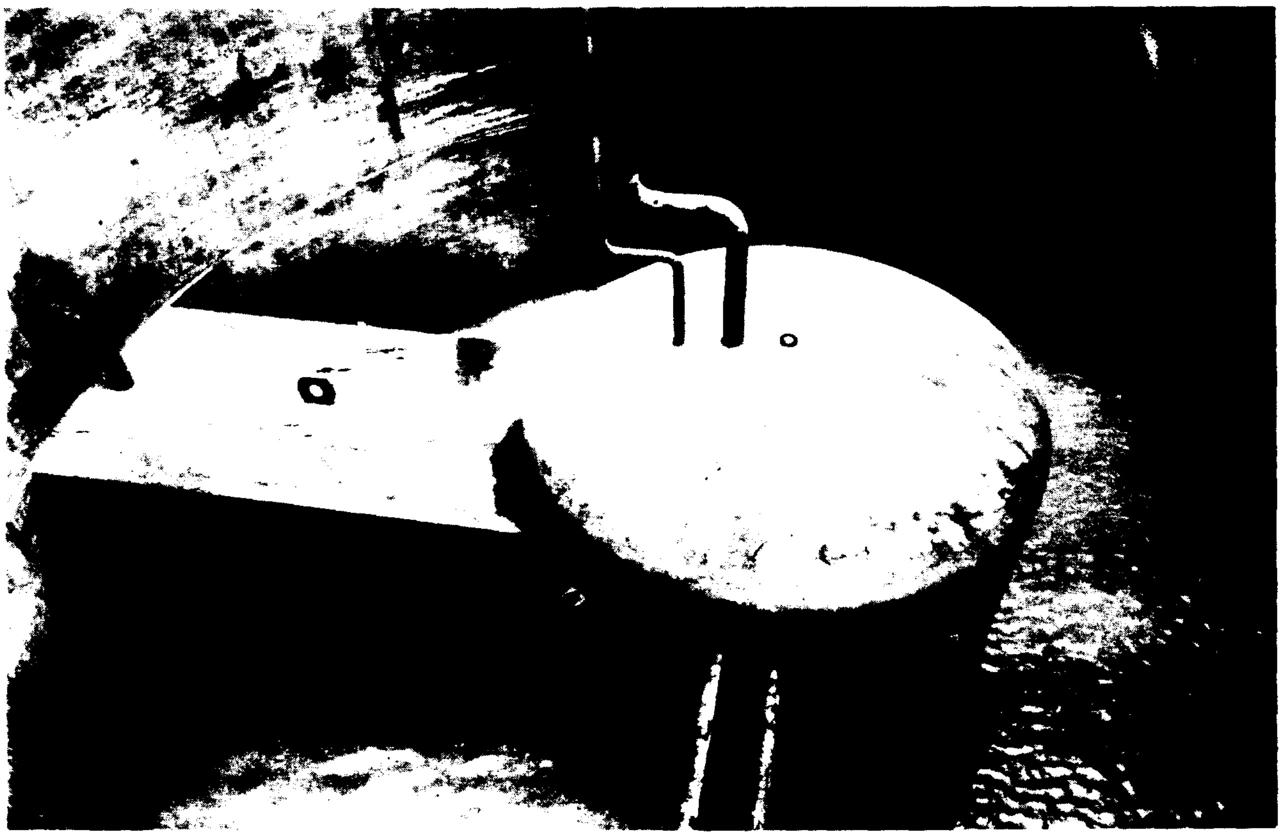
STATION:	21
SITE:	Gene
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	12-31-57/4-17-58

This station consisted of two steel tanks, one inside the other, and three sand-filled baffle boxes. The inner tank was 10 feet in diameter and approximately 11 feet high. The outer tank was 30 feet in diameter and 22 feet 7 inches high in order to maintain 10 feet of water over the inner tank. The inner tank was made of 7/16-inch steel plate, and the outer tank was made of 3/16-inch steel plate. A ¼-inch steel floor was placed on the 15-inch concrete foundation to maintain continuity between the tanks. A structural steel tunnel on the west side of the tank, equipped with water-tight doors, provided access from the outside to the inner tank.

A concrete pad, 12x30 feet, was located outside the entrance tunnel to provide a stable surface for loading equipment in the tank. One 36-inch and one 4-inch-diameter pipe was installed through the tanks on the lines of sight to Stations 1211 and 1311 respectively. The three sand baffles, of timber construction and filled with coral sand, were located on the line of sight to Station 1211 at distances of 25, 41, and 104 feet from the station working point. The first baffle was 10½ feet high, 5 feet thick, and 15 feet wide. The second and third baffles were 13 feet high, 5 feet thick, and 20 feet wide. A fenced area with stabilized pad and a roof was established between the first two sand boxes. A small 4x3-foot elevated platform and ladder were provided on the south side of the tank for mounting antennas.

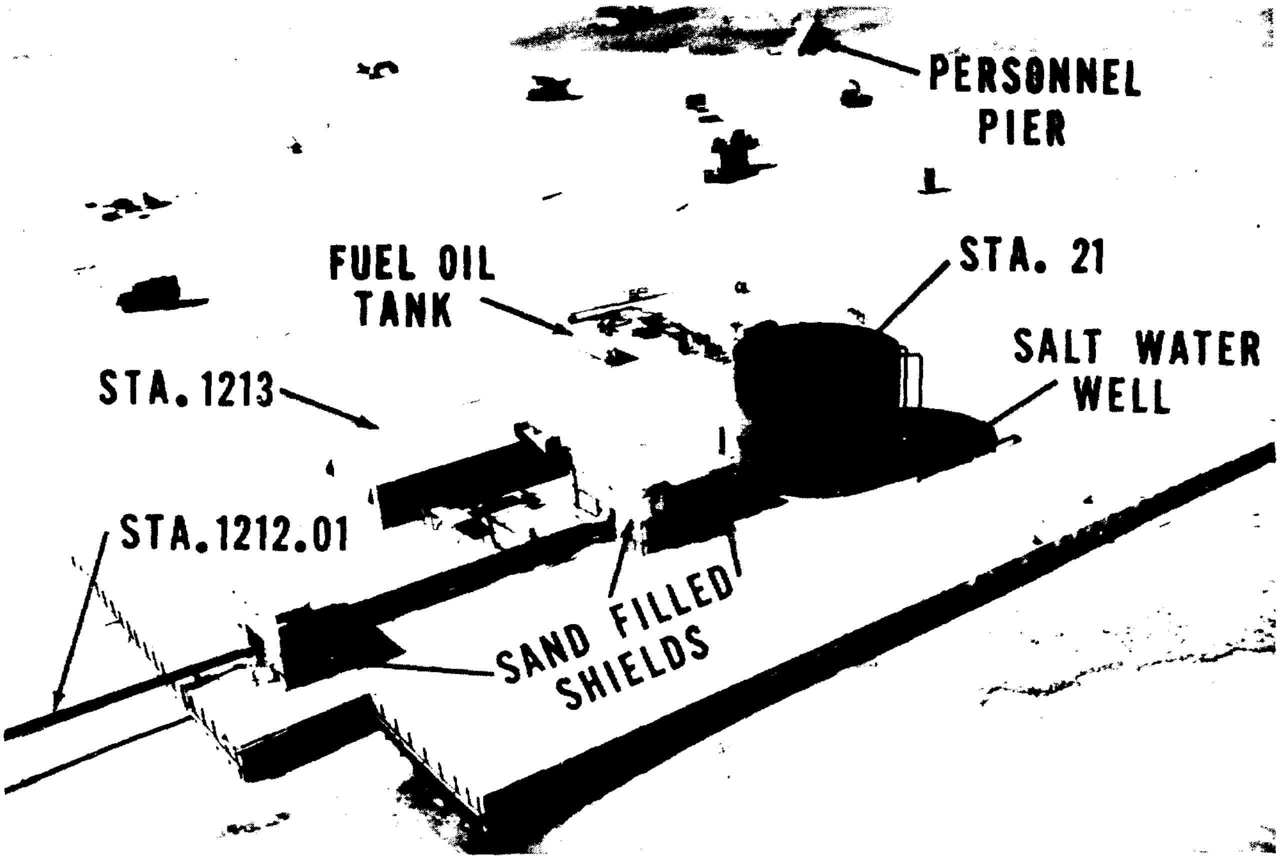
The inner tank was equipped with a revolving one-ton capacity bridge crane on a circular track with an 8-foot hook height. Two 12-inch pipes were run through the foundation to the inner tank to furnish a fresh air supply and exhaust. By means of two 540-gpm, gas driven, centrifugal, pumps and wells, the outer tank was filled with sea water. The tunnel could be filled from the main tank by closing the water-tight doors. The outer tank and tunnel could be drained independently.

Power was supplied by two 30-kw, 120/208-volt motor generators through a power panel. Also this power panel furnished power for three trailer receptacles and the utilities for Station 1312. Utility and scientific power in the inner tank was distributed from an 8-circuit lighting panel. Timing signals were provided by one 51-pair signal cable terminated in a 53-pair signal cabinet. Stations 81.21, 83.21, and 1[illegible]3 were also connected to this cabinet. Telephone instruments were connected in a similar manner to those in Station 20.



(Neg. No. W-V-239-7)

Figure No. 2-23. Station 21 Inner Tank and Access Tunnel.



(Neg. No. W-881-3)

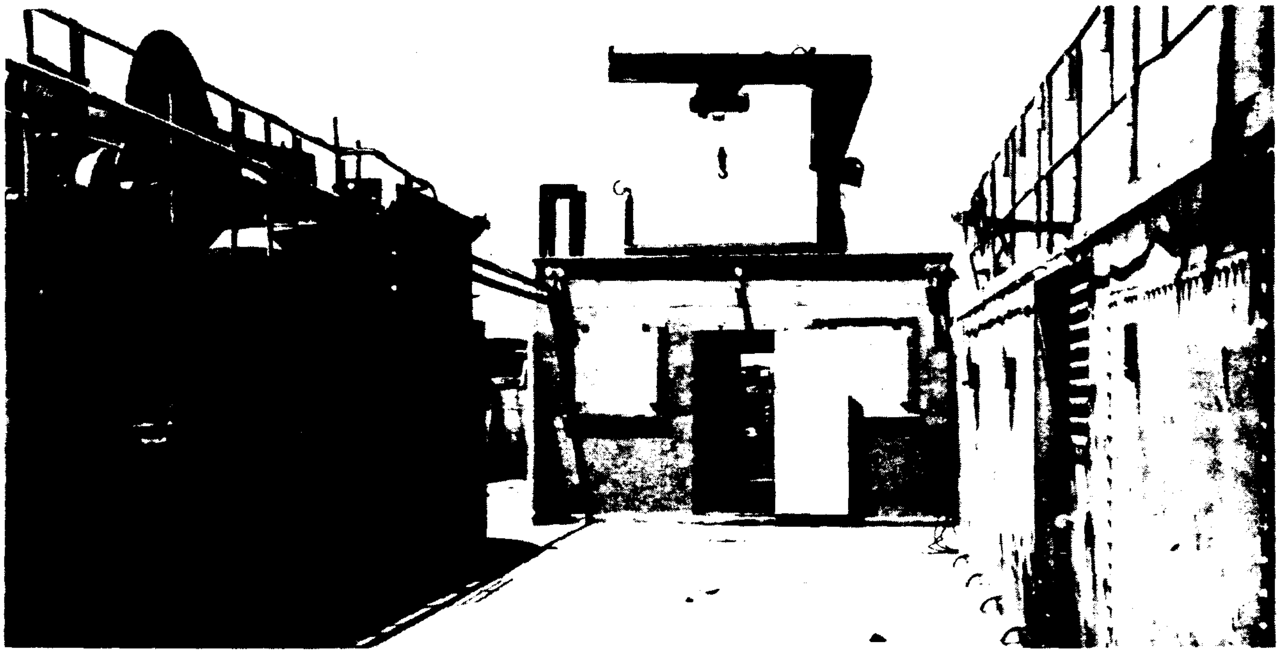
Figure No. 2-24. Ground Zero Arrangement — KOA Event.

STATION:	22
SITE:	Off Janet
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	22
DESIGN PSI:	None
CONSTRUCTION:	6-6-58/7-18-58

A modified LCU hull comprised this station. The modification consisted of removing the bulwark on the portside of the hull and a small portion on the starboard side. In addition, the forward bulwarks were provided with openings for mooring lines from the winches. A new timber cab, 15x21x10-foot-high, was located on the lower hull deck. A jib crane, salvaged from another barge, was installed within the cab and extended through the roof for loading User equipment and the device through an 8x7½-foot roof hatch. Four-point splayed anchoring was utilized with only two forward winches required for positioning. Power was supplied from a 20-kw engine generator.

STATION:	24
SITE:	Off Yvonne
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	24
DESIGN PSI:	None
CONSTRUCTION:	5-24-58/6-28-58

The zero station was a modified LCU hull. Modification consisted of removing the port and starboard side bulwarks and providing mooring line openings through the forward bulwarks. A timber cab, L-shaped, 16x25x10-foot high, was placed on a steel beam grillwork which cantilevered 7 feet over the port side. A pipeline was utilized on the portside for a Pinex experiment. The pipeline was 81 feet long and consisted of 19 feet of 8-inch pipe at the lower end (18 feet below the hull deck) connected to 40 feet of 6-inch-diameter pipe which terminated in an access well on the side of the hull and 19 feet of 6-inch pipe from the well to the cab floor. The pipeline was supported by hanger frames off the portside of the hull and perforated the hull, where necessary, to provide a continu-



(Neg. No. W-V-306-6)

Figure No. 2-25. Device Room and Jib Crane — Station 22.

ous line of sight into the cab. The access well was 2½x5x4½-feet deep welded to the hull side. A ½-ton capacity jib crane hoist was included on the hull deck over the access well for positioning User-furnished equipment. Within the cab a 3x6x6-foot-high concrete shield was placed containing an adjustable lead shield, 8 inches square, on one face. A 1x2⅔-foot blockout was provided in the shield for placing collimation holes sighting to Station 1310 and a detector on Site Yvonne. The blockout was grouted in after alignment of the lines of sight through the shield. A 20-kw engine generator provided utility and instrument power.

STATION:	25
SITE:	Alice Reef
USER:	LASL
PURPOSE:	Zero Station
PARTICIPATION:	25
DESIGN PSI:	None
CONSTRUCTION:	5-30-58/6-28-58

Another modified LCU hull provided this station. The modification consisted of removing a portion of the bulwark on the port and starboard sides amidships. An opening was required on the port and starboard forward bulwarks for mooring line from the winches. A new timber cab, 17x23x13-foot-high, was located on the lower hull deck. A roof hatch, 8x16-foot, and an 8x16-foot reinforcing steel deck, ¾-inch-thick, was placed over the existing deck. Four-point

(Neg. No. W-V-306-3)

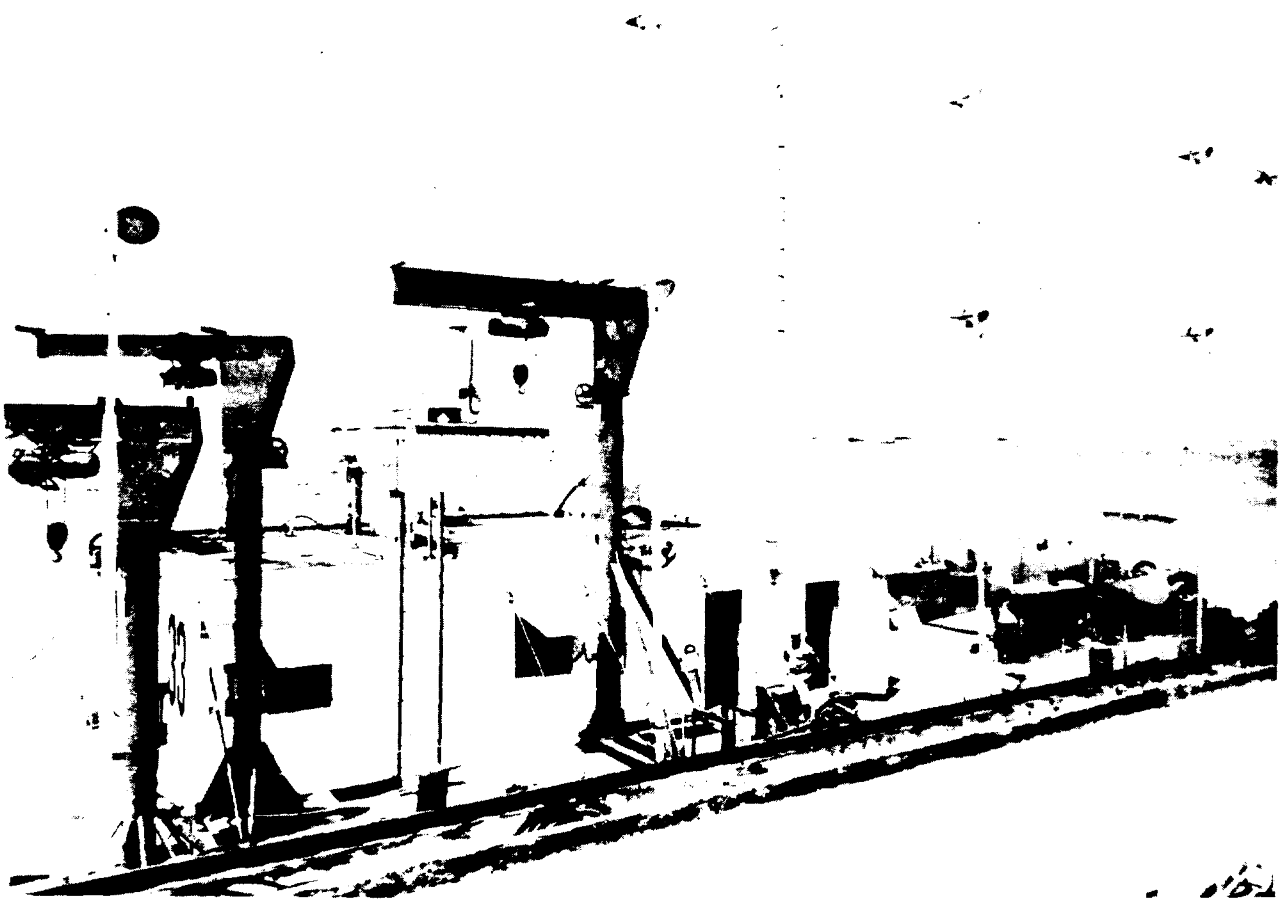
Figure No. 2-26. Pinex and Device Room LCU Station 24.

splayed anchoring was utilized, and only two forward winches were required for positioning. Power was supplied from a 20-kw engine generator.

STATIONS:	23, 27, 28, 30, 33, 37
SITE:	27, 28, 30, 37, Off Janet; 23, 33, Off Yvonne
USER:	LASL
PURPOSE:	Zero Stations
PARTICIPATION:	23, 27, 28, 30, 33, 37
DESIGN PSI:	0.75
CONSTRUCTION:	Sta. 23, 3-21-58/6-5-58; Sta. 27, 12-26-57/5-14-58; Sta. 28, 12-27-57/5-14-58; Sta. 30, 1-8-58/5-27-58; Sta. 33, 1-28-58/5-10-58; Sta. 37, 2-23-58/6-14-58

A two-room timber structure constructed on U. S. Army BC Barges comprised these stations. The wood structure was divided into a ready room, 16x8x8-foot-high, and device room, 16x30x11-foot-high. The device room had a small personnel door and two louvers on the portside, a 6½-foot double door on the bow end, and three parallel sliding doors on the starboard side to give a clear opening 24 feet wide and 10 feet high. A hatch, 8x6-foot, was provided in the roof for installing equipment. Each station was designed to withstand the overpressure developed by events at Site Yvonne so as to maintain dual capability. To collimate the lines of sight to the Alpha Station, a U-shaped concrete shield was placed in each cab. Positioning of these barges was accomplished with a four-anchor mooring consisting of two 30,000-pound Skagit winches on the stern corners and two double bitts on the bow corners. With this system of positioning orientation could be maintained, but it was not possible to spot precisely the barges on a predetermined location as had been done in the past.

All barges were equipped with a jib crane of 1½-ton capacity, 10-foot swing, and a clear



(Neg. No. W-V-286-11)

Figure No. 2-27. Barge Station 33 — 100% Complete.

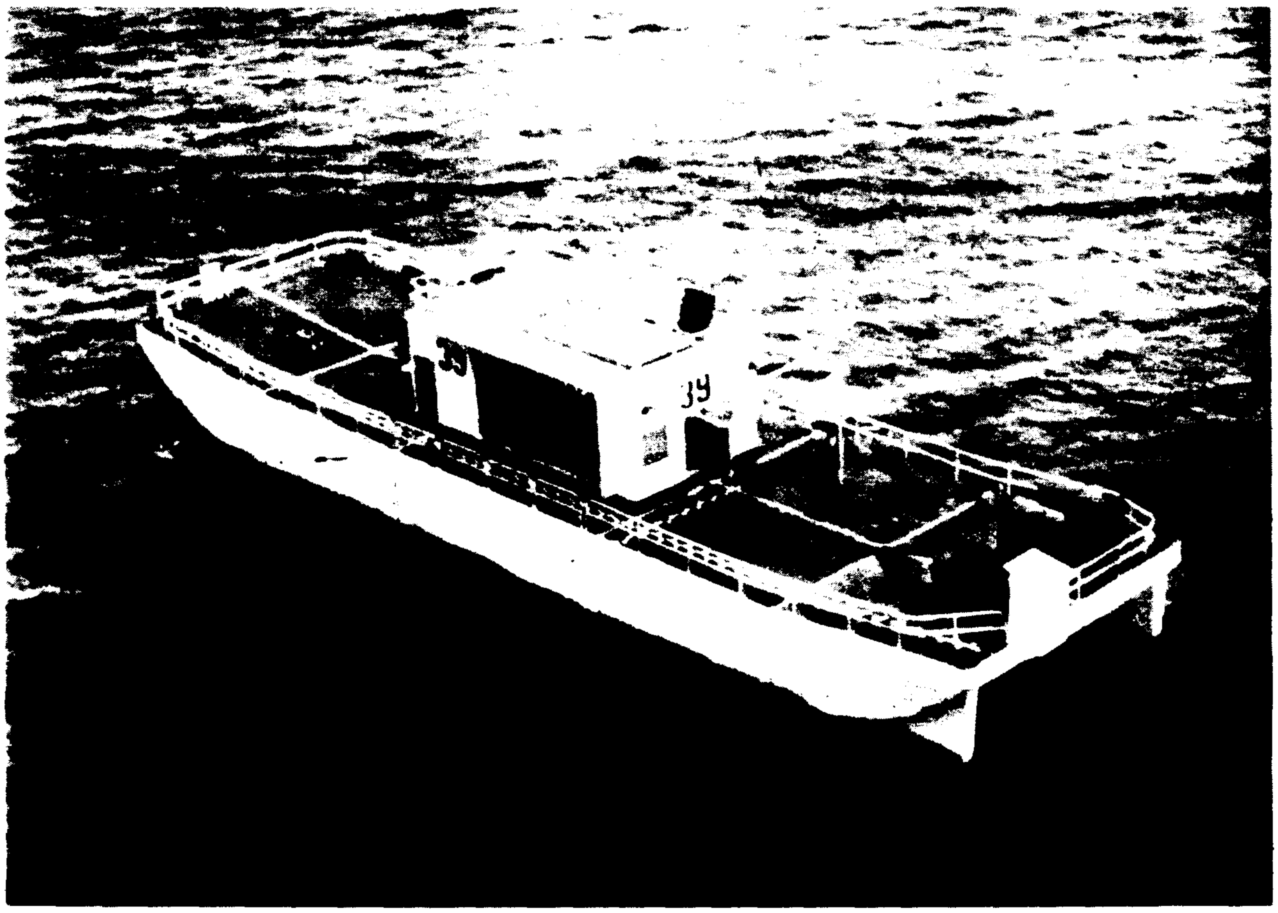
deck hook height of 12 feet for movement of material on and off the barge. For handling the equipment in the device room, various systems were utilized on the different barges. Loads in Station 27 were moved by means of a 1-ton jib crane projecting above the cab roof, adjacent to the portside of the hatch. To move loads in Stations 28, 30, and 37, a monorail A-frame was used. The capacity of the chain hoist on the monorails of Stations 28 and 37 was four tons and that for Station 30 was one ton.

One 20-kw, 3-phase, 120/208-volt diesel generator supplied power through the control panel and to the instrument and lighting panels in the ready room. One 16-pair and one 26-pair submarine cable from the Janet timing station were terminated in a watertight cabinet on the stern end of the barge. From this cabinet, cables were cross connected to signal cabinets in the cab. Telephone circuits were carried in the signal cable between the local exchange and the barge. Three circuits similar to those described under Station 20 were established.

Station 36 was subsequently renumbered and constructed as Station 23.

STATIONS:	38 and 39
SITE:	None
USER:	United Nations
PURPOSE:	Zero Stations
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	Sta. 38, 5-12-58/7-31-58; Sta. 39, 5-20-58/8-1-58

Station 38 was designed as a stand-by barge for Station 39. The two stations were Army-type BC Barges with a timber cab and a shelter for below deck access. The cab was 17x31x12-foot-high with 20-foot-wide sliding doors on two sides and an 8x16-foot roof hatch. An 8x16-foot reinforcing steel plate ¾-inch thick was welded to the deck directly under the hatch opening. A 9x9-foot L-shaped shelter was provided on the deck to weather protect the access stairway below deck. The structure was 7 feet high and of wood construction. Doorways were provided in the watertight bulkheads below deck for access to all compartments. The end bulk-



(Neg. No. W-V-320-9)

Figure No. 2-28. Station 39 — 70% Complete.

heads contained watertight doors. On the deck two 4x14-foot steel plates, ⅝-inch-thick, were welded to provide support for a User-furnished rack to be placed on top at each location.

Power was supplied from two 30-kw engine generators operating individually but with an automatic transfer switch. In addition to cab lighting and power receptacles, outside floodlights were provided and the compartments below deck were lighted.

Two Jobsite-fabricated periscopes, which allowed inspection of the barge bottom from the deck, were movable, buoyant, and adjustable for vision in all directions. Underwater lights were on the lower end of the periscopes. A 12x16x12-foot-high canvas and pipe frame sun shelter was provided adjacent to and aft of the cab.

The station was moored with two-part anchorage. Two lines from the bow were bridled to a common line, and a single line from the stern was tied to anchored buoys.

The requirement for these facilities was cancelled after construction was completed. The stations are now preserved with cocooning and stored at the EPG.

STATIONS:	50.01 through .15
SITE:	Sta. 50.01 through .06, Fox; Sta. 50.07 through .10, Janet; Sta. 50.11, Irene; Sta. 50.12 and .13, Kate; and Sta. 50.14 and .15, Irene — Janet Reef
USER:	SIO/H&N
PURPOSE:	Wave Gages
PARTICIPATION:	Sta. 50.01 through .06, Event 8; Sta. 50.07 through .10 and Sta. 50.12 through 50.13, Events 2, 10, 16, 25, 27, 28, 30, 37; Sta. 50.11, Events 2, 10, 16, 25, 27; Sta. 50.14, Event 28; and Sta. 50.15, Events 28, 30 and 37
DESIGN PSI:	Sta. 50.01 through .03, 300 psi; Sta. 50.04 through .06, 130 psi; and Sta. 50.07 through .15, 80 psi
CONSTRUCTION:	3-25-58/8-2-58

Each of the Ground Stations 50.01 through .13 consisted of a pair of 8-inch pipes 6-foot-high, spaced from 7 to 26 inches and welded together for rigidity by means of steel side plates. The pipes were embedded in a 4x8x3-foot-deep concrete footing which was provided with lifting eyes for future removal and subsequent relocation of the station. The reef Stations 50.14 and .15 each consisted of a 12-inch bearing pile 21 feet long and driven 6 feet into the reef. The lower portion of the pile flanges was reinforced with 1-inch cover plates for added strength.

STATION:	70
SITE:	Nan
USER:	EG&G
PURPOSE:	Timing Station
PARTICIPATION:	All Bikini Events and Event 42
DESIGN PSI:	0.5 psi
CONSTRUCTION:	3-6-58/4-19-58

The structure which contained Station 70, as well as Stations 1031, 3241.01, and 7410, was an existing 44x72-foot reinforced concrete structure used during previous Operations as a timing station. Station 70 occupied Rooms 1 and 2 of the existing building. New construction consisted of closing the open stud wall of Room 1 and providing acoustical tile to the ceiling of the room and new wall in Room 2 which closed off the refrigerated storage area of Room 3. In addition, the existing coping trays in the two rooms were made continuous to allow cable runs from Room 1 to Room 2. A new 52-pair terminal cabinet and signal runs were installed in Room 1.

A new refrigerated storage area was constructed in Room 3. Two new insulated walls were added, one adjacent to Station 1031 (Room 15) and one adjacent to Room 2. The remaining two walls, ceiling, and floor were insulated, and the room was air-conditioned and dehumidified to maintain a refrigerated condition.

STATION:	71
SITE:	Elmer
USER:	EG&G
PURPOSE:	Timing Station
PARTICIPATION:	All Events, Except 1 and 15
DESIGN PSI:	None
CONSTRUCTION:	2-5-58/7-10-58

The station consisted of a 24x37-foot PI&S aluminum building which was constructed of material from existing Buildings 229 and 311. Cable trenches, 1-foot-wide and 6-inches-deep, with steel plate covers were provided in the floor along the three exterior walls and the one interior cross wall. The building was air conditioned by a 3000-cfm unit placed outside the building. A lavatory was provided just outside one end of the structure.

Lighting was provided by five strips of fluorescent fixtures containing radio interference filters. Duplex receptacles were spaced 4 feet on centers around all walls. Four signal terminal cabinets, each with 12 strips, and two telephone terminal cabinets were provided in addition to a power and a lighting panel. The entire building was grounded by a bare copper loop with ground rods at each corner.

STATION: 72.02
SITE: Ursula
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All Eniwetok Events, Except 1, 2, 10, 15, 16, 22, and 42
DESIGN PSI: 70 psi
CONSTRUCTION: 2-14-58/4-20-58

An existing concrete structure, 10x18x12-foot-high, with wing walls and earth cover was rehabilitated to the previous "as-built" condition.

STATION: 73.01
SITE: Irene
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: 21
DESIGN PSI: 70 psi
CONSTRUCTION: 3-3-58/4-17-58

The station was located in Room 2 of REDWING Station 1611. Six cable terminal boxes were provided to receive three 51-pair, one 11-pair, one 6-pair and one 16-pair cable from the submarine cable terminating building or to the various stations on the Gene-Helen-Irene Complex. Two new 2-inch conduits were required to be installed through the exterior concrete wall to accomplish two of the cable runs.

STATION: 74.01
SITE: Oboe
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All Bikini Events
DESIGN PSI: 1.2 psi
CONSTRUCTION: 4-14-58/4-19-58

Station 74.01 was an existing concrete structure, 8x12x8-foot-high, identified previously as Station 74. New work consisted of rehabilitation to the REDWING structure.

STATION: 74.02
SITE: Uncle
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All Bikini Events
DESIGN PSI: 2.2 psi
CONSTRUCTION: 3-31-58/4-5-58

Station 74.02, utilizing the existing REDWING Station 73.07, was a 9-foot-square by 8-foot-high earth-covered concrete structure with wing walls. New work consisted of rehabilitation to the REDWING facility.

STATION: 75.01
SITE: Dog
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: None
DESIGN PSI: 1.9 psi
CONSTRUCTION: None

This structure was an existing heavily reinforced concrete structure, 19x13x15-foot-high, with buttressed front wall, and was to be rehabilitated to the REDWING condition. The requirement for this station was cancelled.

STATION: 75.02
SITE: How
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All Bikini Events, and Event 42
DESIGN PSI: 1.9 psi
CONSTRUCTION: 3-17-58/4-4-58

An existing concrete structure, 8x12x8-foot-high, was rehabilitated to the REDWING condition.

STATION: 76
SITE: George
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: Event 42 and all UCRL Bikini Events, Except 11, 12, 13
DESIGN PSI: 3.6 psi
CONSTRUCTION: 11-23-57/5-8-58

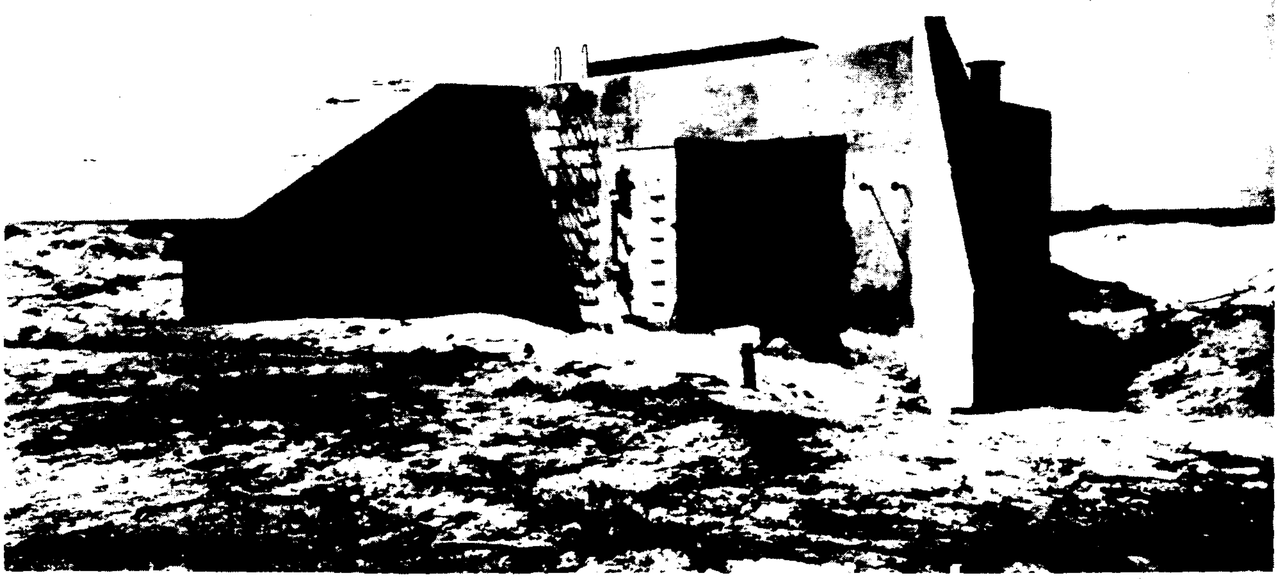
The station was an existing concrete structure, 8x12x8-foot-high, rehabilitated to the REDWING condition.

STATION: 77.01
SITE: Yvonne
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All Eniwetok Events, Except 2, 16 and 42
DESIGN PSI: 16 psi
CONSTRUCTION: 2-26-58/4-11-58

A concrete structure, identified during the previous operation as Station 77, was rehabilitated to the REDWING condition. Four 3-inch conduits stubbed out from the front wall were added.

STATION: 77.02
SITE: Janet
USER: EG&G
PURPOSE: Timing and Telephone Station
PARTICIPATION: 10, 21, 25, 27, 28, 30, and 37
DESIGN PSI: 40 psi
CONSTRUCTION: 12-24-57/5-16-58

This station was a reinforced concrete structure, 18x24x11-foot-high, consisting of two rooms, each with a separate entry through steel blast doors. The front wall was 2 feet thick, and the roof and floor were 1 foot, 6 inches thick. The remaining walls were 1 foot thick. Two 19-foot-long tapered concrete wing walls were located at the rear corners of the structure. They were 10 inches thick, supported laterally by concrete counterforts at 6 foot on centers, and extended diagonally out from the building. An earth-fill two feet deep, was placed over the station. An air fan unit and ducts were located in the building. The telephone room contained a dehumidification unit which was to be operated when the air fan unit was turned off and the outside ducts closed. The building contained a battery-driven converter system for supplying ac power through zero.



(Neg. No. W-V-198-1)

Figure No. 2-29. Timing Station 77.02 — 80% Complete.

STATION: 78.01
SITE: Charlie
USER: EG&G
PURPOSE: Timing Station
PARTICIPATION: All UCRL Bikini Events, Except 11, 12, 13
DESIGN PSI: 120 psi
CONSTRUCTION: 11-11-57/4-18-58

REDWING Station 1319 was modified to provide this timing station. Use of the structure for HARDTACK necessitated the existing entry be relocated to the opposite end of the building. A new entry was provided by cutting through the 5½-foot-thick wall and installing a steel blast door. The existing blast door at the other end of the building was closed, and the earth fill barricade replaced so that the new door was accessible and the remainder of the structure was under the fill.

Three signal terminal cabinets were installed, one for 16-pair cables and two for 51-pair cables. A 5-kw expendable generator was provided for each of the three events. Power was supplied through zero by use of a battery-driven converter system installed within the station and connected to a new power and lighting panel.

STATION: 80.01
SITE: Elmer
USER: LASL
PURPOSE: Gas Monitoring
PARTICIPATION: All Eniwetok Events, Except 1, 2, 15, 16, 17, 43, and 44
DESIGN PSI: None
CONSTRUCTION: 3-5-58/4-19-58

This station was located at the 100-foot level of the new 300-foot tower, Station 91. It consisted of a steel platform frame with steel floor grating, 5x17-foot, located on the easterly side of the tower within the tower cross section. Handrails were provided around the platform perimeter.

STATION: 82.01
SITE: Elmer
USER: SC
PURPOSE: Zipper Antenna for Alpha Monitoring
PARTICIPATION: All Eniwetok Events, Except 1, 2, 15, 16, 43, and 44
DESIGN PSI: 0.75 psi
CONSTRUCTION: 3-25-58/4-19-58

Station 82.01 was located at the 163-foot level of the new 300-foot tower, Station 91. The 20-foot triangular cross section of the tower at this level was framed with steel channels and floored with steel grating to include the area adjacent to the ladders. Handrails were provided around the platform perimeter and a wood shelter 4x6x7-foot-high was constructed on the north edge of the platform. This shelter was air-conditioned and dehumidified by equipment located on the roof. Electrical requirements were two receptacles, a light within the shelter, and control equipment for the air-conditioning system.

STATION: 82.02
SITE: Nan
USER: SC
PURPOSE: Zipper Antenna for Alpha Monitoring
PARTICIPATION: All Bikini Events, Except 11, 12, 13
DESIGN PSI: 0.75 psi
CONSTRUCTION: 3-25-58/4-19-58

The existing platform at the 200-foot level of the 300-foot tower, Station 90, was utilized for this Alpha Monitoring station. The platform framing was modified by removing the 5-foot-wide raised portion of the floor and providing a level deck by replacing the numbers and adding a new checkered plate. A wood shelter, 4x6x7-foot-high, was constructed at the west edge of the platform. This shelter was air-conditioned and dehumidified by equipment located on the roof. Two electrical receptacles, a light, and control equipment for the air-conditioning system were provided.

STATION: 84.01
SITE: Elmer
USER: EG&G
PURPOSE: Weather Radar
PARTICIPATION: All Events, Except 1, 2, 15, and 16
DESIGN PSI: None
CONSTRUCTION: 3-7-58/4-19-58

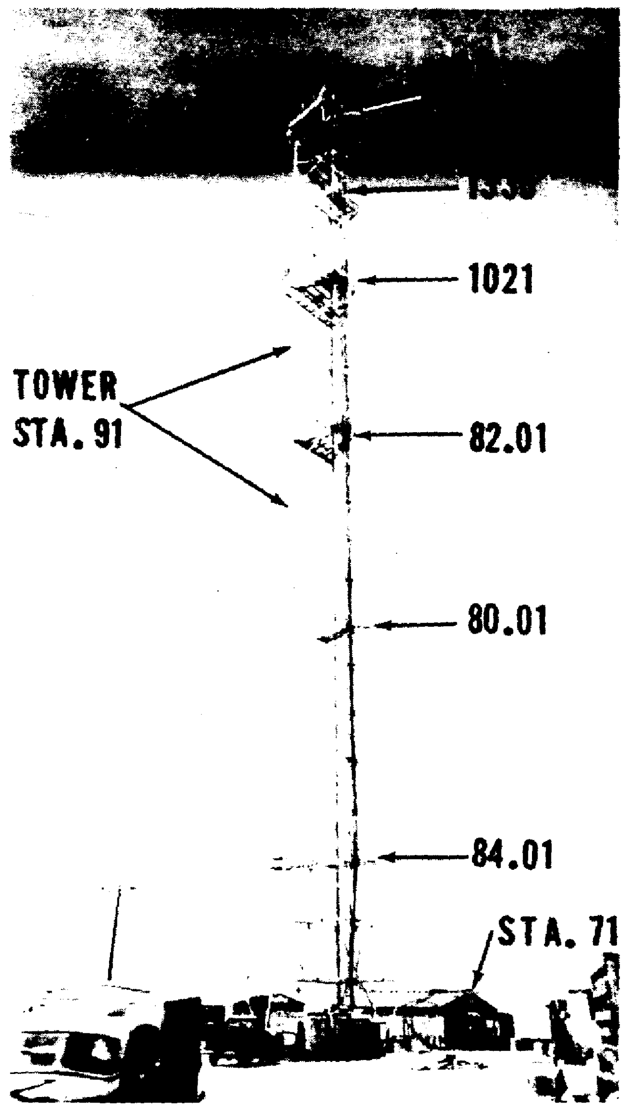
Station 84.01, located at the 38-foot level of the 300-foot tower, Station 91, consisted of steel framing and steel grating forming a platform, 6x10-foot, which extended 8 feet beyond the tower side. To provide access to the platform from the elevator and ladder located on the opposite side of the tower, a catwalk was framed with the platform members. A wire rope catenary supported a ⅞-inch styroflex from the platform to Station 71 located below.

STATION:	90
SITE:	Nan
USER:	EG&G
PURPOSE:	Observation Tower
PARTICIPATION:	All Bikini Events, and All Eniwetok Events, Except 1 and 15
DESIGN PSI:	None
CONSTRUCTION:	4-1-58/7-25-58

An existing 300-foot triangular steel tower, 20 feet on a side with corner guys at three levels, was rehabilitated to REDWING condition. Modification to the tower included the addition of Station 82.02 to the 200-foot level and a new power line to the 275-foot level. Included in this tower was the cab, Station 1510.

STATION:	91
SITE:	Elmer
USER:	EG&G
PURPOSE:	Observation Tower
PARTICIPATION:	All Events
DESIGN PSI:	None For Tower (See other Stations on Tower for their Design Loads)
CONSTRUCTION:	10-2-57/8-16-58

This 300-foot steel tower, in stock at EPG but not previously erected, was triangular in plan section, 20 feet on a side, similar to Station 90 on Nan, except for guys at the 250-foot level only. The existing connection details were modified at the 250-foot level for fastening more rigid guys to limit tower deflection and torsion. Two guys splayed at each of the three corners to accomplish this. The cab in stock was not utilized but was replaced by a new structure discussed under Station 1511. After the bare tower was erected and when all the stations located on the tower were made known, the tower framing was reinforced for anticipated loads by field welding two structural angles to the main tower legs up to the 250-foot level, replacing the diagonal bracing between the 25- and 75-foot levels and by adding diagonal bracing between the 75- and 150-foot levels and between the 200- and 287½-foot levels. To protect against uplift, additional concrete was poured around the tower footings.



(Neg. No. W-V-255-2)

Figure No. 2-30. 300-Foot Tower Station 91 and Various Platform Stations.

The elevator car was modified to include a scissors-type gate, and the elevator hoist was modified to utilize a slack rope device which maintained tension on the elevator support cables. The tower was provided with obstruction lights at the top and at the 150-foot level and ground floodlights at the 25-foot level. The power distribution panel and signal terminal cabinets were located in an enclosure at the base of the tower. A steel framed, aluminum covered shelter, 20x15x10-foot high, housed the elevator hoist on the ground and was located about 45 feet from the tower centerline.

STATIONS: 92.01, 92.02, 92.03, 92.04
SITE: Wilma, Mack, How, William
USER: EG&G
PURPOSE: Observation Towers
PARTICIPATION: 92.01, All Eniwetok Events; 92.02, All Eniwetok Events Except 1 & 15; 92.03, and 92.04, All Bikini Events, Plus Event 42
DESIGN PSI: None
CONSTRUCTION: 12-2-57/4-20-58

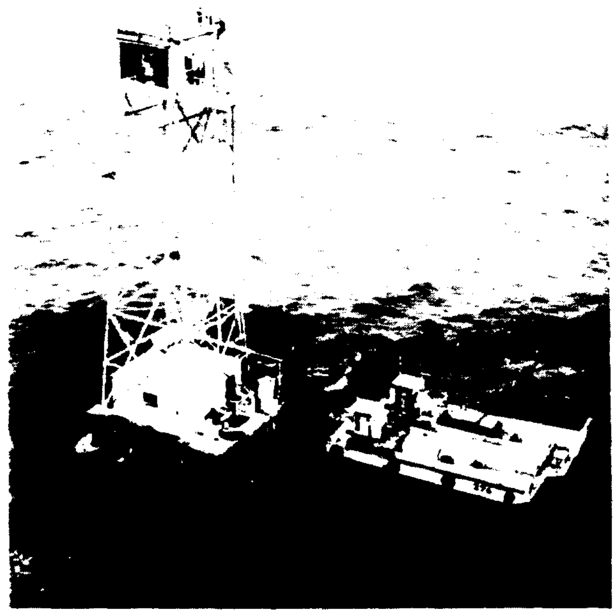
All of these timers were used during REDWING as Stations 1513, 1514, 1516, and 1515 respectively. They were 14-foot-square steel towers, 75 feet high. Rehabilitation of the stations to their REDWING condition was accomplished.

STATION: 105
SITE: Elmer
USER: DOD/ONR
PURPOSE: Antenna
PARTICIPATION: 43, 44
DESIGN PSI: None
CONSTRUCTION: 3-3-58/4-19-58

Located at the 263-foot level of the 300-foot tower, Station 91, this antenna installation consisted of a steel-framed platform, 5 feet square, outboard and adjacent to the tower elevator shaft. A 2½-foot-wide catwalk provided access to the platform from the outboard tower ladders. An 11-foot-long antenna support of pipe was mounted on one tower leg just under the station level. Electrical service to the platform was provided by a duplex receptacle.

STATIONS: 110.01, 110.02, and 110.05
SITE: Off Glenn
USER: DOD/NOL
PURPOSE: Recording Platform
PARTICIPATION: 43
DESIGN PSI: None
CONSTRUCTION: 3-23-58/5-5-58

Each of these stations consisted of User-furnished sectionalized barges on which mooring equipment, test equipment supports, and a generator were installed.



(Neg. No. W-V-318-11)

Figure No. 2-31. Stations 92.02 and 1514.02 — Mack Photo Tower.

STATIONS: 111.01 through 111.08
SITE: Glenn
USER: DOD/NOL
PURPOSE: Pressure Measurement Gauges
PARTICIPATION: 43
DESIGN PSI: None
CONSTRUCTION: 3-4-58/4-19-58

Existing buoys were modified in accordance with User requirements for these stations.

STATION: 121.02
SITE: Henry
USER: DOD/NOL
PURPOSE: Rocket Station for Air Blast Measurements
PARTICIPATION: 43
DESIGN PSI: None
CONSTRUCTION: 2-19-58/4-26-58

To create this station, two tents, each provided with a work bench, were erected in a cleared area 50x500 feet. Seven grounding rods were provided 50 feet apart along the 500-foot side of the area. A 3-kw generator supplied power to the tents.

STATIONS: 125.01 through 125.09

SITE: Irene, 125.01 through .06; Yvonne, 125.07 through .09

USER: DOD/RW

PURPOSE: Pressure Recording Cannisters

PARTICIPATION: 125.01 through .06, 21; 125.07 through .09, 20

DESIGN PSI: None

CONSTRUCTION: 4-17-58/4-26-58

No engineering was performed for this station. The Contractor provided support only.

STATIONS: 131.01 through 131.04

SITE: James, Irwin, Henry, Keith

USER: DOD/NOL

PURPOSE: Temperature and Humidity Recorder Station

PARTICIPATION: 43

DESIGN PSI: None

CONSTRUCTION: 4-8-58/4-14-58

Each of these stations consisted of three concrete anchor blocks to secure guys from a 24-foot-high User-furnished and installed tower.

STATIONS: 160.01 through 160.03

SITE: Henry, Elmer, James

USER: DOD/SIO

PURPOSE: Wave Recording

PARTICIPATION: 160.01 - .02, 43; 160.03, 44

DESIGN PSI: None

CONSTRUCTION: 4-8-58/5-3-58

Portable wood shacks 5x6x6½ feet high, comprised these stations. Station 160.02 was located on the personnel pier on Elmer and was supplied with line power.

STATIONS: 163.01 through 163.06

SITE: 163.01, James - Irwin Reef; .02, James; .03 and .06 Henry; .04 Glenn; .05 Irwin

USER: DOD/SIO

PURPOSE: Measure Water Level Rise

PARTICIPATION: 163.01 - .02, 43; 163.03 - .06, 44

DESIGN PSI: None

CONSTRUCTION: 4-10-58/4-26-58

To measure variation in water level, 16-foot wood poles were anchored 4 feet into concrete on the reef. The poles were painted alternately black and white. A cable reel support fabricated from 3-inch-diameter pipe was provided for each station.

STATIONS: 170.01 through .08

SITE: 170.01 - .03, Helen; 170.04 - .08, Yvonne

USER: DOD/BRL

PURPOSE: Pressure-Time Measurement

PARTICIPATION: 170.01 - .04, 21; 170.05 - .08, 20

DESIGN PSI: None

CONSTRUCTION: 3-10-58/4-26-58

From one to three concrete blocks, 4 feet square by 2 or 2½ feet deep, were used at each of these stations to house gage cannisters. The blocks were set flush with the grade.

STATIONS: 171.01, 171.04, and 171.05

SITE: Helen, Yvonne

USER: DOD/BRL

PURPOSE: Pressure-Time Measurement

PARTICIPATION: 171.01, 21; 171.04 - .05, 20

DESIGN PSI: None

CONSTRUCTION: 3-11-58/4-20-58

Stations 171.01, Helen, and 171.04, Yvonne, consisted of a one-gage tower, and Station 171.05, Yvonne, consisted of two-gage towers. The gage towers for Stations 171.01 and .04 were 3 feet high and consisted of two 8-inch pipes adjacent to each other and fastened with full height side plates. The front and rear were streamlined, using full height angles. The footing for the tower was 4x8x4-foot deep and the tower was embedded 3 feet. The gage towers for Station 171.05 were existing towers from REDWING Station 117 series relocated from Site Pearl to Yvonne.

Stations 171.02 and .03 were deleted prior to their installation.

STATIONS: 178.01 through .36
SITE: Yvonne
USER: DOD/BRL
PURPOSE: Pressure-Time Measurement
PARTICIPATION: 1, 15
DESIGN PSI: None
CONSTRUCTION: 7-7-58/8-2-58

Stations 178.01 through .13 were single-ground baffles. Each of these stations was a concrete block 4 feet square at the base, 2 feet square at the top by 2 feet deep, and had a well in the center to house gage cannisters.

Stations 178.14 through .21 were gage towers. Each gage tower consisted of two 3-inch diameter Schedule 40 pipes tied together with a lattice of 3/16x3-inch steel bar and projected 3½ feet above a concrete footing 2x5x2 feet deep.

Stations 178.22 through .36 were User-furnished and installed.

STATIONS: 180.01 through 180.03
SITE: 180.01 - .02, Helen; 180.03, Irene
USER: DOD/SRI
PURPOSE: Ground Motion Study
PARTICIPATION: 21
DESIGN PSI: None
CONSTRUCTION: 2-7-58/4-24-58

Each of these installations consisted of two 6-inch-diameter, 100-foot-deep holes spaced 35 feet apart. Temporary 6-inch pipe casing was provided with lugs to withdraw the casing. One hole at each station contained a concrete well head, 6 feet square by 1½ feet deep, in which the User embedded an instrument assembly at the top of the pipe.

STATIONS: 181.01 through 181.03
SITE: Yvonne
USER: DOD/SRI
PURPOSE: Ground Motion Study
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 3-11-58/4-20-58

Construction of these stations was identical to that of Stations 180.01 through 180.03.

STATION: 182.01
SITE: Yvonne
USER: DOD/SRI
PURPOSE: Power and Recording Shelter
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 3-3-58/4-18-58

Adapted from existing GREENHOUSE Station 57, this structure was 14x27x10 feet high, with 4-foot-thick roof and end walls, 5-foot-thick front wall, and 2-foot-thick rear wall and floor. Entry was through an exterior concrete vestibule having 2-foot-thick walls and slabs. New construction consisted of shoring the roof of the vestibule with a steel beam and two pipe columns and providing a wood tunnel, 3½x6½ feet clear and 26 feet long, for access through an earth fill which was placed to the roof level of the structure.

STATION: 182.02
SITE: Irene
USER: DOD/SRI
PURPOSE: Power and Recording Shelter
PARTICIPATION: 21
DESIGN PSI: None
CONSTRUCTION: 3-3-58/4-18-58

This station, existing IVY Station 600, was a two-room concrete structure 14x28x12 feet high. Walls and slabs were 3 feet thick. New construction consisted of placing plywood cover over the walls and slabs of the larger room, new electrical receptacles, and wiring. Power was supplied through a drop cord from a 5-kw, 110-v generator located outside the building. The structure was earth-covered with sandbag retaining walls provided at the sides of entry.

STATIONS: 190.01 - .02
SITE: Helen, Yvonne
USER: DOD/AFSWC
PURPOSE: Determination of Soil Loading and Attenuation
PARTICIPATION: 190.01 - 21; 190.02 - 20
DESIGN PSI: None
CONSTRUCTION: 2-27-58/4-20-58

Each of these stations consisted of User-furnished drums placed throughout an excavated area, 129 feet long, varying in width at the top from 10 to 42 feet, and 10 feet wide on the bottom. The depth varied from 7 feet at the narrow end to 27 feet at the wide end. The excavations were backfilled with select material simultaneously with the placing of User-furnished drums throughout the material.

The excavations indicated were the required minimum, but they were not necessarily limited to those dimensions. All portions of the excavation below the 3-foot depth were in water at maximum high tide. All drums were recovered for the User after the events.

STATION: 201
SITE: Yvonne
USER: DOD/GM/CWL
PURPOSE: Balloon to Support Detectors
PARTICIPATION: 1, 15
DESIGN PSI: None
CONSTRUCTION: 7-20-58/7-27-58

A User-furnished balloon, Station 201, flown at an altitude of 1500 feet, was used to support detectors and Stations 211.01 through .36. The balloon was moored from two concrete deadmen 3 feet on a side and four concrete deadmen 3½ feet on a side. A standard trailer receptacle, connected to the lighting panel in Station 15, provided 5-kw of 110-volt power on the ground under the balloon.

STATIONS: 203.01 and .02
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Station 203.01, Probe, and Station 203.02, Probe Winch
PARTICIPATION: 1, 15
DESIGN PSI: None
CONSTRUCTION: 7-19-58/8-6-58

Station 203.01 was User-furnished and installed.

Station 203.02 was a 4-inch-thick concrete slab, 4x4 feet, with two projecting ½-inch anchor bolts for mounting a User-furnished winch. For this station 100 sandbags were furnished.

STATIONS: 204.01 through .50
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Fall-out Collectors
PARTICIPATION: 1
DESIGN PSI: None
CONSTRUCTION: 7-19-58/8-6-58

Concrete blocks, 10x10 inches by 2 inches, and 200 sandbags were provided as this series of stations.

STATIONS: 210.01 through .12
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Aerial Survey Markers
PARTICIPATION: 210.01 - .03, 44; 210.04 - .06, 43; 210.01 - .12, 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-19-58/7-24-58

Installed vertically, each station was a reinforced concrete cross, 6x6-foot overall and 6x10 inches in cross-section of the arms.

STATIONS: 211.01 through .36
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Neutron, Thermal, and Gamma Detectors Suspended from Balloon
PARTICIPATION: 1
DESIGN PSI: None
CONSTRUCTION: 7-24-58/7-24-58

A cable suspended from balloon Station 201, was used for mounting numerous detectors at various heights and for positioning a ring 400 feet above the ground. To tie the cable down, 100 sandbags were provided.

STATION: 231
SITE: Elmer
USER: DOD/NRDL
PURPOSE: Source Trailer
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 4-8-58/4-26-58

The station consisted of a User-furnished trailer located near the ocean shore south of Building 218. A barbed wire fence enclosed the trailer in a 30-foot-minimum-width yard which extended to the low water line.

STATIONS: 240.01 - .02

SITE: Janet

USER: DOD/CWL

PURPOSE: Neutron Flux Measurements

PARTICIPATION: 28, 37

DESIGN PSI: None

CONSTRUCTION: Sta. 240.01, 2-25-58/5-24-58 Sta. 240.02, 2-25-58/6-20-58

Each station consisted of a line array of 25 User-furnished floats, each anchored by a vertical cable to concrete anchor blocks 1½x2x1-foot-high located on the lagoon floor. Located at either end of each array was a steel buoy anchored to a concrete anchor block, 3x4x2 feet high. All anchor blocks were interconnected by cable to allow recovery of the entire array by pulling one end buoy and block.

STATIONS: 241.01 through .10

SITE: Yvonne

USER: DOD/CWL

PURPOSE: Neutron Detector

PARTICIPATION: 1, 15

DESIGN PSI: None

CONSTRUCTION: 7-23-58/8-2-58

User-furnished detectors were attached to a cable laid on the ground.

STATIONS: 242.01 through .08

SITE: Yvonne

USER: DOD/CWL

PURPOSE: Neutron Detectors

PARTICIPATION: 1, 15

DESIGN PSI: None

CONSTRUCTION: 7-24-58/8-2-58

A User-furnished buoy anchored by a vertical cable to a concrete anchor block, 1½x2x1 foot high, comprised each of these stations. Six anchor blocks were connected together by a cable to allow recovery of the stations from one end. The seventh station was anchored and recovered separately.

STATIONS: 290.01 through .04

SITE: Yvonne

USER: DOD/CWL

PURPOSE: Incremental Gamma Dosimeter Transport Station

PARTICIPATION: 1, 15

DESIGN PSI: None

CONSTRUCTION: 7-20-58/7-23-58

Each of these stations consisted of a concrete collar, 12 inches high, 36 inches in outside diameter, 19 inches in inside diameter, and four ½-inch anchor bolts on a 24-inch-diameter circle. A hole approximately 8½ feet deep under the collar accommodated a project-furnished cylinder.

STATIONS: 291.01 through .36

SITE: Yvonne

USER: DOD/CWL

PURPOSE: Film Badge Stations

PARTICIPATION: 1, 15

DESIGN PSI: None

CONSTRUCTION: 7-18-58/7-24-58

Each station consisted of a ½-inch pipe, threaded at top, with 18 inches set in the ground and 33 inches projecting above grade.

STATIONS: 322.01 through 322.04

SITE: Yvonne, Helen, Irene

USER: DOD/NAVCEL

PURPOSE: Determination of Strength and Effect on Earth-Covered Steel Arches

PARTICIPATION: 322.01, 20; 322.02 - .04, 21

DESIGN PSI: None

CONSTRUCTION: 1-22-58/4-24-58

The Users furnished these stations, corrugated multi plate steel arch structures having concrete floors and wall foundations. The structures were earth-barricaded. Entry to each structure was through a corrugated metal pipe, 48 inches in diameter, which terminated in a 6-foot-square concrete entrance provided with a manhole access. The end walls of each structure were back guyed to a concrete deadman. Each structure contained two 2-level wood platform structures the full width of the arch for mounting gages along the interior of the arches.

(Neg. No. W-V-217-3)

Figure No. 2-32. Station 360.01 — 65% Complete.

STATIONS:	360.01 - .02
SITE:	Helen
USER:	DOD/AFSWC
PURPOSE:	Reinforced Concrete Test Slabs
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	2-5-58/4-24-58

Station 360.01 was composed of two concrete structures. One structure was 86½ feet long, 7 feet wide, and consisted of 7-foot-square concrete test slabs set on spread footings. The slabs were precast in the States and were set on the footings so that their tops were flushed with grade. The slabs varied in depth from 12 to 37½ inches, and the spacing and magnitude of the reinforcing steel and stirrups were varied. The second structure was 40 feet long, 7 feet wide, and utilized 7x2-foot concrete test beams set on 1-foot-high walls which were located along the longitudinal edges of a concrete mat foundation. Six-inch-thick concrete walls separated the beams, and 14-inch walls were located at the ends of the structure to house gages furnished by the User. The beam depths varied from 22½ to 58½ inches, and the reinforcing steel and stirrups varied equally as much.

Station 360.02 was composed of a single concrete structure similar to the second structure of Station 360.01, except with beam depths ranging from 12½ to 32½ inches.

STATIONS:	540.01 - .02
SITE:	Fred
USER:	540.01, DOD/WADC; 540.02, DOD/NASWF
PURPOSE:	Radar Data Recorder
PARTICIPATION:	20, 21, 27, 28, 29, 30, 32, 33, 34, 37
DESIGN PSI:	None
CONSTRUCTION:	4-28-58/4-28-58

User-furnished trailers and equipment com prised these stations; only signal cables wer added.

STATIONS:	540.01 - .03
SITE:	Nan, Yvonne, William
USER:	DOD/NASWF
PURPOSE:	Radar Reflector
PARTICIPATION:	42
DESIGN PSI:	None
CONSTRUCTION:	3-22-58/4-10-58

Each station consisted of a User-furnishe radar reflector mounted on four 3x3x2-foot-[illegible] concrete footings.

STATION: 612
SITE: Nan
USER: DOD/ESL
PURPOSE: Rocket Launch
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-11-58/4-1-58

These rocket-launching stations consisted of a 10-inch concrete slab 28x125 feet, a portable aluminum structure, and a tent. The slab contained anchor bolts for tying down launchers. The portable structure was furnished and erected by the User. This station was abandoned by the User and relocated at Johnston Island.

STATIONS: 630.01 - .05
SITE: 630.01 - .03, Tare; .04 and .05, Fox
USER: DOD/DOFL
PURPOSE: Radiation Effects
PARTICIPATION: 630.01 - .03, 11 and 13; 630.04 - .05, 7, 11, and 13
DESIGN PSI: 630.01 (300 psi); 630.02 (150 psi); 630.03 (25 psi); 630.04 (150 psi); 630.05 (150 psi)
CONSTRUCTION: 3-10-58/4-26-58

Station 630.01 consisted of a two-compartment concrete structure 12x20x10-foot-high, with top of the concrete 1 foot below grade. The compartments were 3⅔ feet square, 5½ feet deep and were enclosed by 4-foot-thick walls. The compartments were sealed with 2½-foot-thick tapered, concrete plugs, and the entire structure was covered with 1 foot of sandbags to grade.

Station 630.03 was similar to Station 630.01 but with 2-⅓-foot-thick concrete walls and a cargo net filled with sandbags in lieu of concrete plugs.

Stations 630.02, .04, and .05 were one-compartment structures but similar to Station 630.03 with approximately the same wall thickness. Eyebolts and sleeves were on the front wall of the stations for mounting instruments.

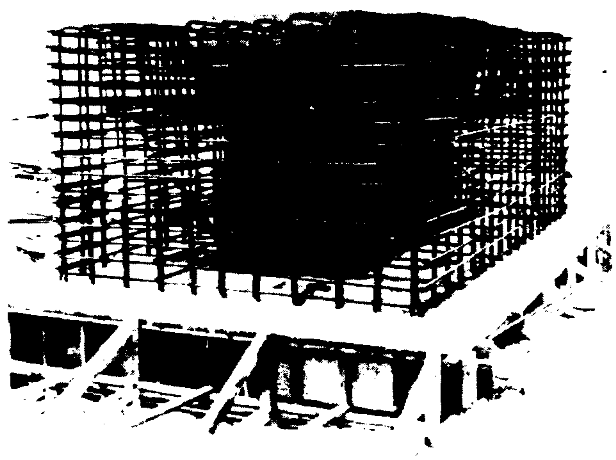
STATIONS: 681.01 - .03
SITE: Glenn
USER: DOD/MDL
PURPOSE: Recording Station
PARTICIPATION: Station .01 - .03, 43
DESIGN PSI: Stations not designed for overpressure. See Stations 946.01 and .02 for photo station overpressures.
CONSTRUCTION: 3-31-58/5-17-58

The LCU and the power, fuel, and tie-down appurtenances composing these stations were furnished by the User.

Also located on Station 681.02 were Photo Stations 946.01 and .02. Three hulls were utilized and were assigned new station numbers for each of two additional events.

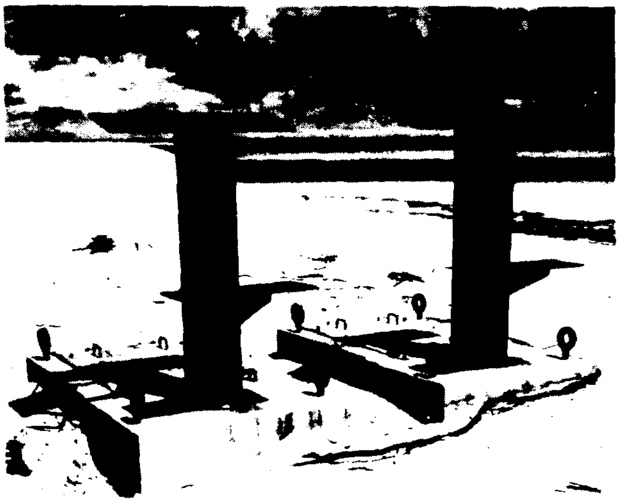
STATIONS: 810.01 - .03
SITE: Lucy, Olive, Fox
USER: DOD/NML
PURPOSE: Thermal Material Display
PARTICIPATION: 810.01, None; 810.02, 28 and 37; 810.03, 4
DESIGN PSI: None
CONSTRUCTION: 2-24-58/5-23-58

Beside the two camera mounts each of these stations utilized a User-furnished instrument shelter and rack. The instrument shelter was of steel construction, 12 feet high and installed so that the top 6 feet, an entry shaft, was barricaded with an earth-fill.



(Neg. No. W-V-235-11)

Figure No. 2-33. Station 630.01 65% Complete.



(Neg. No. W-V-414-6)

Figure No. 2-34. Station 810.01.

The two camera mounts were located about 40 feet in front of the shelters. Each consisted of a pair of 8-inch pipes, 5 feet high, and fastened together with ¼-inch side plates. The mounts were set in a 4x7x3-foot-deep concrete footing which also contained a 2x3x2-foot-deep hole for use as a battery box.

STATION: 831
SITE: How
USER: DOD/EG&G
PURPOSE: Zenith Tracking
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-10-58/3-10-58

This station consisted of a 10-foot-square concrete slab near the 75-foot tower, Station 92.03. With the relocation of the ABMA Program, this facility was cancelled.

STATION: 860
SITE: Yvonne
USER: DOD/WADC
PURPOSE: TV Tower
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 3-31-58/4-5-58

This 100-foot-high triangular lightweight steel tower station was guyed at the 90-foot level. On top of the tower were a pair of User-furnished outrigger beams which supported specimens at that level. A sheave assembly was provided at the outriggers to place the specimens.

STATION: 861
SITE: Yvonne
USER: DOD/WADC
PURPOSE: Speed of Sound Measurements
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 4-17-58/4-26-58

Located in a 50x100-foot stabilized area, this station was composed of a User-furnished pipe and tripod assembly.

STATION: 862
SITE: Nan
USER: DOD/WADC
PURPOSE: MSQ Radar Tracking
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-24-58/3-27-58

The station consisted of a stabilized area used for parking MSQ trailers. Timing signals were provided. With the relocation of the ABMA Program, this facility was cancelled.

STATIONS: 870.01 and .02
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Thermal Flux Measurement
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-21-58/7-27-58

User-furnished submarine-type steel shelter stations were installed underground in holes 5½ feet deep and 6x9-foot clear at the bottom and backfilled to the lip of the hatch with sand fill. One timing signal was provided to each shelter.

STATIONS: 871.01 and .02
SITE: Yvonne
USER: DOD/CWL

PURPOSE: Transportainer Shelters
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-22-58/7-22-58

Each station was a transportainer. The two transportainers were installed 6 feet apart and behind a sandbag revetment 8 feet wide and 7 feet high. Two timing signals were provided to each station.

STATIONS: 872.01 through .08
SITE: Yvonne
USER: DOD/CWL
PURPOSE: Thermal Detectors
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-18-58/7-22-58

Each station was a 3-inch-diameter, extra strong, galvanized steel pipe projecting 30 inches above grade, threaded on top, and embedded in a concrete anchor block 2 feet in diameter by 2 feet deep .

STATION: 910
SITE: How
USER: DOD/CDC
PURPOSE: Rocket Station
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-3-58/3-31-58

Fifty feet of the two 100-foot-long slabs of REDWING Station 261.01 were used for this station. The 12-foot space between the two slabs was filled with a 12-inch-thick slab 50 feet long to provide a launching pad. Two new electrical junction boxes and a conduit were installed. With the relocation of the ABMA Program, this facility was cancelled.

STATIONS: 930.01 through .03
SITE: How
USER: DOD/EG&G
PURPOSE: Photo Station
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 2-18-58/3-26-58

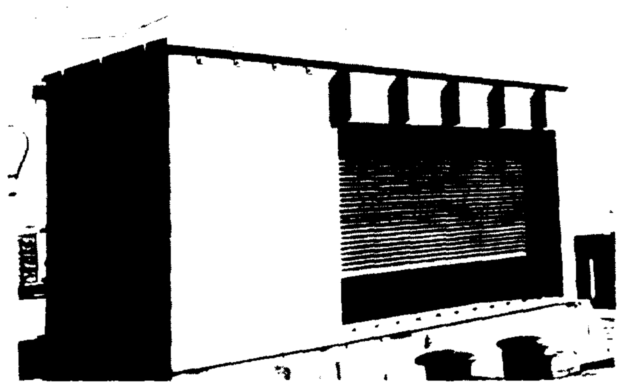
A 10-foot-square stabilized area was used to locate each of these photographic stations. The three areas were situated about the firing pad of Station 6001. With the relocation of the ABMA Program, the facility was cancelled.

STATION: 940
SITE: Glenn
USER: EG&G/DOD
PURPOSE: Pad for Photo Truck
PARTICIPATION: 43, 44
DESIGN PSI: None
CONSTRUCTION: 2-17-58/4-26-58

This station consisted of a 20x25-foot raised and stabilized area used for photographic equipment location.

STATIONS: 941, 942
SITE: Glenn
USER: EG&G/DOD
PURPOSE: Photo Station
PARTICIPATION: Sta. 941 - 44; Sta. 942 - 43
DESIGN PSI: 1 psi
CONSTRUCTION: Sta. 941, 4-18-58/5-3-58; Sta. 942, 5-1-58/5-7-58

One facility was constructed to serve as the two stations. The station number applicable was assigned for the first location, then renumbered for the second location. A wood structure 9x19x9-foot-high was located on the starboard gun mount platform of an LCU hull. The starboard sidewall had a remotely operated drop door; the port sidewall contained six shutters. Power was supplied by two User-furnished 5-kw, single-phase generators.



(Neg. No. W-V-282-2)

Figure No. 2-35. Stations 941 and 942, 100% Complete.

STATION: 945
SITE: Henry
USER: EG&G/DOD
PURPOSE: Camera Tower
PARTICIPATION: 42, 43, 44
DESIGN PSI: None
CONSTRUCTION: 2-24-58/5-14-58

The photo station consisted of a plywood shelter, 7x11x8-foot-high, mounted on 10-foot-high wood tower. The shelter had an opening on one side with a cantilevered overhead hoist beam for raising materials into the shelter by chain hoist. The opposite side contained a hinged, plywood, drop door actuated by an explosive link and timing signal.

STATION: 946.01 - .02
SITE: Glenn
USER: EG&G/DOD
PURPOSE: Photo Station
PARTICIPATION: Sta. 946.01 - 44; Sta. 946.02 - 43
DESIGN PSI: 1 psi
CONSTRUCTION: 4-21-58/6-14-58

One facility was constructed on the LCU hull, Station 680.02, to serve as Station 946.01 or .02, depending upon the participation. The facility consisted of a wood structure, 9x19x9-foot-high, which spanned between the forward upper decks. The forward wall contained a motor-operated roll-up steel door, 12-foot wide and the rear wall contained 6 shutters. Power was supplied by a User-furnished 20-kw, three-phase generator.

STATION: 1021
SITE: Elmer
USER: LASL
PURPOSE: Thermal Time Interval
PARTICIPATION: All Events Except 1, 15, 42, 43, and 44
DESIGN PSI: 0.75 psi
CONSTRUCTION: 2-25-58/4-19-58

This station was a platform and shelter located at the 225-foot level of the 300-foot tower, Station 91, consisting of a corrugated, aluminum-covered, wood frame built over a steel beam and floor plate platform. Walls and ceiling were insulated between studs and joists. The structure was 9-foot-square and was contained within the triangular configuration of the tower cross-section. The roof and walls contained several 2-foot openings, and a 4 foot-wide covered catwalk was provided on two sides. The structure was air-conditioned and dehumidified with two 1400-cfm units located on the roof. Lights, wall receptacles, and 20-kw power for a User-furnished motor generator were provided for the station.

STATION: 1030
SITE: George
USER: LASL/NRL
PURPOSE: Optic and Recording Station
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 12-9-57/4-10-58

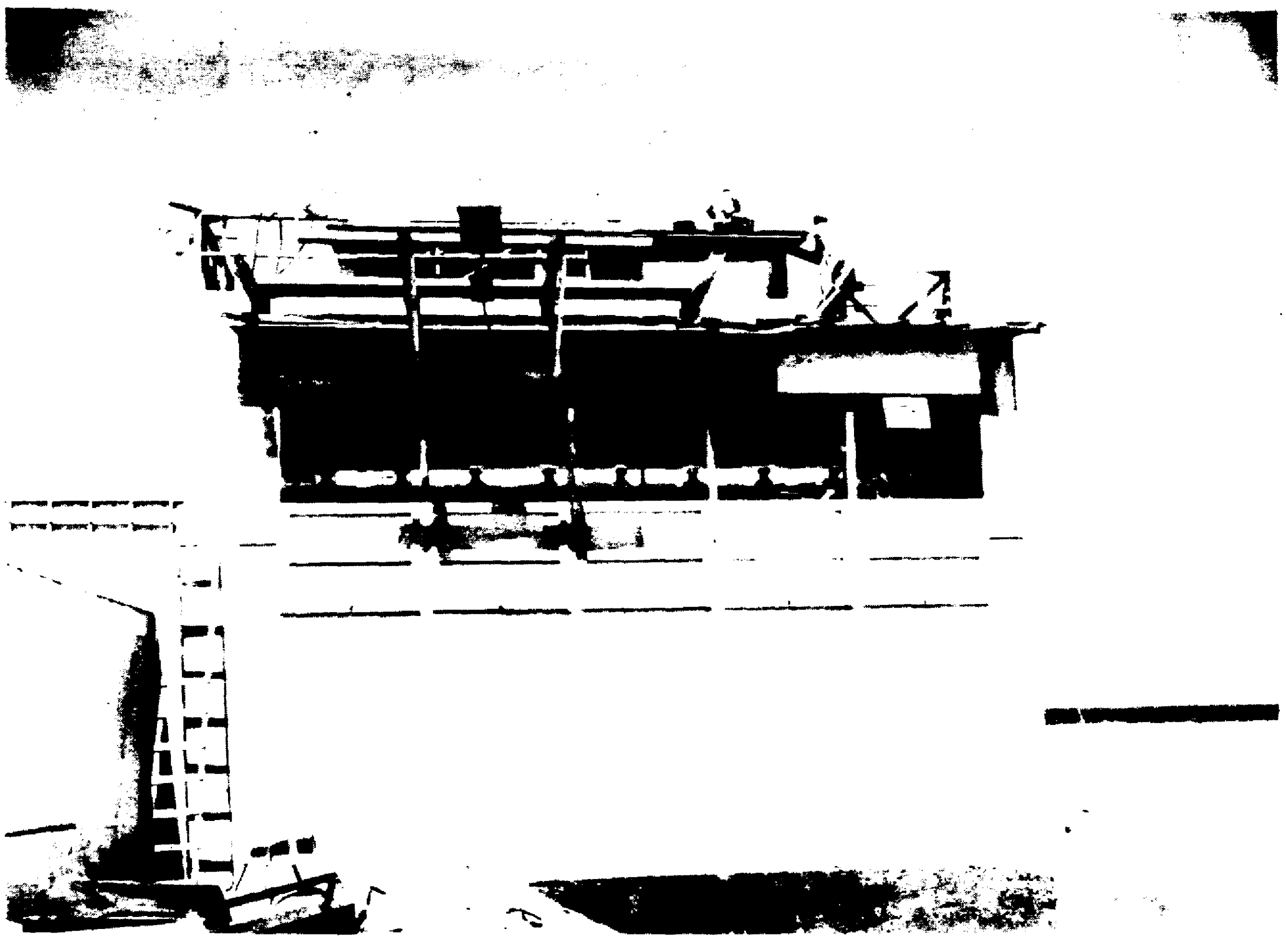
Rehabilitation and modification to existing REDWING Station 1528 consisted of adding two 24x6-foot wood frame shelters on the lagoon side upper and lower level roof decks; the addition of a Screen Room and Dark Room within the existing station; the extension of the station electric, telephone, and timing signal circuits; the provision of a mechanically operated movable roof and side wall panels on the wood shelters; additions and modifications to the air conditioning and dehumidification system in the existing and new construction areas; and the installation of original equipment removed during the interim period. The construction for this station was completed; however, it was abandoned when the ABMA Program was moved to Johnston Island.

STATION: 1031
SITE: Nan
USER: LASL
PURPOSE: Screen Room and Work Room
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 2-24-58/4-10-58

A portion of the station was located in Room 15 of the existing reinforced concrete structure used as timing Station 70 in previous operations. Room 15 was partitioned in half, and one of the new rooms was fully screened with copper screening on open wood studs for one wall and with sheet aluminum over the other three walls, ceiling, and floor. The other room was provided with a wood table and a workbench. Receptacles, wiring, User-furnished motor generator set, and control equipment were installed. The remainder of the station was located on top of the existing structure and over Room 15. It consisted of a 10x14x8-foot-high wood shelter on a concrete slab. The 14-foot north wall of the shelter contained two 5x6-foot wood drop doors and the roof had a 5x12-foot opening with an automatic opening hatch cover. This cover was operated by a motor-driven screw shaft located on a steel A-frame at the roof level but operated from within the shelter. This structure was air-conditioned by a window-type unit on the wall. With the relocation of the ABMA Program, this facility was cancelled.

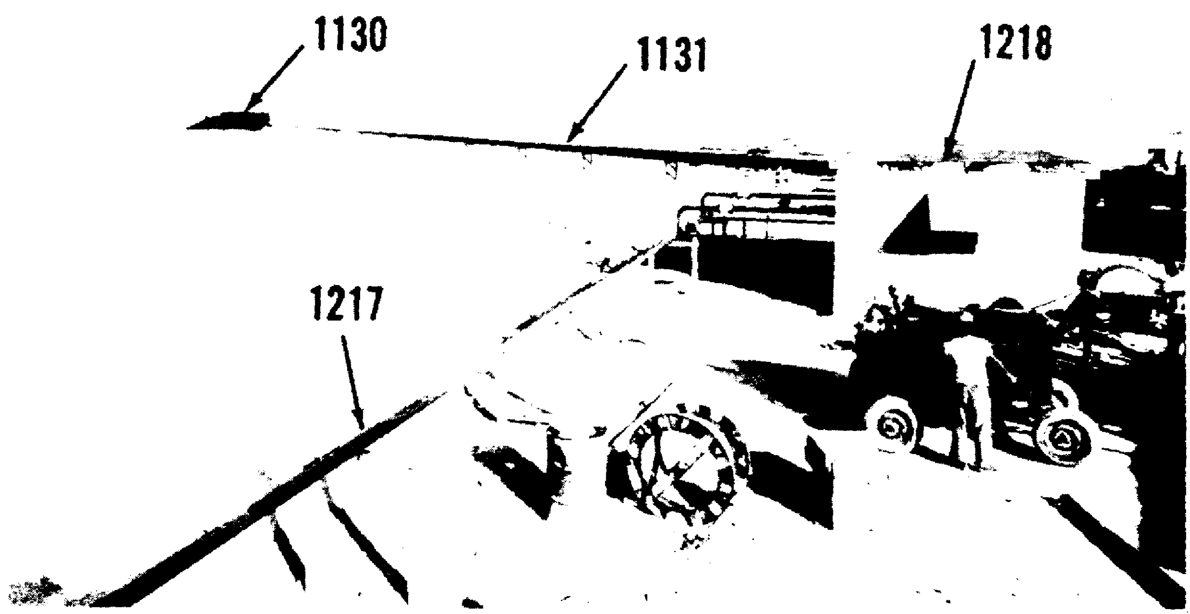
STATION:	1130
SITE:	Yvonne
USER:	LASL
PURPOSE:	Neutron Wheel Bunker
PARTICIPATION:	20
DESIGN PSI:	470 psi
CONSTRUCTION:	1-11-58/4-20-58

This bunker was a heavily reinforced concrete structure of irregular plan designed to survive the CACTUS event. Sidewalls and front wall facing Station 20 were earth barricaded to roof level. The foundation slab was 3 and 4-foot-thick, walls were 2⅓, 3, 4, and 5-foot-thick, and the roof slab was 3 and 3½-foot-thick. This structure was a terminal of a Vacuum Pipeline Station 1131, running to Station 20. The structure was of Z-shape, 26⅓x18 feet overall in plan, containing a single 5-foot-square room space and an L-shaped entrance passage from a removable entrance blast door. An access tunnel 28 feet long was through one earth barricade slope to a vacuum pipe, connecting chamber situated on the Station 20 side of the room and separated therefrom by a 5-foot-thick wall. The inner room space and part passage contained a 10-foot-long, overhead, ½-ton monorail crane. The station contained lights, receptacles, telephone, field phone, and signal services. An outside centrifugal fan connected to a 12-inch, round, flexible cotton hose ventilated the station with the blast door removed.



(Neg. No. W-V-233-5)

Figure No. 2-36. Station 1030 Camera Room — 70% Complete.



(Neg. No. W-V-257-12)

Figure No. 2-37. Stations 1130, 1131, 1217, and 1218 — Yvonne.

(Neg. No. W-V-195-11)

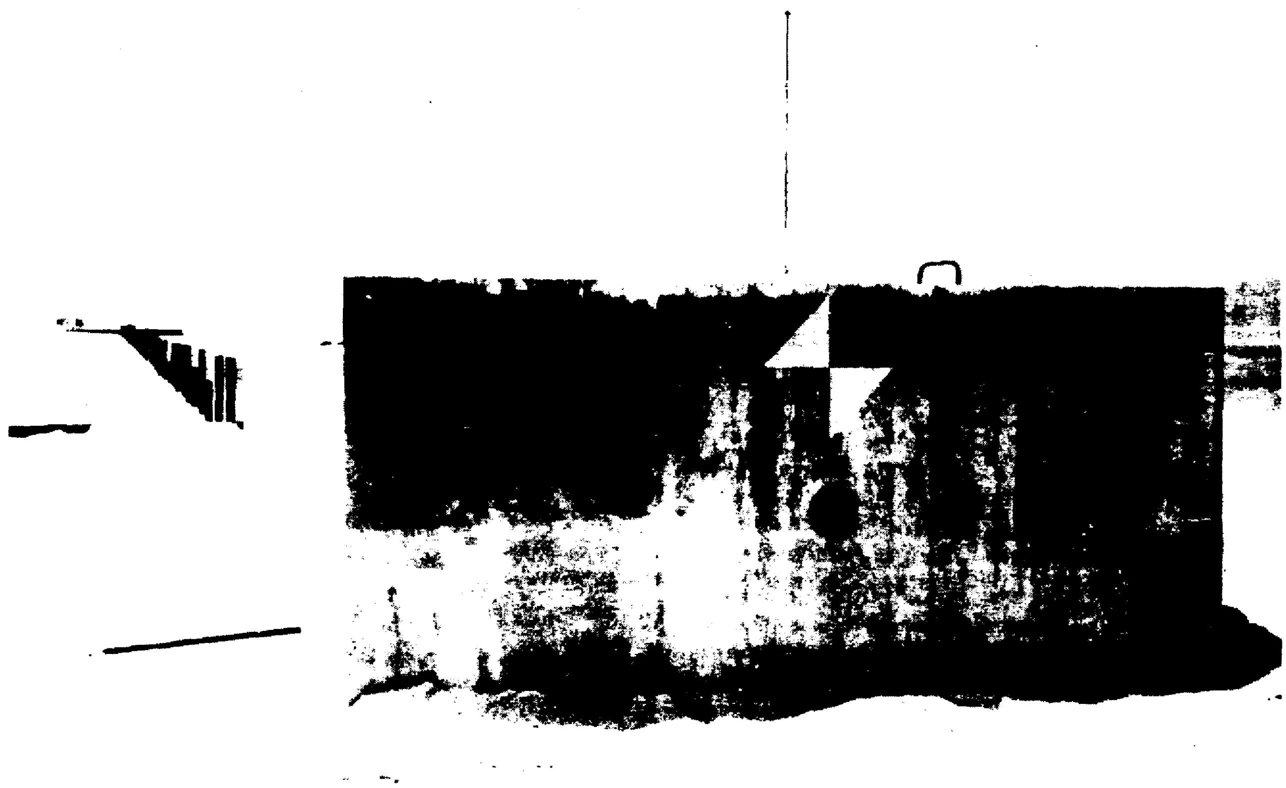
Figure No. 2-38. Station 1130 — 40% Complete.

STATION: 1131
SITE: Yvonne
USER: LASL
PURPOSE: Vacuum Pipeline
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 2-13-58/4-11-58

Vacuum Pipeline, Station 1131, began inside Shot Station 20 and terminated at Neutron Wheel House, Station 1130. The overall pipeline length was 491 feet. Beginning at Station 20, the steel pipe sizes and lengths were as follows: 24 inches - 176 feet, 20 inches - 110 feet, 16 inches - 100 feet, 12 inches - 90 feet, and 8 inches - 15 feet. A 4-inch branch line connected to the Vacuum Pump House, Station 1218. The main pipeline was supported at 30-foot intervals in a welded angle, yoke assembly at the top of 8-inch steel-pile section posts embedded in 5x3x2-foot-thick concrete spread footings. Footings on the reef were tied to the coral with four ¾-inch-diameter by 18-inch-long dowels.

STATION: 1210.01
SITE: Helen
USER: LASL
PURPOSE: Pinhole Station
PARTICIPATION: 21
DESIGN PSI: None
CONSTRUCTION: 1-6-58/4-20-58

Station 1210.01 was a Pinhole Station located on a man-made island at the end of a causeway off the ocean side of Site Helen. The structure was of reinforced concrete construction 14x3-foot overall in plan, consisting of a 3-foot-thick foundation slab with 3-foot-thick perimeter walls 6 feet high. The single floor space enclosed was 8x7-foot in plan. The station was earth barricaded to the top of the wall Elevation +13.0. The structure contained 120- and 208-volt outlet receptacles, 480-volt primary service transformer, and a field telephone. This structure was the terminal of the 4-inch diameter steel pipe section of the Vacuum Pipeline, Stations 1212.01 and 1212.02, Sites Gene-Helen-Irene. A canvas cover was provided to protect the room area space from the weather.



(Neg. No. W-V-207-8)

Figure No. 2-39. Pinhole Station 1210.01 — 85% Complete.

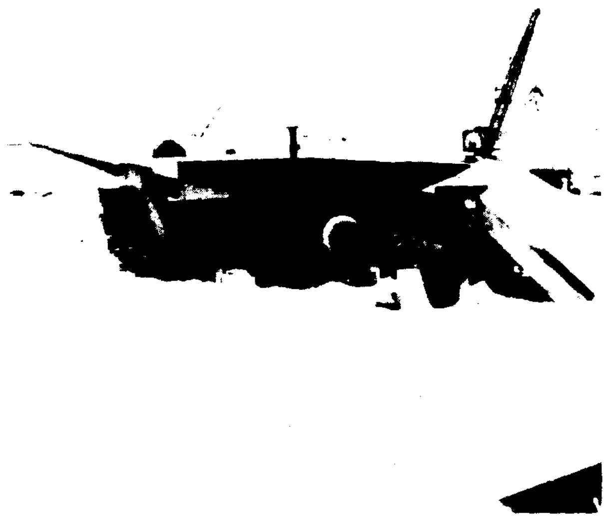
STATION: 1210.02
SITE: Yvonne
USER: LASL
PURPOSE: Pinhole Station
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 1-6-58/4-20-58

Station 1210.02 was a Pinhole Station located at the north end of Yvonne near Station 20. This station was oriented in alignment with Shot Station 20, Vacuum Pipeline Station 1217, and Pinex Station 1216. This structure was of reinforced concrete construction, 14x13 feet in overall plan, consisting of a 3-foot-thick foundation slab with 3-foot-thick perimeter walls 6 feet high. The single floor space was 8x7 feet in plan. The station was earth-barricaded to the top of wall Elevation + 13.0. The structure contained only electrical outlet receptacles and 8-inch pipe sleeves in the walls in line with the orientation previously described. A canvas cover was provided to protect the room area from the weather.

STATION: 1211
SITE: Irene
USER: LASL
PURPOSE: Pinex Recovery
PARTICIPATION: 21
DESIGN PSI: 80 psi
CONSTRUCTION: 1-29-58/4-26-58

Pinex Recovery Station 1211 was situated in a room space of a reinforced concrete structure located at the Irene terminal end of Vacuum Pipeline, Station 1212.02. The Structure also provided one other room space for Phonex Measurement, Station 1410. The structure was 22x54½ feet in plan with a projected area on one side 15-1/6x3½ feet and a pair of slot walls and wing walls projecting off the opposite side adjoining the Station 1211 room. Enclosing exterior walls were 3 and 4½ feet thick, and interior walls were 3 feet thick.

The structure was earth-barricaded on all sides and had a 5-foot fill over the roof slab. Permanent access to the structure was by a concrete tunnel passage through earth-fill at the rear of the structure. The two projecting access slot walls for sample recovery from outside the structure were 2 feet thick and 4 feet high. The slot and walls terminated at a retaining wall face 11 feet from the outside wall line of the main structure with some fill against the retaining wall section to form a trough-shaped access space to the slot from outside grade.



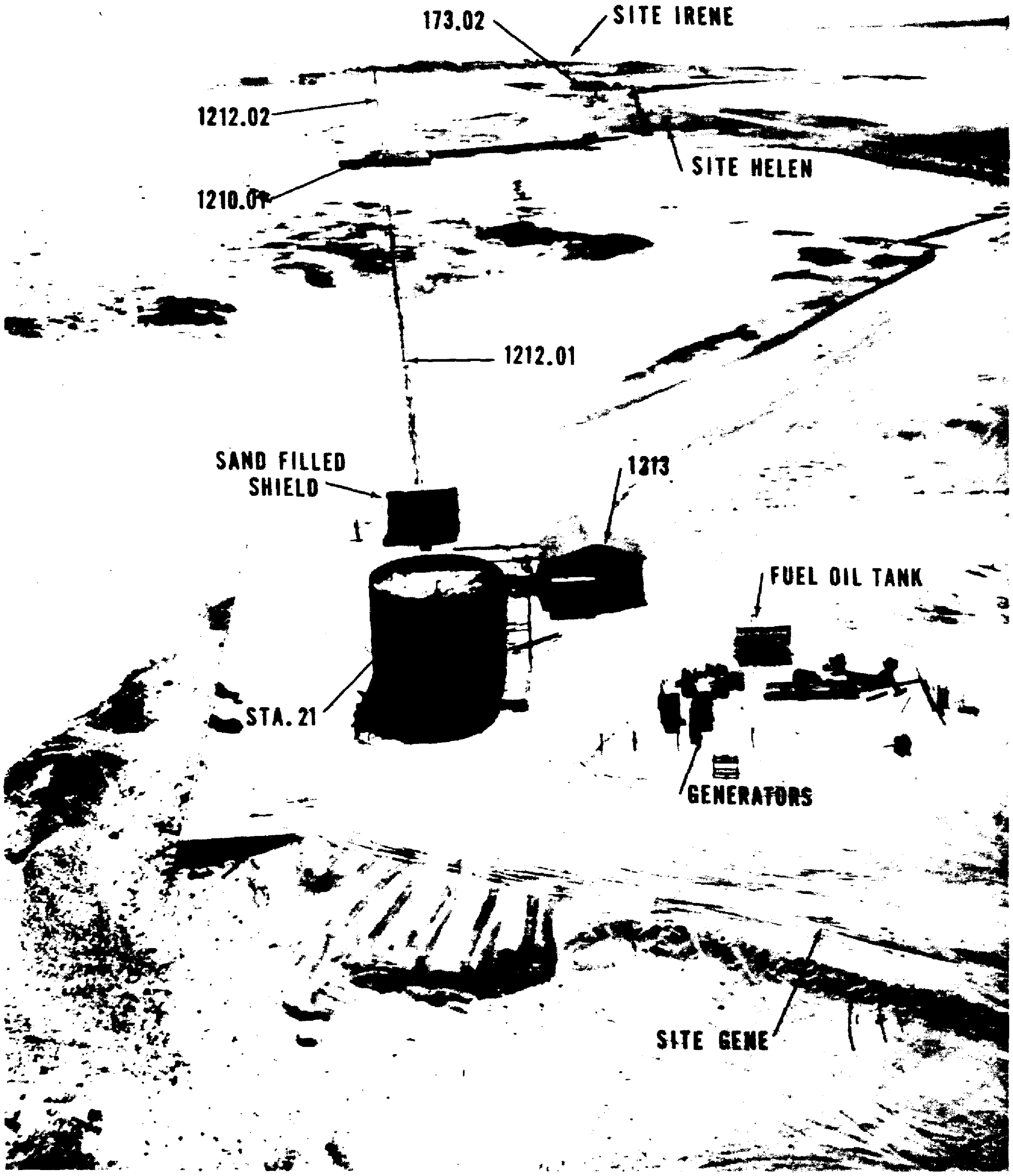
(Neg. No. W-V-260-5)

Figure No. 2-40. Stations 1211 and 1410 Ready for Backfill.

A 36-inch ID pipe projected from Station 1211 through the rear wall on line with the Vacuum Pipeline. A 6-inch support framework detail was situated in the station room space, centered, and aligned with the recovery slot. The User was furnished 6000 feet of 1-inch steel cable, sockets, and a concrete anchor block and marker buoy connected to the User's sample block. Power was supplied from Station 1525.

STATIONS: 1212.01 and 1212.02
SITE: Gene-Helen-Irene
USER: LASL
PURPOSE: Vacuum Pipeline
PARTICIPATION: 21
DESIGN PSI: None
CONSTRUCTION: 1-14-58/4-12-58

Stations 1212.01 and 1212.02 were vacuum pipelines located on the ocean reef off Sites Gene, Helen, and Irene; short runs of pipeline were on land at Gene and across the man-made island off Site Helen, and a long length of pipeline was on Site Irene. The pipelines were aligned between the work points of Station 21, Gene, and Station 1211, Irene. The centerline of pipe elevation was on a true horizontal level between the Station 21 and Station 1211 work points at Elevation + 10.00 feet.



(Neg. No. W-881-2)

Figure No. 2-41. Gene-Helen-Irene Complex.

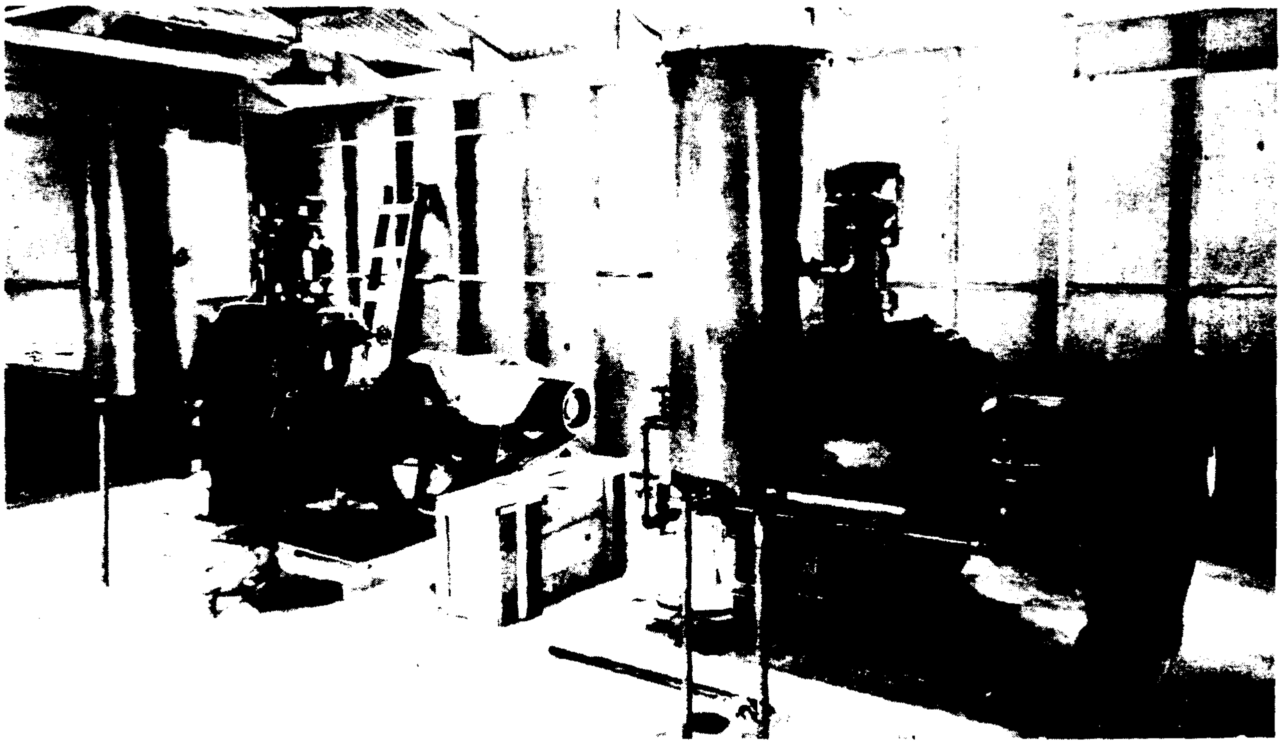
Station 1212.01 pipeline was over the ocean reef from Station 21 to Pinhole Station 1210.01 located on a man-made island off Site Helen. The pipeline was supported throughout its length on 8-inch steel piles driven into the reef at intervals of 30 feet for the 36-inch, 18-inch, and 16-inch pipe sizes, 25 feet for 12-inch pipe, 20 feet for 8-inch pipe, and 14 feet for 4-inch pipe. A typical support consisted of one vertical pile with a welded angle yoke frame detail at the top of the pile. Adjustment of line and grade was accomplished by welded steel shims to the frame only. Two bellows-type expansion joints were installed in the 12-inch pipe section at approximately the center of the pipeline length, and one on each side of a two-pile anchor and support. The ends of the pipeline were anchored by a two-pile detail at the first support on Site Gene and at the end of pipe on the man-made island by embedment of the pipe in the concrete wall of Station 1210.01 with welded slip on square plates flush against the inner and outer wall surfaces. The total length of this line was approximately 1500 feet.

Station 1212.02 pipeline ran overland and over the ocean reef from Station 1211, Irene, to Pinhole Station 1210.01 on the man-made island. The pipeline was supported on 8-inch steel piles at intervals of 30 feet for 36-inch, 30-inch, 24-inch, 20-inch, and 16-inch pipe sizes, 25 feet for 12-inch pipe, 20 feet for 8-inch pipe, and 14 feet for 4-inch pipe. Typical supports were the same as for Station 1212.01, except for the overland piling on Site Irene where the piling driven into sand was encased in concrete for lateral stability. Three bellows-type expansion joints were installed in this run of pipe. The end of the pipeline at Pinhole Station 1210.01 was anchored in the same manner as for Station 1212.01. The opposite end of the line was anchored at Station 1410, Site Irene.

The vacuum was produced by vacuum pumps located in Station 1213 close to the Site Gene end of the line.

STATION:	1213
SITE:	Gene
USER:	LASL
PURPOSE:	Vacuum Pump House
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	2-13-58/4-18-58

The Pump House consisted of a 24x28-foot single-room, wood-framed structure with plywood-sheathed exterior walls 9 feet high,



(Neg. No. W-V-239-6)

Figure No. 2-42. Interior of Station 1213 — 80% Complete.

trussed rafters with purlins, corrugated aluminum roof sheathing, and concrete floor slab. The station contained two User-furnished Kinney Model KD-780 vacuum pumps, piping manifolds for make-up to Vacuum Pipeline Station 1210.01, telephone and field phones, signal cabinet, electric circuits for the vacuum pumps, outside salt water pump, receptacles, and light fixtures. Electric power for the two vacuum pumps was provided by a 100-kw portable generator outside and adjacent to the station building. Power for the light fixtures and receptacles was provided by a lower voltage generator source near the trailer park at Station 21.

STATION: 1216
SITE: Yvonne
USER: LASL
PURPOSE: Pinex Structure
PARTICIPATION: 20
DESIGN PSI: 470 psi
CONSTRUCTION: 1-7-58/4-20-58

The reinforced concrete terminal structure of Vacuum Pipeline Station 1217 was aligned with Pinhole Station 1210.02 at the opposite end of the pipeline and with Station 20. The structure consisted of an embedded segment of the end 8-inch steel pipe section of Station 1217 in the 30½x4-foot-wide wall section on a continuous wall footing 8 feet wide and 2 feet thick. The structure was earth barricaded to the top of wall Elevation + 13.75 on three sides, leaving access on the end of the structure to a terminal flange on the vacuum pipeline. Electric power was supplied to three outlet receptacles at the end wall of the structure from a transformer station at this end of the island. For this station the User was furnished a 3x4x6-foot concrete anchor block and 6000 feet of 1-inch steel cable.

STATION: 1217
SITE: Yvonne
USER: LASL
PURPOSE: Vacuum Pipeline
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 2-17-58/4-11-58

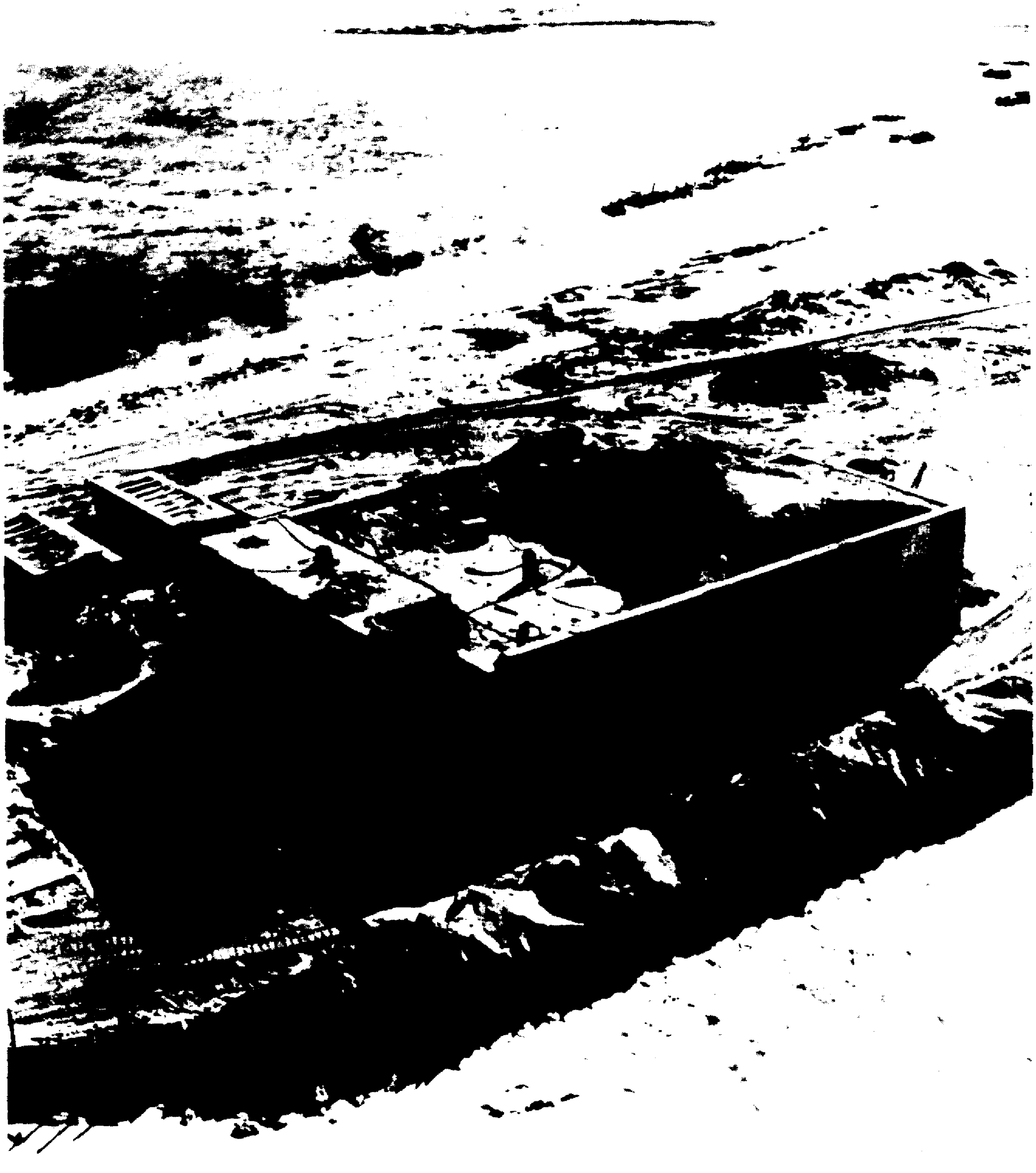
Vacuum Pipeline Station 1217 ran between Pinhole Station 1210.02 and Pinex Structure 1216, all aligned with the working point of Station 20. The total length of pipeline including the embedded portion of pipe in Station 1216 was 396 feet: 96 feet of 4-inch-diameter steel pipe and 300 feet of 8-inch. A 4-inch branch line connected to Vacuum Pump House, Station 1218. The main pipeline was supported on steel angle A-frames spaced at 14 feet and 20 feet respectively for the 4-inch-diameter and 8-inch diameter pipe. The support frames were from 3 feet to 4½ feet high, and the lower end of the two post angles were embedded in concrete pier footing 1½ feet square. The length of pipeline was earth-barricated for its entire length, with the top of the fill at Elevation + 13.0. The average depth of fill was 7 feet.

STATION: 1218
SITE: Yvonne
USER: LASL
PURPOSE: Vacuum Pump House
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 1-24-58/4-20-58

The Vacuum Pump House was a 13x18x8-foot wood-framed building with plywood exterior wall sheathing, flat-sloped roof deck with plywood sheathing, dry sheet composition roofing, and 4-inch concrete floor slab. The building housed two User-furnished Kinney Model KS-47 vacuum pumps to produce the vacuum required for Vacuum Pipeline Stations 1217 and 1311. Construction features included an outside salt water well, cased, with turbine pump, pipe manifolding between vacuum pipeline stations and the vacuum pumps, 4-inch cast iron floor drain line to lagoon, light, telephone, field phone, and receptacles. The electric power source was Transformer Station "A" on Site Yvonne.

STATIONS: 1220.01-.02
SITE: Yvonne
USER: LASL
PURPOSE: Monex Station
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-27-58/4-24-58

Two identical Monex Stations were constructed off-shore at the north end of Site Yvonne. One was in the lagoon, Station 1220.01, and the other on the north reef shelf, Station 1220.02, both oriented toward Station 20, Site Yvonne. The structures consisted of a steel beam frame and floor plate supported by four steel bearing piles to support sand-filled framed plywood bins and sandbags surrounding four lengths of 2-inch pipe four feet long. Also provided were two concrete anchor blocks with



(Neg. No. W-858-5)

Figure No. 2-43. Station 1310 Modification — 45% Complete.

eight 100-foot lengths of 3/4-inch wire rope and clamps to be installed to the station detectors.

STATION:	1310
SITE:	Yvonne
USER:	LASL/EG&G
PURPOSE:	Recording Station
PARTICIPATION:	1, 15, 17, 20, 22, 23, 24, 29, 32, 33, and 34
DESIGN PSI:	50 psi
CONSTRUCTION:	11-12-57/4-23-58

Station 1310 required a second-story addition to REDWING Station 1310 for a new Detector Room over existing Room "D." This addition provided a room space 8 feet wide by 44½ feet long with an 11-foot, 10-inch ceiling enclosed by three full-height walls and a partial ceiling-height wall with a roof slab. Wall and roof sections were 5-foot-thick reinforced concrete. A considerable amount of concrete cutting and modifications to the existing earth barricades were incidental to the room addition.

The floor plan of Station 1310 provided six utility room spaces, a long entrance passage, and an escape hatch vestibule. A Utility Room was 42½x14 feet and contained two new power centers, a lavatory and water closet, two fresh water storage tanks, station air inlet and exhaust pipes and fans, lighting fixtures, electrical control panels, signal panel, electrical receptacles, and refrigerant and compressor units for dehumidifier package units. Room "C" was 42½x 12 feet and contained electrical receptacles, signal cabinet, telephone, light fixtures, electric heaters, and two dehumidifier units. Room "D" 45½x8 feet, contained electrical receptacles, telephone, 2 motor generator sets, copper-clad steel wall plates over a portion of the wall surfaces surrounding the cable entrance ducts, light fixtures, electric heaters, and two dehumidifier units. The Motor Generator Room "B" contained an instrument control panel, receptacles, telephone, light fixtures, heater and dehumidifier unit, and a 25-kw motor generator set. The Detector Room Addition included six collimator pipes through the west end-wall, eight lead-shielded openings in the north wall, four collimator slide assemblies with a portable hydraulic lift pump, monorail and hoist, lighting fixtures, signal cabinet, telephone, and power outlet boxes and receptacles.

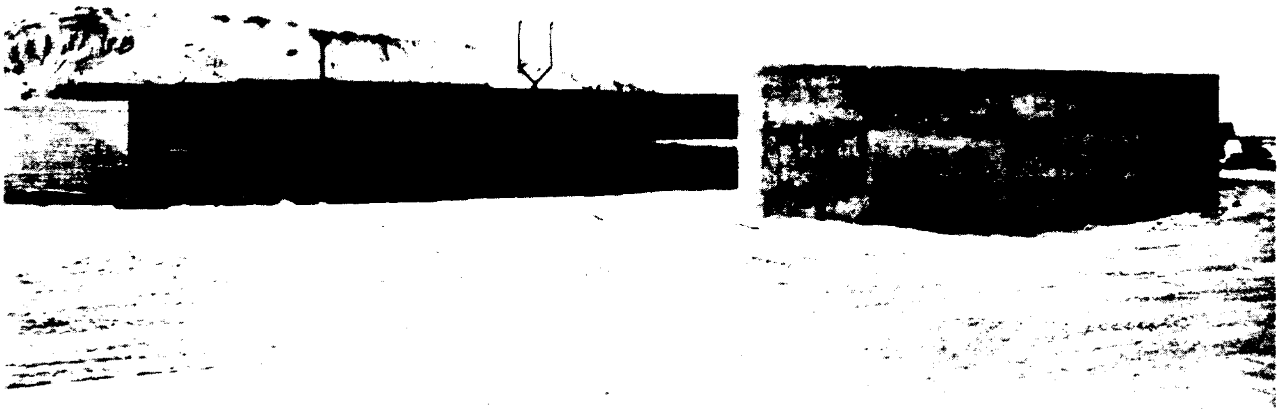
In addition to the main structure, provisions were made for make-up of coaxial cables runs to shot stations in the lagoon with a Pull Box and a Splice Pit Structure. The Splice Pit Structure was located closer to the lagoon than the Pull Box. The Pull Box had a 10-inch-thick floor slab and four 10-inch-thick walls rising 12 inches above the floor slab, and a 7/16-inch steel bolt-down cover plate and angle frame. Three 5-inch-diameter conduits ran from the Pull Box to the Splice Pit. The Splice Pit was a reinforced concrete man-hole type structure having a 5-foot-square by 6-foot high splicing chamber lined with ⅛-inch thick copper plate below a 2½-feet-square sandbagged entrance shaft 6⅓ feet high. The floor level of this structure was Elevation +5.5. Three 5-inch-diameter conduits were run from the Splice Pit toward the lagoon to the existing beach bulkhead wall opposite.

STATION:	1311
SITE:	Irene
USER:	LASL/EG&G
PURPOSE:	Detector Room
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	1-23-58/4-17-58

This station provided a room space 24 feet long and tapered in width from 10½ feet to 13 feet, 10 inches; it was housed in a new earth-barricaded reinforced concrete structure. Five 24-inch-diameter steel collimating pipes, 50 feet long, were constructed between the west wall of the station room and a retaining wall support at the end of the pipes. Center-line elevation of the pipes was at Elevation +11.0, and the top of the retaining wall and earth fill was at Elevation +17.0. Access to the station room was through a reinforced concrete tunnel section, 4 feet wide by 6½ feet high, under the barricade fill to the station south wall. The roof slab over was 14-inch-thick reinforced concrete. A continuous angle girt detail was anchored to the west wall of the station room above and below the collimator pipe openings to seat 28-inch-square by ½-inch-thick lead plates. Five detector scaffolds of wood construction were provided at the ends of the collimator pipes, each 5x2½x2 feet high. The station room contained lights on portable cords, outlet receptacles, signal cabinet, and utility and experimental power panels.

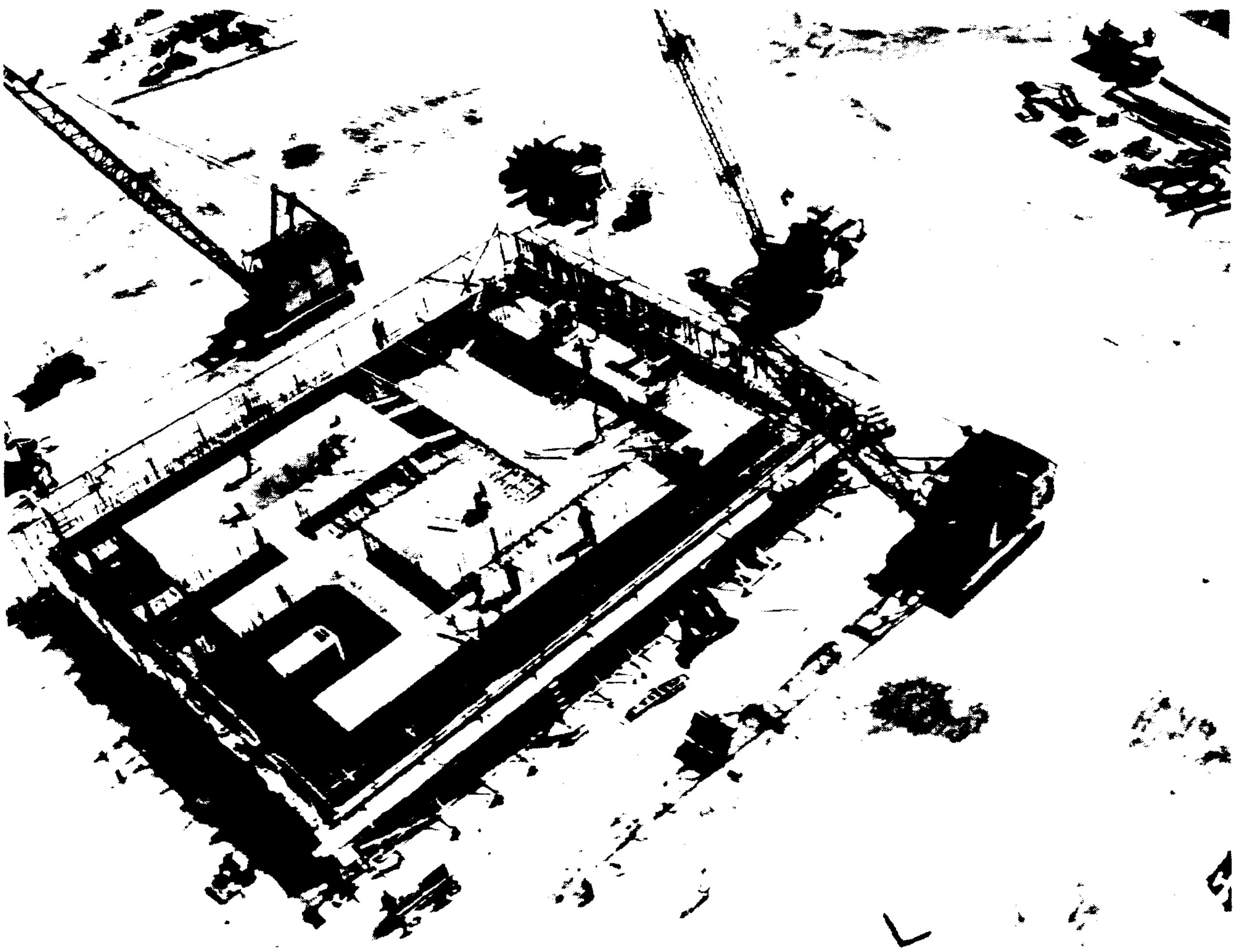
STATION:	1312
SITE:	Janet
USER:	LASL/EG&G
PURPOSE:	Recording Station
PARTICIPATION:	2, 10, 16, 25, 27, 28, 30, 37
DESIGN PSI:	67 psi
CONSTRUCTION:	9-20-57/4-25-58

Station 1312 was the largest scientific construction unit built for Operation HARDTACK. Total structural concrete poured for this structure was 3673 cubic yards. An additional 406



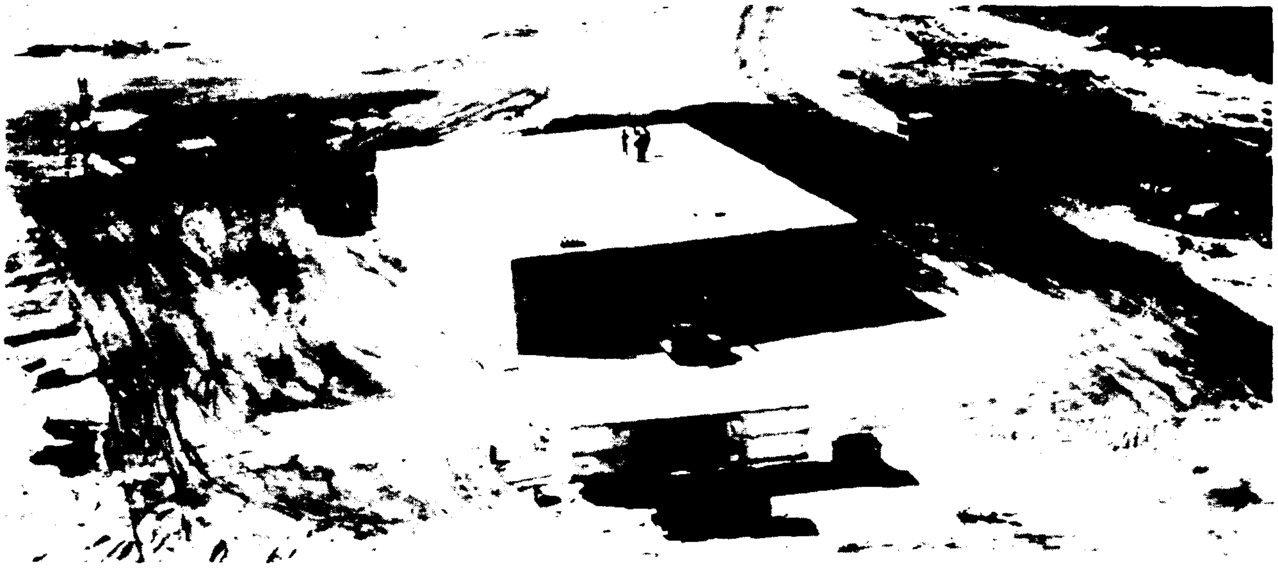
(Neg. No. W-V-257-2)

Figure No. 2-44. Station 1311 — 95% Complete.



(Neg. No. W-V-137-4)

Figure No. 2-45. Pouring Concrete Walls — Station 1312.



(Neg. No. W-882-3)

Figure No. 2-46. Station 1312 — 100% Complete.

(Neg. No. W-V-280-2)

Figure No. 2-47. Room "A" — Station 1312.

cubic yards of lean concrete was poured to replace unsuitable foundation material. The general plan of Station 1312 provided a 81x62x 16½-foot-high concrete superstructure over a 93x74x6-foot-thick foundation slab with a 44x7 x6-foot-thick slab projection along one end to encase a fuel storage tank and to provide an indestructible approach apron at the entrance to the station. The roof slab was 6 feet thick, except for an 8-foot slab over the Instrument Room. Ceiling heights were 10½ feet throughout, except for an 8½-foot ceiling height in the Instrument Room. Exterior walls were 6 feet thick, and the interior room division walls were 4, 5, and 6 feet thick.

The floor plan of this station provided five utility room spaces, long connecting passages, and an escape hatch compartment to the outside and through the roof. A Mechanical Equipment Room, 37x18 feet, contained the station power control panel, two 100-kw diesel generators, two salt water wells and pumps, an 840-gallon fresh water storage tank, dehumidification units, ductwork, air exhaust fans, lavatory and water closet, and pneumatically operated exhaust-air blast doors. The Bogue and Battery Room, 17x18 feet, contained a User-furnished Bogue unit, a battery unit, space heater, dehumidification unit, and a lead brick-filled steel baffle at the room entrance. The Detector Room, 50x8 feet, contained a space heater and dehumidification unit, four collimator slide assemblies, blast doors over collimator holes, a lead entrance door to the room, and electrical outlets. A Dark Room, 7x8 feet, contained a stainless steel sink and drain top.

STATION:	1314
SITE:	Irene
USER:	LASL/EG&G
PURPOSE:	Recording Instrument Rooms
PARTICIPATION:	21
DESIGN PSI:	70 psi
CONSTRUCTION:	3-5-58/4-17-58

Station 1314 was located in Rooms 1 and 3 of existing REDWING Station 1611. The work involved was electrical reconstruction. Utility power was supplied to the station from generators located outside and near the structure. Experimental power was provided by a User-furnished Bogue unit located in Room 3. The Bogue unit required utility and battery power. The experimental power was distributed to Stations 1311 and 1525 power boxes and to a trailer receptacle in Room 1. Terminal cabinets for a trigger system were installed in Room 1. Signal cables were brought in through existing sleeves and connections made to terminal cabinets. A User-furnished coaxial cable was brought into Room 1 and connections made by the User.

STATION:	1315
SITE:	Yvonne
USER:	LASL/EG&G
PURPOSE:	Coaxial Cable Junction Pit
PARTICIPATION:	20
DESIGN PSI:	36 psi
CONSTRUCTION:	2-7-58/4-20-58

This station was provided by rehabilitating existing REDWING Station 1314.

STATIONS:	1316.01 and 1316.02
SITE:	Yvonne
USER:	LASL
PURPOSE:	Alpha Detector Station
PARTICIPATION:	20
DESIGN PSI:	110 psi
CONSTRUCTION:	2-17-58/4-20-58

Station 1316.01 was provided by rehabilitating and modifying existing REDWING Station 1311.04. This station was a concrete structure, earth barricaded, and it contained a telephone, signal cabinet, disconnect switches, convenience outlet, and conduits through the station walls. A new entrance tunnel of wood frame construction was built for access through the barricade fill to the entrance crawl hole door. Coaxial cable supports were provided between this station and Station 20 using 4x4 wood posts with a 2x6 crossarm spaced at 10-foot intervals for five ⅞-inch copper coaxial cables. This cable run was paralleled on both sides by a barbed wire fence. Station 1316.02 was provided by rehabilitating REDWING Station 1311.03.

STATIONS:	1317.01 - .02
SITE:	Yvonne
USER:	LASL
PURPOSE:	Reinforced Concrete Baffle
PARTICIPATION:	20
DESIGN PSI:	50 psi
CONSTRUCTION:	4-4-58/4-21-58

Station 1317.01 was a 17-foot-long reinforced concrete wall, 18 inches thick and 16⅓ feet high on a foundation slab 6 feet wide and

18 inches thick. The wall section projected approximately 13 feet above grade. Two rows of 4¼-inch-diameter pipe sleeved holes were in the wall section in a pattern aligned with the work points of the Detector Room Addition at Station 1310 and Station 20 to provide lines of sight through the Station 1310 north wall collimator holes.

Station 1317.02 was a 17-foot-long reinforced concrete wall, 18 inches thick and 19 feet, 10 inches high on a foundation slab 6 feet wide and 18 inches thick. The wall section projected approximately 18 feet above grade. Two rows of four 14-inch-diameter pipe sleeves were in a pattern aligned with the work points of the Detector Room Addition of Station 1310 and the holes in the Station 1317.01 wall section and Station 20 to provide lines of sight through the Station 1310 north wall collimator holes. Four rows of angles were attached to the Station 20 side face of the wall to seat lead slab shields.

STATION:	1320
SITE:	Yvonne
USER:	LASL/SC
PURPOSE:	Antenna Station
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	4-8-58/4-10-58

User-furnished antennas were mounted on a 12-foot steel pipe mast on a concrete base on the lagoon side of Site Yvonne near Station 1310. Two pair of timing cables and an underground 2-kw, 110-v single-phase power service were run to the station.

STATION:	1330
SITE:	Elmer
USER:	LASL
PURPOSE:	Remote Measuring
PARTICIPATION:	None
DESIGN PSI:	0.75 psi
CONSTRUCTION:	2-22-58/8-16-58

This measuring station was located at the 288-foot level of the 300-foot tower, Station 91. The entire tower plan section, except at the elevator shaft, was framed and floored with steel checker plate. The station was cancelled, however, after steel erection was completed. A wood cab was to have been provided within the tower limits, but it was not constructed.

STATION:	1410
SITE:	Irene
USER:	LASL
PURPOSE:	Phonex Measurement
PARTICIPATION:	21
DESIGN PSI:	80 psi
CONSTRUCTION:	1-29-58/4-26-58

This station was situated in the room space of a 54½x22-foot reinforced concrete, earth-barricaded structure located at the Irene terminal of Vacuum Pipeline, Station 1212.02.

The space for Station 1410 was 36x16 feet with a ceiling height of 6½ feet. The exterior walls and one interior division wall separating Station 1211 were 3 feet thick. The roof and floor slabs were also 3 feet thick. Station 1410 also provided a timing signal cabinet, field telephone, light fixtures, receptacles, switch panels, control for an air exhaust fan mounted on a 14-inch-diameter pipe duct through the room ceiling and fill over. A stock wood door and a standard blast door were provided at the entrance to the room at the end of the interior passage from the outside. Power was furnished from Station 1525 to the receptacles in the interior passage.

The structure also provided one other room space for Pinex Recovery Station 1211.

STATION:	1510
SITE:	Nan
USER:	LASL/EG&G
PURPOSE:	Photo Tower Cab
PARTICIPATION:	All Bikini Events
DESIGN PSI:	None
CONSTRUCTION:	4-1-58/7-25-58

Utilizing the existing tower cab on the 300-foot tower, Station 90, this station was rehabilitated to the REDWING condition.

STATION:	1511
SITE:	Elmer
USER:	LASL/EG&G
PURPOSE:	Photo Tower Cab
PARTICIPATION:	All Eniwetok Events, Except 1, 2, 15 and 16
DESIGN PSI:	0.75 psi
CONSTRUCTION:	1-11-58/5-31-58

A cab was placed on the top of the 300-foot tower, Station 91. The original cab in stock was rejected in favor of a new steel-framed structure, 16x18x12-foot-high. The cab contained mechanically operated aluminum roll-up doors on three sides and aluminum siding on the fourth side. The roof of the structure was designed as a working level with handrails around the perimeter and was provided with an access ladder from the cab.

STATION: 1512
SITE: Alice
USER: LASL/EG&G
PURPOSE: Photo Station
PARTICIPATION: 21
DESIGN PSI: None
CONSTRUCTION: 2-13-58/4-4-58

This station was obtained by rehabilitating existing REDWING Station 1541. This facility was a two-story, heavily reinforced concrete structure. The only requirements were to re-install mechanical and electrical equipment, to renew deteriorated exterior wood construction, and to sandblast and paint steel surfaces where necessary.

STATIONS: 1513.01 - .02
SITE: Yvonne, Janet
USER: LASL/EG&G
PURPOSE: Photo Tube
PARTICIPATION: 1513.01 - 17, 20, 22, 23, 24, 29, 32, 33, 34; 1513.02 - 10, 21, 25, 27, 28, 30, 37
DESIGN PSI: None
CONSTRUCTION: Sta. 1513.01, 2-26-58/4-11-58; Sta. 1513.02, 12-24-57/5-24-58

Station 1513.01 was on the roof of existing Station 77.01, Site Yvonne, and Station 1513.02 was located on the roof of new Station 77.02, Site Janet. Each station consisted of two concrete blocks, 14 feet long, poured with roof slab of the timing station below. One block was 4x4 feet in cross section, and the other was 3x4½ feet. There were three 42-inch-square steel plates mounted on each block and conduit runs down through the blocks and roof slab. The blocks were utilized to set photographic equipment.

STATIONS: 1514.01 through 1514.04
SITE: Wilma, Mack, How, William
USER: LASL/EG&G
PURPOSE: Photo Cabs on Tower
PARTICIPATION: 1514.01 - .02, All Eniwetok Events Except 1, 2, 15, 16, and 42; 1514.03 - .04, All Bikini Events
DESIGN PSI: None
CONSTRUCTION: 12-2-57/4-20-58

The cabs on the 75-foot towers, Stations 92.01 through .04 respectively, were used for these stations. The cabs were 14 feet square and contained roll-up doors on three sides. Rehabilitation of the stations to their REDWING condition was accomplished.

STATION: 1515
SITE: Oboe
USER: LASL
PURPOSE: Pad for Photo Trailer
PARTICIPATION: 11, 12, and 13
DESIGN PSI: Not Applicable
CONSTRUCTION: 3-3-58/3-8-58

The location of this station was the top of the earth-fill over Station 2132. A User-furnished trailer was located on the stabilized fill, and an access road was provided. Power was supplied from the 10-kw generator serving Stations 2130 and 2132.

STATION: 1520
SITE: Yvonne
USER: LASL/SC
PURPOSE: Recording and Photo Station
PARTICIPATION: 1, 15, 20, 28, 33
DESIGN PSI: 16 psi
CONSTRUCTION: 12-2-57/4-20-58

This station was provided by rehabilitating and modifying existing REDWING Statior 1520. Rehabilitation included re-installing elec tric motors, sandblasting, painting, and reconditioning of the existing facility. New constructi included an air compressor and air supply lin from the Equipment Room to the Camera Roor., a User-furnished motor generator set for scientific equipment power, a new 4160-v, 208/120-v 3-phase, 60-cycle, 150-kva indoor transforme an electrical switch, and a circuit breaker.

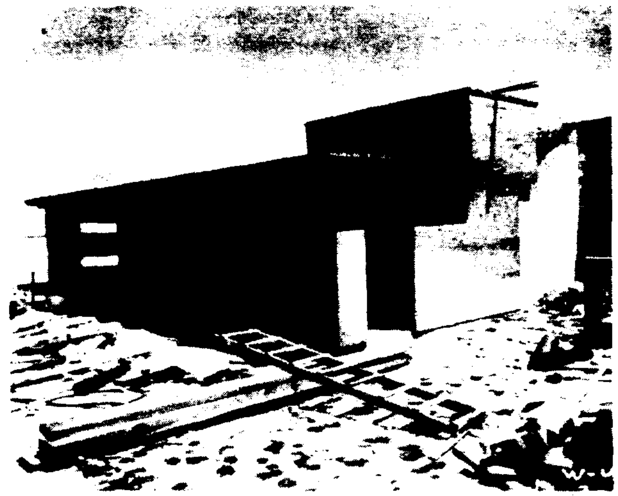
STATION: 1522
SITE: Yvonne
USER: LASL
PURPOSE: Mirror House

PARTICIPATION: 20 and 33

DESIGN PSI: 3 psi

CONSTRUCTION: 2-19-58/4-20-58

To obtain this station, a 14x37-foot wood-framed room was added to Station 1520. The structure was built over an extension of an existing concrete floor slab and foundation. Height of the building was 8 feet with a 7-foot-wide by 13½-foot-long area at one side rising 12 feet. The structure was of wood stud wall construction with plywood sheathing and flat roof joist framing with plywood sheathing and composition roofing. Two structural steel mirror frame assemblies were provided inside the structure.



(Neg. No. W-V-240-6)

Figure No. 2-48. Station 1522 40% Complete.

STATIONS: 1523.01 through 1523.04

SITE: Yvonne

USER: LASL

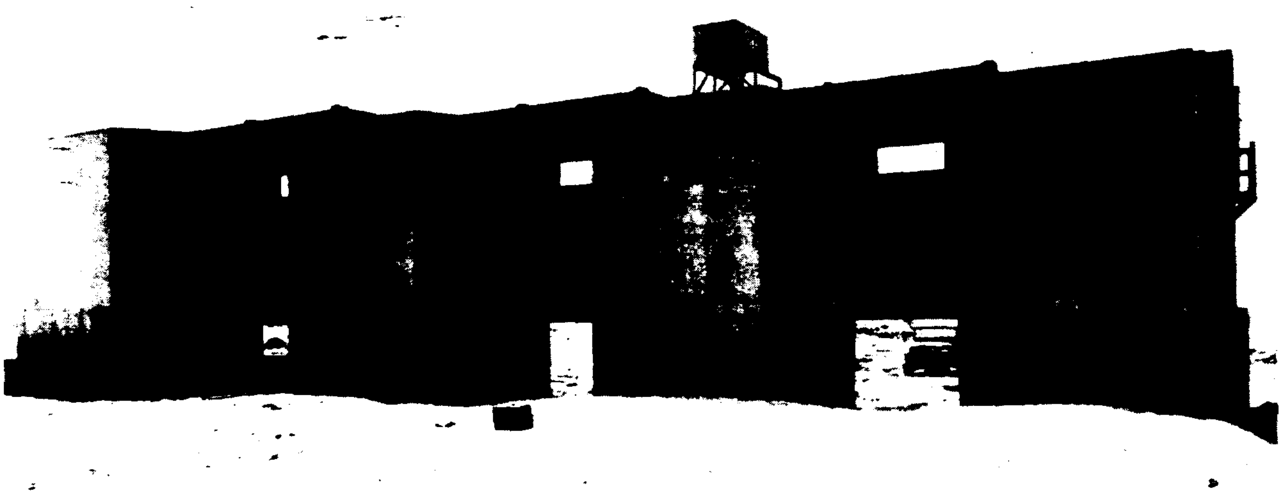
PURPOSE: Mirror Towers and Shelters

PARTICIPATION: 20

DESIGN PSI: None

CONSTRUCTION: 2-15-58/4-20-58

Four identical steel frame towers with wood frame enclosing shelters were provided for Stations 1523.01 through 1523.04. Tower footings were 10-foot, 2-inch-square by 3-foot-thick reinforced concrete. Tower framing consisted of four 6-inch-diameter steel pipe columns on 9-foot centers at their base Elevation +6.5, rising to support a 5-foot-square steel platform frame and grating at Elevation +26.0. Two panels of angle X-bracing with one intermediate horizontal member were provided on each of the four sides of the tower. Each tower frame and footing was housed in a 13⅓-foot-square wood frame shelter built over a continuous foundation wall and footing and rising to a lower level plate line at Elevation+31.0 support of a flat slope roof. The shelter framing was of wood stud wall construction with plywood sheathing and composition roofing. Each shelter had a wood frame and plywood platform interior platform at Elevation +24.0. Access to the tower base and upper level platform was provided by doorway openings, vertical wood ladder to the upper level, and steel rung ladder to the base level. The four stations were grouped in a close staggered spacing pattern. The station shelter south walls away from Station 20 were extended to meet the



(Neg. No. W-V-258-10)

Figure No. 2-49. 1523 Stations — 95% Complete.

adjacent wall of the shelter opposite. The interconnecting wall was framed of horizontal wood girts with plywood sheathing between Elevation +16.0 and the roof level of the shelters. A level pattern of 5-foot-wide by 2-foot-high openings were provided in the south shelter walls and interconnecting walls facing Station 1522 and centered at Elevation +28.0. The south surfaces of this entire structure were painted black. Each shelter structure was furnished electric power from an island transformer station, telephone, field phone, signal cabinet, lighting, and convenient outlet receptacles.

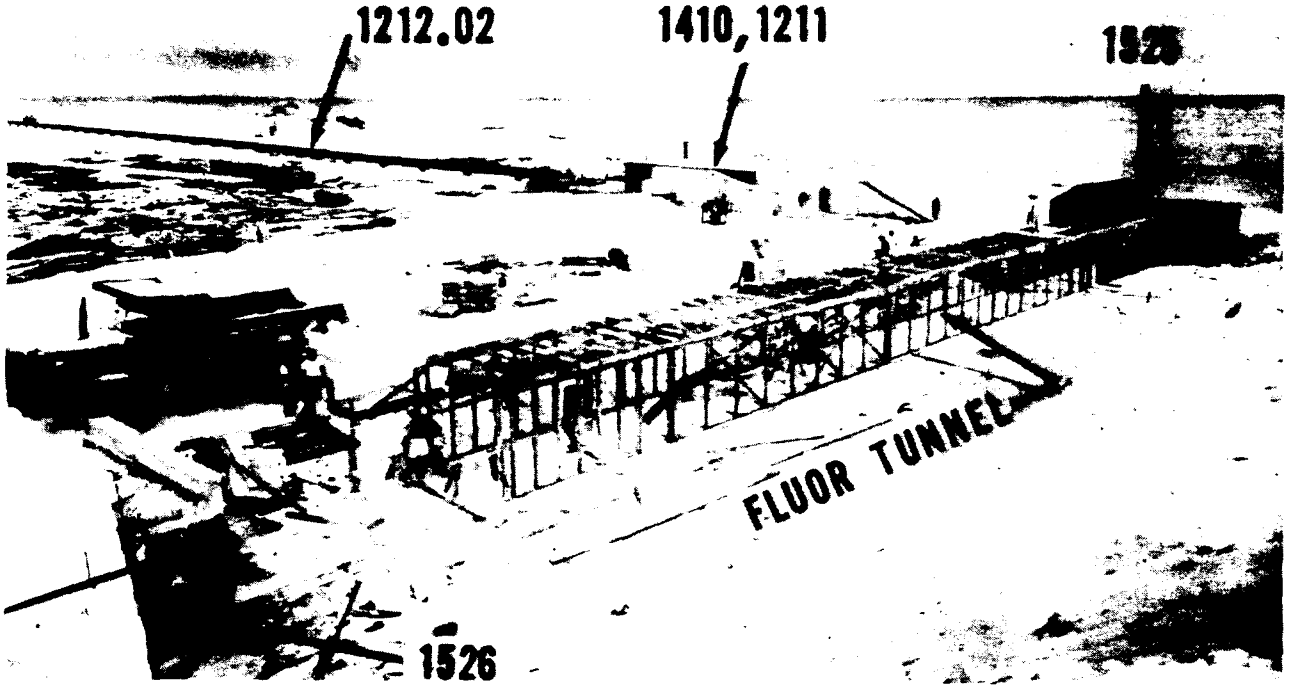
STATION:	1524
SITE:	Irene
USER:	LASL
PURPOSE:	Camera Stand Station
PARTICIPATION:	21
DESIGN PSI:	70 psi
CONSTRUCTION:	1-8-58/4-25-58

Station 1524 occupied Room 4 of REDWING Station 1611. The room was 24x15 feet in plan with a 9-foot ceiling height. The floor slab was 3⅔ feet thick, walls were 4 feet thick, and the roof slab was 3½ feet thick, all of heavily re-inforced concrete construction. The room was copper screened on walls and ceiling; it contained two electric heaters, a dehumidifier unit, light fixtures, convenience outlets, and a camera stand. The camera stand was a steel frame, 24 feet long by 2 feet wide by 2 feet high, with a 24x½-inch aluminum plate cover 24 feet long. Five existing buried 24-inch-ID steel pipes extended from a port opening in the west wall of the station through an existing retaining wall. The overall length of the pipes was 25 feet. The existing fill over the pipe area extended from a 10-foot-deep fill, top of fill Elevation +26.5, to the top of the retaining wall at Elevation +18.0, This fill area was raised over the top of the wall level to barricade Station 1526 to Elevation +23. Wing walls of the existing retaining wall were removed to provide a straight wall section 50 feet long. This wall section then provided the east wall of new Station 1526 and a portion of the east wall of new Station 1311. At the west end of the five 24-inch pipe sections, on the east wall of Station 1526, a heavy pneumatically operated steel guillotine door was installed and connected to the signal system for closing during use. A 4-inch helium exhaust pipe extended from the camera stand through the most southerly 24-inch pipe into Station 1526 and up through the station roof.

STATION:	1525
SITE:	Irene
USER:	LASL
PURPOSE:	Fluor Station and Mirror Tunnel
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	1-22-58/4-15-58

This station consisted of a re-inforced concrete Fluor Station with a wood frame light-tight tunnel connecting to Station 1526. The Fluor structure only was earth-barricaded to a depth of 5 feet over the roof slab. A single room space, 13¼x11¼ feet, with a 6½-foot ceiling height was provided by the Fluor structure. The floor slab was 1½ feet thick; the front wall facing Station 21 was 5 feet thick; other walls and the roof slab were 2 feet thick. A re-inforced concrete breast wall, 37¼ feet long, was shaped around both sides of the front wall, rising to 3 feet above the roof slab. Fill against the front face of the breast wall was shaped to provide a V-shaped cut opening to a 36-inch-diameter pipe sleeve in the Fluor structure front wall on a line-of-sight to Station 21. A 6-foot-wide by 5½-foot-high tunnel section 10 feet long with 12-inch thick re-inforced concrete walls, floor, and roof slab extended from the Fluor structure south wall and connected to the end of the wood frame tunnel to Station 1526. The tunnel was 152 feet long, of wood stud and joist frame construction over a combined floor and footing concrete slab, and contained plywood sheathing over wall and roof framing. Wood frame tunnel sections were 32½ feet long by 7 feet clear inside width, 50 feet long by 8 feet clear, 50 feet long by 9 feet clear, and 19½ by 10 feet clear. The average clear ceiling height of the flat slope roof joists was 7¾ feet. Four light-tight louvered 3x7-foot access doors and twenty 3x¾x5½-foot light-tight louvered vent wall panels were installed in the length of the wood framed tunnel. The structure contained utility and experimental electric power panels, signal panel, field telephone, lights and convenience outlets.

STATION:	1526
SITE:	Irene
USER:	LASL
PURPOSE:	Mirror House
PARTICIPATION:	21
DESIGN PSI:	None
CONSTRUCTION:	1-8-58/4-16-58



(Neg. No. W-V-239-3)

Figure No. 2-50. Fluor Tunnel Connecting Stations 1525 and 1526 — 65% Complete.

This station utilized a room space 25 feet long by 15 feet wide, with a 9¾-foot ceiling height with an extended area 17½ feet long by 12 feet wide. The long east side wall of the station, except for the north 5½-foot length, was an existing retaining wall portion of Station 1524. The west side wall and the 5½-foot-long east wall were 12 inches thick over a continuous spread footing. The roof slab was keyed and dowelled into the existing retaining wall, 14 inches thick under a 5-foot barricade fill over the larger room space and 12 inches thick over the smaller extended room area. The east side retaining wall surface contained the hydraulically operated guillotine door assembly portion of Station 1524. Access to the station was provided through the wood frame tunnel portion of Station 1525. The station contained portable lights, convenience outlets, power panel, field phone, and portable power and field phone cable to Station 1525 through the wood from the tunnel to the Fluor structure.

STATIONS:	1527 and 1611
SITE:	Yvonne
USER:	LASL
PURPOSE:	Fluor Station 1527 and Detector Station 1611
PARTICIPATION:	20
DESIGN PSI:	None
CONSTRUCTION:	Sta. 1527, 2-27-58/4-20-58 Sta. 1611, 2-15-58/4-28-58

Detector Station 1611 consisted of a reinforced concrete structure, 21 feet long, 7¼ feet wide by 7 feet high, divided into four cells. The work point of each cell was 100 feet from the work point of Station 20 on radial lines. The length of this structure was along the arc of the radial lines of the four collimator pipelines of Station 1527, diverging from a radial center at Station 20. Each cell contained a copper box. 1½x1x1-5/12 feet high, lead and paraffin shielding, micarta detail, and precast wall panels on the Station 20 side of the structure. Extending away from Station 20 and beginning at each cell of the concrete structure were four 48-inch-diameter corrugated metal pipes under 13 feet of fill, diverging in radial lines to terminate at the four Mirror Tower Stations 1523.01 through 1523.04. Shaft openings over the pipe sections were filled with sandbags during the test operation.

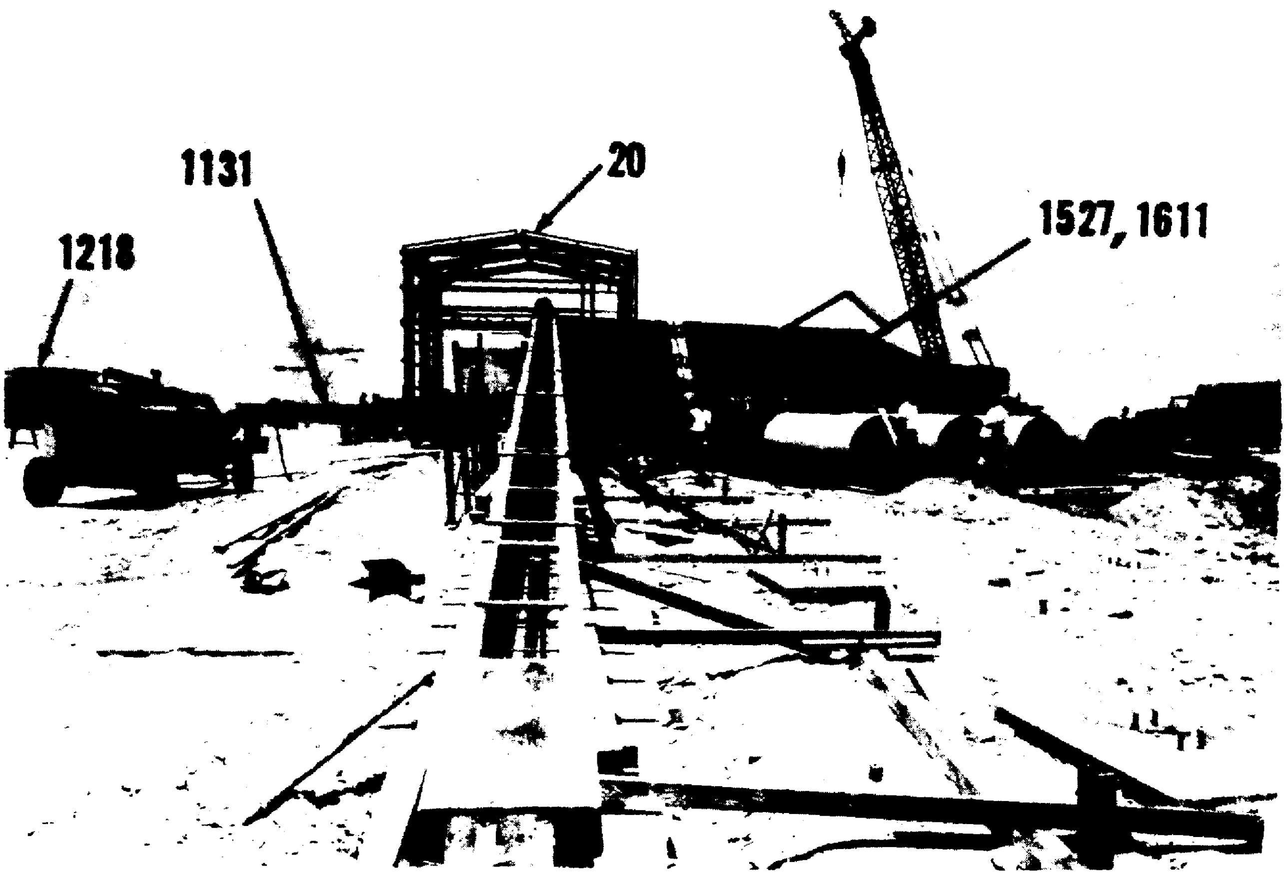
Beginning at the north wall of the Detector Station and on converging alignment toward the Station 20 work point were four T-shaped steel plate duct sections 14¼ feet long, terminating at a concrete retaining wall and separated from a second and nearly parallel retaining wall by approximately three feet. The duct sections were bedded and covered in a sand-filled wooden crib structure. The crib consisted of five longitudinal continuous spread footings and vertical planked division walls tied together with ribbons, planked over, and covered with earth fill. Beginning at the second retaining wall and on radial alignment with the T-duct and the work point of Station 20, four runs of pipeline were constructed. The pipelines terminated at a concrete retaining wall at the south side of Station 20. They were supported on a steel post and beam with upright saddle detail supported on three concrete spread footings at three of six support frames. At three more closely spaced pipe supports the lines were suspended from a steel beam over two steel posts by adjustable tie rods and adjustable horizontal tie rods. These lines were also covered by earth-fill.

STATIONS:	1528.01 - .02
SITE:	Yvonne
USER:	LASL
PURPOSE:	Fluor Stations
PARTICIPATION:	20
DESIGN PSI:	None

CONSTRUCTION: 3-22-58/4-10-58

Station 1528.01 was in two parts. First, a wood frame platform tower, 5-foot-square in plan, 22 feet high, was located at the north end of Site Yvonne near the high tide line. Tower platform was at Elevation +27.21. The tower was supported on an 8-foot-square by 16-inch-thick re-inforced concrete spread footing. The second part of this station was a wood-frame baffle structure located approximately 500 feet southeast of the platform structure. The frame closely resembled a sign board and consisted of two bolted, laminated 4x12 columns, the lower ends buried 10 feet to support a 2x12 frame sheathed with ⅜-inch plywood on one side between columns. The sheathed area was 12 feet wide by 12 feet high with a 5-foot-wide by 2-foot-clear opening at its geometric center. Top level of this frame was at Elevation +34.0. The structure was painted two coats of blackboard slating paint.

Station 1528.02 was also in two parts. First, the wood-frame platform was only 2½ feet high above the top of a spread foundation slab on top of a deep coaxial cable fill close to Station 20. Top of platform was at Elevation +27.17.



(Neg. No. W-V-240-11)

Figure No. 2-51. Stations 1527 and 1611 — 40% Complete.

The baffle structure was located approximately 500 feet southeast of the platform and of construction identical to the baffle frame for Station 1528.01.

STATION:	1610
SITE:	Yvonne
USER:	LASL/SC
PURPOSE:	Instrument Bunker
PARTICIPATION:	1, 15, 20
DESIGN PSI:	70 psi
CONSTRUCTION:	2-10-58/4-20-58

Station 1610 was provided by modifying and adding to REDWING Station 3020. This afforded a clear room space in the former station enclosed with copper screening around the wall perimeter, two User-furnished motor generator sets, portable outlet receptacles, lights, and signal panel. Outside the former station wall to the south, a re-inforced concrete tunnel maze terminated at an entrance blast door. Wing walls retained earth barricade fill areas surrounding the tunnel. Two 24-inch-OD steel pipes were provided through the station south end wall under the barricade fill to provide ventilation air from an air-conditioning unit situated in a new Mechanical Equipment Room 30 feet from the station. The Mechanical Equipment Room was of wood frame construction, 15-foot-square in plan, 10 feet high, with a 4-inch concrete floor slab, exterior plywood sheathing, and flat roof with built-up composition roofing. A concrete slab area, fenced with wood posts and rails, adjoined one end of the Mechanical Equipment Room. A Trigger House of wood frame construction, 4-foot-square in plan by 4½ feet high was also provided and was situated 10 feet off the line of sight between Stations 1310 and 20. A 4-inch conduit run extended from Station 1610 to the Trigger House for coaxial cable.

Power was obtained from the 4160-v, 3-phase, 60-cycle island power distribution system by tapping the 3/C#25-kv cable which passed this location.

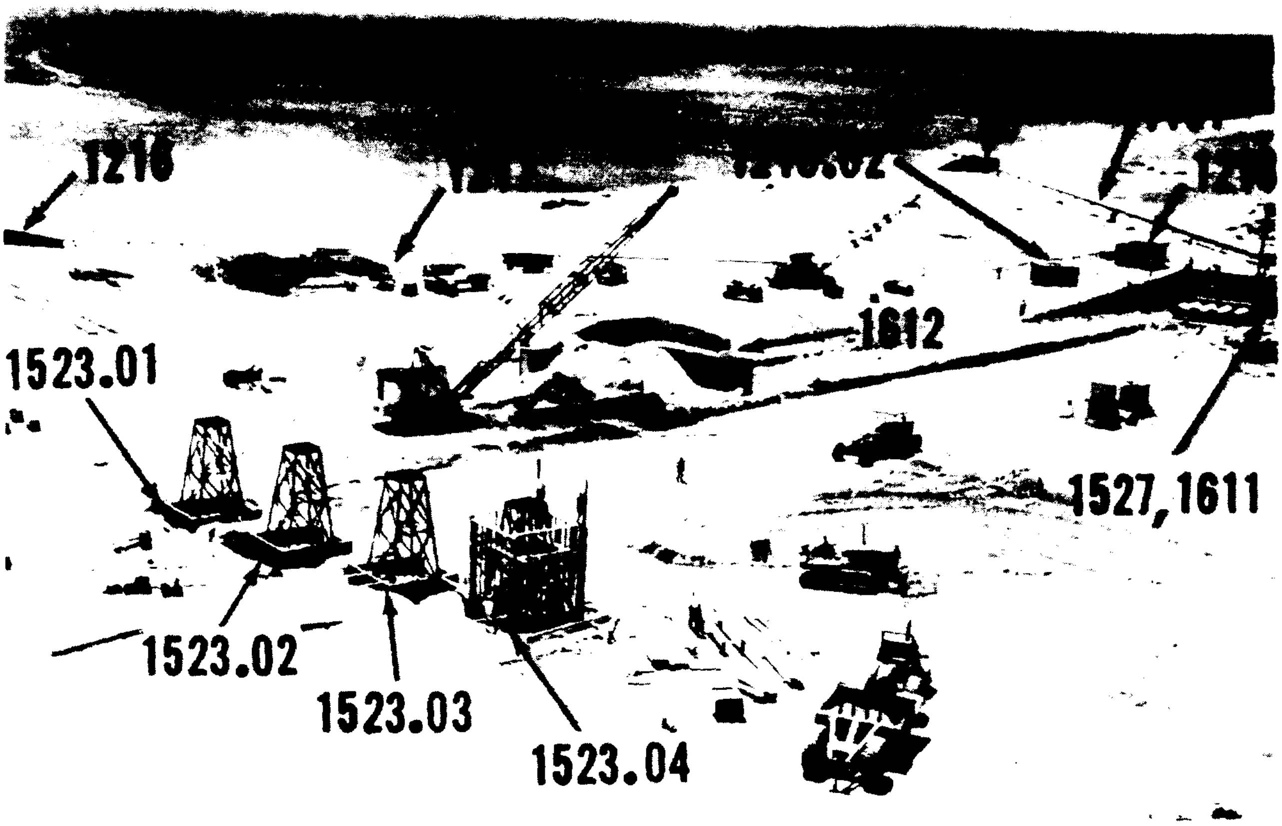
The Mechanical Equipment Building contained the following electrical equipment: Signal Terminal Cabinet, Telephone Terminal Cabinet Panel "PA" and Panel "LA." Panel "PB" was mounted outside on the South Wall.

The main station structure consisting of the corridor and the Instrumentation Room contained the following: The Instrumentation Room had two 20-kw motor generator sets, User-furnished. The entire room was copper screen shielded with special enclosure about the motors of the motor generator sets. This room was the terminus of the fourteen ⅞-inch aluminum-shielded coaxial cables and for a field telephone circuit. The corridor contained the magnetic starter for the motor generator sets, the portable lighting equipment, and the service power receptacle. A common battery-type island telephone was wall-mounted in the corridor.

STATION:	1612
SITE:	Yvonne
USER:	LASL
PURPOSE:	Detector Station and Pipelines
PARTICIPATION:	20
DESIGN PSI:	None
CONSTRUCTION:	2-15-58/4-23-58

A re-inforced concrete detector structure and two segments of six radial pipelines comprised this station. The pipelines diverged from a radial center at the Station 20 work point and terminated at the detector structure wall. The lines of the first segment terminated at a retaining wall approximately 242 feet from the Detector Station. Thence, beginning at a retaining wall separated by 4 to 5 feet from the first wall, a segment of six radial pipelines extended to a retaining wall 17½ feet distant from the work point of Station 20. The first segment of pipe was supported on a vertical steel plate and post detail at intervals throughout its length. One edge of the plate was anchored to a retaining wall also on a radial alignment and adjacent to the lagoon-side pipe; the other edge was supported by a steel post on a concrete footing pad. The second segment of the pipelines was supported on a steel upright extending from a transverse steel beam and post frame detail supported on concrete spread footings. Spacing of the support frames was 15 feet. The pipeline segments were buried in fill throughout their lengths.

The Detector Station provided a room space, 29⅔ feet long, 3 feet wide, and a 6½-foot ceiling height. The foundation slab was 2 feet thick, the north wall toward Station 20 was 4 feet thick, other walls were 1½ feet thick, and the roof slab was 2 feet thick. The structure had an 8½-foot-deep earth fill barricade over the roof. Access to the Detector Room was through a wood frame tunnel over a concrete floor having plywood sheathing over wall studs and roof joists. The six pipelines terminated 12 inches inside the north wall face. The wall section was blocked out to form a 2-1/6-foot-square opening, 3 feet long at the end of each pipeline, and the perimeter surrounding the walls of the blockout section were lined with 1-inch-thick micarta. Three rows of convex-shaped lead brick were placed to fill the opening against the pipes.



(Neg. No. W-869-11)

Figure No. 2-52. Scientific Stations — North End of Yvonne.

Cable boxes of sheet copper detail fabrication were provided in each opening behind the lead brick. Portable lights, telephone, field phone, and a signal cabinet were at the end of the tunnel. A telephone cabinet was provided in the Detector Room. Power was furnished from the island Transformer Station "A."

STATION: 1616
SITE: Yvonne
USER: LASL
PURPOSE: Plywood Baffle
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 3-22-58/4-20-58

Station 1616 was a wood frame baffle structure, 37⅔ feet wide by 19-1/6 feet high. The frame was supported on two laminated wood posts supporting 2x12 girts stiffened with 2x8's to channel shape the girt section, vertical 2x4 flat nailer strips between girts, and with ⅜-inch plywood sheathing. A pattern of openings in the plywood was made for lines of sight from Station 1522 through Stations 1616 and 1617 to Stations 1523.01 through 1523.04 and adjacent marker lights. Top of wall was at Elevation +27.50; bottom of wall was at Elevation +8.28 and grade Elevation at +9.0±.

STATION: 1617
SITE: Yvonne
USER: LASL
PURPOSE: Plywood Baffle
PARTICIPATION: 20
DESIGN PSI: None
CONSTRUCTION: 3-22-58/4-20-58

Station 1617 was a wood frame baffle structure 60¼ feet long by 4 feet high supported on three 12-inch-diameter wood posts. The wall frame consisted of two rows of three 2x8 channel-shaped girts with 2x4 flat vertical nailers between and ⅜-inch plywood solid sheathing over. Top of wall was at Elevation +26.0, grade Elevation was at +10±. The station work point was aligned with Baffle Station 1616 and Station 1522.

STATION: 1710
SITE: Bruce
USER: LASL
PURPOSE: Electro-magnetic Measurements
PARTICIPATION: All Events, Except 1 and 15
DESIGN PSI: None
CONSTRUCTION: 3-8-58/4-19-58

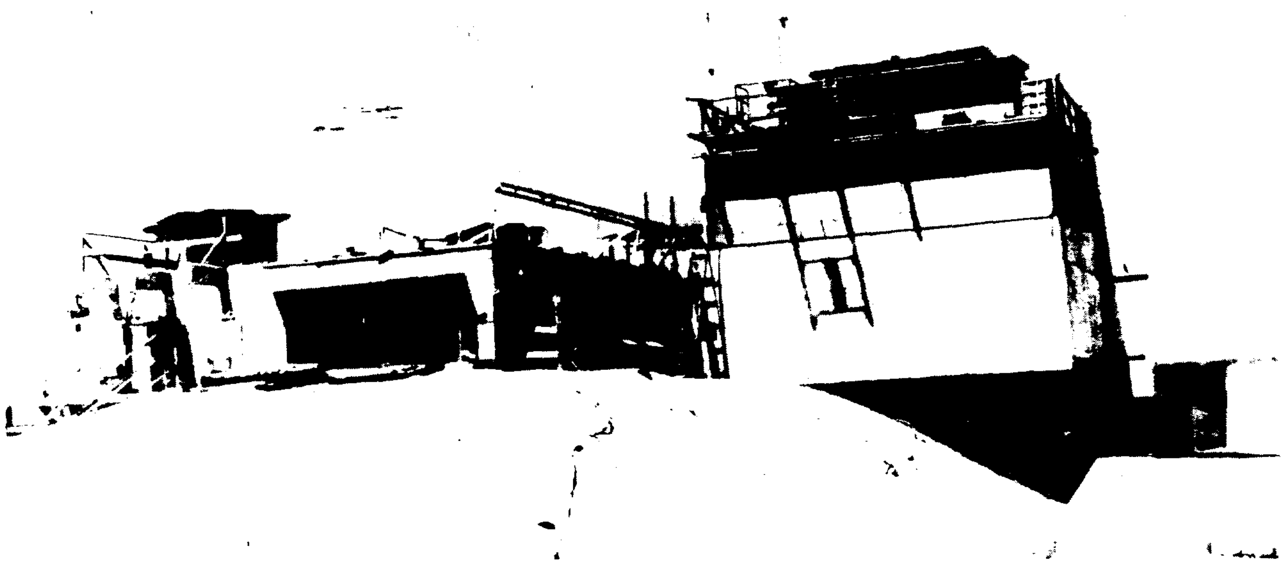
This station was provided by rehabilitating and reconstructing REDWING Station 1630. Additional facilities included telephone service to the Site Elmer switchboard.

STATION: 1711
SITE: George
USER: LASL
PURPOSE: Generator Shed and Trailer
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-1-58/4-10-58

Station 1711 consisted of an 8-foot-square wood-frame Generator Shed and a User-furnished trailer situated on a 50x100-foot cleared area 50 feet south of REDWING Station 76 at the south end of Site George. The Generator Shed was built over a 5-inch-thick concrete floor slab, 2x4 wall and roof framing with 3/8-inch plywood sheathing over. The shed housed a User-furnished motor generator set, starter, and regulator on 3-phase 220-v power from Station 1030 to provide 3-phase and single-phase trailer and instrument power at outside receptacles. Signal and field phone circuits were provided in the shed. This station was moved to Johnston Island.

STATION: 1810
SITE: George
USER: NRL/LASL
PURPOSE: Recording Shelter, Thermal and Spectroscopic Measurements
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 12-30-57/4-10-58

To provide this station, REDWING Station 1830 was rehabilitated, modified, and added to. Rehabilitation consisted of installing and replacing miscellaneous mechanical and electrical equipment. Modifications and additions to the existing station consisted principally of providing an air-conditioning system of larger capacity. The new system was improvised by using components from Jobsite stock and existing stations not planned for HARDTACK participation. The addition to the station was a wood and steel frame building, 18½ feet wide by 60 feet long and 9 feet high, situated between and framed off the walls of Station 1030 and



(Neg. No. W-V-268-5)

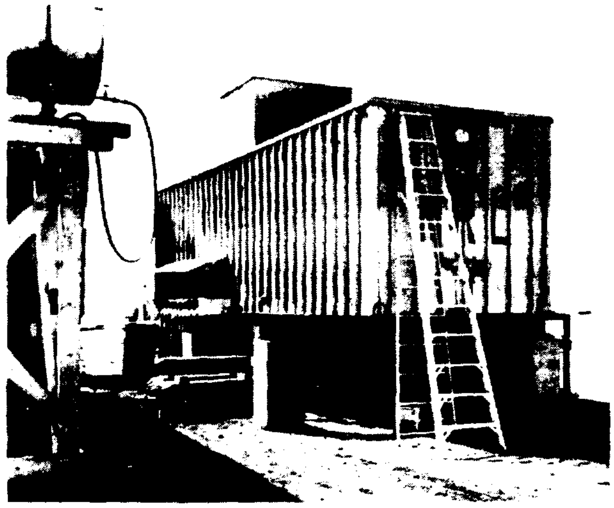
Figure No. 2-53. Rear View of Stations 1030 (Right) and 1810 — Site George.

the existing concrete wall of Station 1810. The addition was built over a filled area extending from the ocean side wall lines of the existing stations and between the stations to a top of slope eight feet beyond the lagoon end of the new building frame. The top of fill area spread from 18½ feet wide between buildings to 28 feet beyond the lagoon wall line of Station 1030. The fill was 12 feet deep, bulkheaded at the ocean wall line of existing stations by a 20-inch-thick reinforced concrete wall and sloped down to grade on the ocean sides. The frame building floor was a 5-inch-thick concrete slab on ground. Wall framing was 2x4 studs with plywood sheathing. The roof frame provided a 55-foot-long by 6½-foot-clear hatch opening with removable wood frame panels surrounded by solid roof deck areas. The lagoon end-wall of the frame had a 15⅓-foot-wide by 3-foot-wide wood shutter opening out and hinged at the head line. Access to the frame building was by wood stairs up the slope of the fill in front of Station 1030. Twelve flanged 16-inch-diameter pipe spools were installed in the Station 1810 concrete wall along the length of the new frame building.

General descriptions of miscellaneous general construction and mechanical and electrical installations for this total station development are too extensive to describe here in further detail. This total station construction development was completed, but occupancy of the station was abandoned when the events were moved from Site How to Johnston Island.

STATION:	1811
SITE:	How
USER:	NRL/LASL
PURPOSE:	Thermal Radiation Measurements
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	1-27-58/4-5-58

Development of this station required a 100x70-foot stabilized area providing a 20x18-foot by 8-inch-thick concrete slab, a concrete foundation wall and footing 33 feet long, three pedestal footings with steel cross beams and other miscellaneous steel details to support a NRL trailer off the ground, and a tent slab. Two User-furnished 20-kw motor generator sets were installed on the 8-inch slab adjacent to a signal cabinet and an island power supply panel board. Electric service was provided for the tent and the island telephone circuit to the supported trailer and one additional parked trailer. A 2400/208/120-v, 75-kva transformer was provided at a barbed wire fence enclosure adjacent to the area. This site development was completed, but with the relocation of the ABMA program, this facility was cancelled.



(Neg. No. W-877-4)

Figure No. 2-54. Station 1811 — Site How 90% Complete.

STATION:	1812
SITE:	Bravo
USER:	NRL/LASL
PURPOSE:	Aiming Light
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	3-18-58/3-28-58

Located at the north end of Site Bravo, this station consisted of an 80-foot-long guyed pole buried 8 feet at its base and rising to Elevation +80.0. Two User-furnished 500-watt searchlights were mounted on a cross-arm at the top of the pole. Power was supplied from a 2-kw gasoline-driven generator. With the relocation of the ABMA program on How Island this station was not used after completion of construction.

STATION:	2130
SITE:	Oboe
USER:	UCRL
PURPOSE:	Rocket Launching Pad
PARTICIPATION:	4 and 5
DESIGN PSI:	No overpressure
CONSTRUCTION:	2-10-58/2-27-58

The facilities of this station consisted of a concrete launcher pad, tent, and User trailer.

The pad was 22x92 feet by 6 inches thick except for a 4½-foot-wide portion 1 foot thick. Two 92-foot-long unistruts were placed on the thickened portion. A 10-kw, 3-phase generator supplied power to the 16x32-foot tent and adjacent launcher pad.

STATIONS:	2131.01 through .05
SITE:	2131.01, Mary; .02, Sally; .03, Wilma; .04 and .05, Yvonne
USER:	UCRL
PURPOSE:	Rocket Launchers
PARTICIPATION:	Sta. 2131.01, .02, .03, .05, Events 21 and 28; Sta. 2131.04, Event 20
DESIGN PSI:	No overpressure
CONSTRUCTION:	1-28-58/4-20-58

Each station consisted of a concrete slab, and Stations 2131.01 through .03 also utilized a 16x32-foot tent. Two types of slabs were designed: one 10 feet square, 6 inches thick with a 3½-foot-wide portion thickened to 1 foot; the other 6 feet square, 6 inches thick. Both types contained two unistruts across the slab. Station 2131.01 utilized six 10-foot slabs and one 6-foot slab. Power was furnished to the tent and slab area by a 2-kw generator. Stations 2131.02 and .03 utilized nine 10-foot slabs and one 6-foot slab. Power was supplied by a 2-kw generator for Station 2131.02 and a 5-kw generator for Station 2131.03. Station 2131.04 utilized two 10-foot slabs and one 6-foot slab, and Station 2131.05 utilized eight 10-foot slabs and one 6-foot slab. Power for both stations was provided from the scientific line serving other stations on the site.

STATION:	2132
SITE:	Oboe
USER:	UCRL
PURPOSE:	Bunker (Programmer)
PARTICIPATION:	4 and 5
DESIGN PSI:	Rehabilitation of Existing Station
CONSTRUCTION:	1-7-58/3-8-58

Existing REDWING Station 191.01 was converted for use as Station 2132. The 12x25-foot earth-covered concrete building was rehabilitated and provided with power from a 10-kw generator serving Station 2130 as well. Station 1515 was located on top of the earth-fill.

STATIONS:	2150.01 through .04
SITE:	Charlie
USER:	UCRL
PURPOSE:	Threshold Detectors
PARTICIPATION:	3
DESIGN PSI:	Not designed for overpressure
CONSTRUCTION:	3-31-58/6-23-58

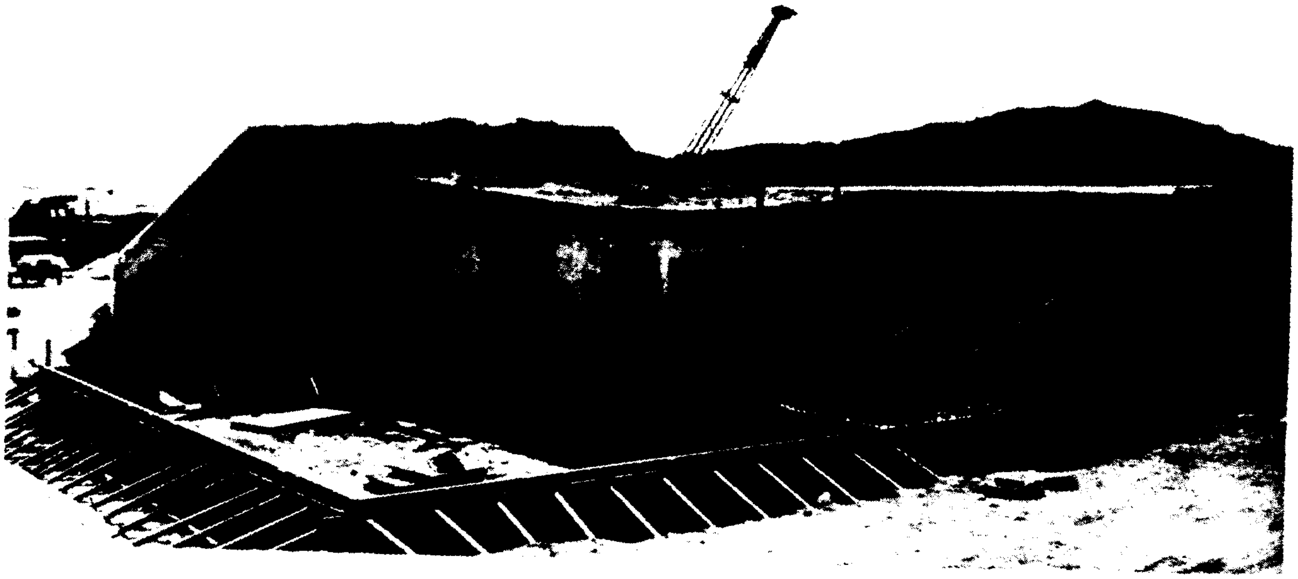
For each of these stations a pair of Navy cubes were strap-welded together to form a float 10x7 feet. A 2-foot-high, 2-foot-square angle frame platform was placed on the center of each float and contained clamps on top to fasten a 1-inch steel cable. The floats were anchored by the use of a hand-winch and anchor into the wind by a pair of anchors splayed on the leeward side. A 1-inch steel cable extended from the 2-foot platform to a steel rail driven into the coral in about 11 feet of water. One rail was provided for each pair of stations.

STATIONS:	2151.01 through .03
SITE:	Fox
USER:	UCRL
PURPOSE:	Threshold Detectors
PARTICIPATION:	8 and 9
DESIGN PSI:	Not designed for overpressure
CONSTRUCTION:	3-11-58/6-10-58

Each station consisted of a steel rail driven into the coral at the −5.0 Elevation. The top of the rails was at Elevation+6.0. A 1-inch cable was fastened to the pile and extended to Stations 2410.01, .02, and .03 respectively.

STATION:	2200
SITE:	Sugar
USER:	UCRL
PURPOSE:	Recording Station and Generator Room
PARTICIPATION:	All Bikini Events
DESIGN PSI:	95 psi
CONSTRUCTION:	11-14-57/8-1-58

Existing during Operation REDWING, this station was modified for Operation HARDTACK. The existing earth-covered building was of re-inforced concrete 43 feet square, 17 feet high with walls 3½ feet thick and slabs 4 feet thick. This building was divided into three equal-sized rooms: A, B, and C. The rooms were con-



(Neg. No. W-122-4)

Figure No. 2-55. Addition to Station 2200 — 15% Complete.

(Neg. No. W-V-212-10)

Figure No. 2-56. Generator Rooms "E" and "F" — Station 2200 60% Complete.

nected by a common corridor at one end which led to an L-shaped tunnel leading out of the fill.

Room D was added to the structure. It was 26 feet square by 17 feet high with 3½-foot-thick walls and 4-foot-thick slabs. This room supported the 150-foot tower, Station 2250. Although the new room was in contact with the existing structure, new walls were placed to reduce vibration in the room, to isolate the heavy reactions from the tower to a single structure, and to avoid excessive breaking of existing concrete to establish continuity. An opening was made in the existing corridor wall to place a lead door for a shielded entry. The earth-fill over the station was extended to a 15-foot depth for shielding purposes.

Rooms E and F of the Generator Station Addition were located adjacent to Room D and parallel to the tunnel entry. The Generator Station Addition was a structure, 30x54x18 feet high, divided into two rooms with outside entry into Room F, and entry from Room F to the existing tunnel corridor utilizing a 5-foot corridor with blast door. An opening in the existing wall was provided for the blast door. The roof and floor slabs were 4 feet thick, and the walls were 3½ feet thick, except for the exposed 54-foot wall which was 4½ feet thick. This wall was heavier because of the numerous exhaust and intake openings required for generator cooling. Room E contained two 2½-foot-square openings with blast doors for air intake and exhaust for each of three generators. Room F contained two 3½-foot-square openings with blast doors for air intake and exhaust for each of the two generators. The generators were mounted on raised foundations 6 inches high.

Retaining walls were located on each end of the Generator Station to provided ventilation for the generators and for entry. Another retaining wall was located at the tunnel end.

Room D was air-conditioned utilizing the main equipment in the existing building with one additional compressor and condenser required. The two dehumidification units required in Room D were also provided. Two new salt-

(Neg. No. W-V-263-5)

Figure No. 2-57. Interior of Generator Room "F" — Station 2200.

water pumps furnished water to the system from a new 16-inch well reservoir filled from the existing Navy cube intake structure on the shore.

The generators in the Generator Station were air-cooled, and the radiators were ducted to the 2½-foot or 3½-foot-square exhaust openings. The fumes were exhausted through piping to flapper gates located just above the fill over the building.

The generator exhaust and intake blast doors were pneumatically operated from two signal activated solenoid controls located in Room E. A control was utilized for all the vent doors in each room. A manual by-pass system was included. A coaxial cable air dryer was installed in existing Room A and piped into the existing manifold in Room B.

The electrical facilities were rehabilitated to the "as-built" condition, with several changes and additions. Two 35-kw and one 25-kw generators were installed in Room E to provide instrument power, and two 100-kw generators were installed in Room F for utility power. The two utility generators were connected through disconnect switches to a common bus to allow parallel operation. Each of the instrument generators were on individual buses. The distribution panels feeding the instrument, control, and lighting panels were connected by three double-throw disconnect switches to the generator buses. By combination of switch positions, any generator could be selected as the power source.

New circuit-breaker distribution panels, one for control power and one for instrument power, were added in Rooms A, B, and C. Two instrument and one control power panel as well as normal lighting and convenience outlets were installed in the new Optical Room D. Common telephone, field telephone, and intercom cables were installed from within the station to the trailer parking area. New power outlets were installed for additional trailers.

STATION:	2210
SITE:	Tare
USER:	UCRL
PURPOSE:	Coax Connector Pit
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	155 psi
CONSTRUCTION:	1-29-58/6-7-58

The connector pit consisted of an earth-barricaded, re-inforced concrete structure 15x28x13 feet. The front wall, erected to ensure that the structure would be stable through all events, was sloped 1½ to 1 and was 16 feet thick at the base. The other walls and floor slab were 2½ feet thick and the roof was 5 feet thick. The room within the building was 10 feet square by 5 feet high with entry through a 4-foot-square opening in the roof. Removable stepped concrete plugs provided the closure for the opening. A canvas-covered, wood-framed weather shield, 8-foot-square by 7-foot-high, was included over the roof opening.

(Neg. No. W-V-212-1)

Figure No. 2-58. Station 2210 — 90% Complete.

STATION:	2220
SITE:	Tare
USER:	UCRL
PURPOSE:	Kennel Bunker
PARTICIPATION:	None
DESIGN PSI:	185 psi
CONSTRUCTION:	None

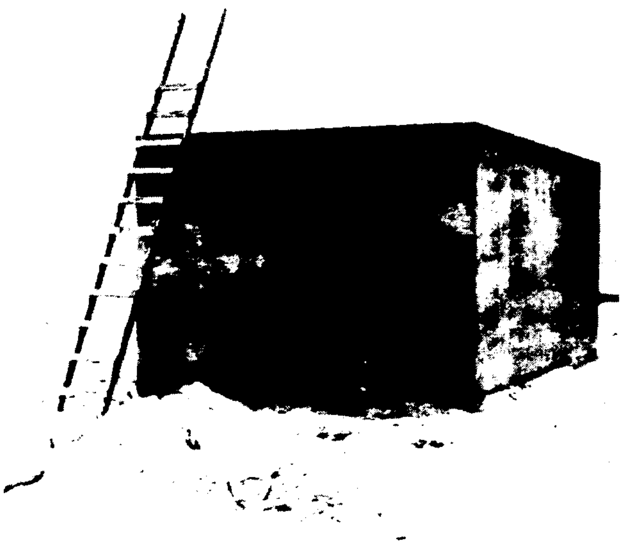
This station was designed as a two-structure facility connected by 45-foot-long, 25-inch-diameter pipe. One structure was to be 19x26x13 feet high with 3-foot-thick concrete walls, a sloped front wall 14 feet thick at the base, and 3½-foot-thick floor slab. The structure was divided into two compartments, each with three layers of 20-inch-thick removable slabs for the roof.

The other structure was to be 19x35x18-foot-high with 7-foot-thick concrete walls, a sloped front wall 19 feet thick at the base, and a 4½-foot-thick floor slab. The structure contained a single compartment with five layers of removable roof slabs stacked to compose a 7½-foot-thick roof.

All compartments of both structures were to contain lead lining interlocked against shielding leaks. The requirement for the station was cancelled prior to construction.

STATION:	2230.01 and .02
SITE:	Tare
USER:	UCRL
PURPOSE:	Doghouse Detector
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	350 psi
CONSTRUCTION:	2-6-58/6-7-58

Station 2230.01 was a reinforced concrete bunker 14x20x15 feet high. The walls were 4¾ feet thick, and the floor slab was 4 feet thick. Entry into the station was through the roof which consisted of three layers of 2-foot-thick removable slabs that covered the entire station. A 10-inch pipe sleeve through the forward wall led to a User-furnished lead tube 50 feet long. The tube was supported on a concrete slab 4 feet wide and 48 feet long. The building was level with the top of an earth-fill at Elevation +17. Within the building a User-furnished lead shielding structure was placed to house a detector.



(Neg. No. W-V-235-9)

Figure No. 2-59. Station 2230.01 — 90% Complete.

Station 2230.02 consisted of a reinforced concrete bunker, 15½x2x21x14½ feet high. The walls were 5¼ feet thick, and the floor slab was 4 feet thick. Entry into the station was through the roof which consisted of three layers of 2-foot-thick removable slabs that covered the entire station. A 24-inch pipe sleeve was set in the forward wall on a 12° slope. The pipe was 10 feet long and terminated on the outside with a hinged, domed aluminum blast cover. The structure was in an earth fill which necessitated an extension to the earth shielded 24-inch pipe. This extension consisted of a 10-foot-long, 42-inch-diameter corrugated metal pipe which terminated just outside the fill and afforded access to the 24-inch pipe. A concrete slab supported the 24-inch pipe. Within the building a User-furnished lead structure was placed to house a detector. About 10 feet of additional lead wall was procured to increase the shielding of one wall.

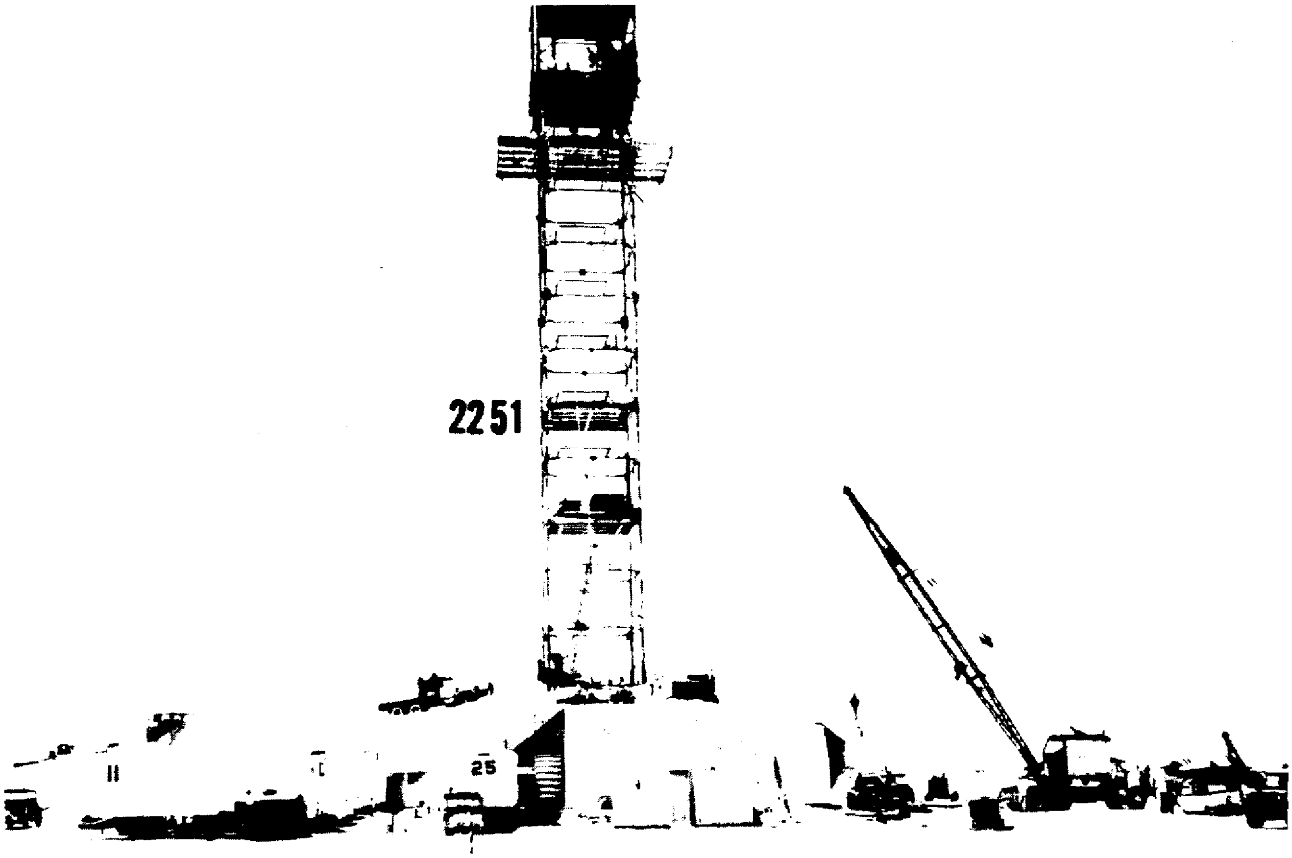
Both stations were provided with wood-framed, canvas-covered weather shields over the roof entry.

STATION:	2240
SITE:	Sugar
USER:	UCRL
PURPOSE:	Radio Detector Station
PARTICIPATION:	3 through 9
DESIGN PSI:	None
CONSTRUCTION:	3-3-58/4-19-58

A steel platform and a copper disc were placed over a concrete slab. The slab was 15 feet square with a 2-foot-cube concrete pit in the center covered over with a steel plate. The platform was 3½ feet square, 5 feet high, and was constructed of steel angle. A 6½-foot-diameter copper sheet over plywood was placed on the frame, and copper wires were fastened every 15° around the circumference of the sheet. The wires extended radially down to grade and were fastened to a screw anchor.

STATION:	2250
SITE:	Sugar
USER:	UCRL
PURPOSE:	Diagnostic Tower
PARTICIPATION:	All Bikini Events
DESIGN PSI:	4.5 psi
CONSTRUCTION:	1-29-58/4-26-58

A 150-foot-high, top-guyed steel tower with cab was located on top of Station 2200, Room D. The tower was constructed with the bottom four 25-foot bays and the top two 25-foot bays of a standard 300-foot shot tower. The cab on top of the tower was a standard shot-tower cab, but the doors and siding were omitted. Three platforms and the cab were located on the tower. A fourth platform was designed but was subsequently cancelled. The cancelled platform (No. 6) was to have been located at the 37½-foot level of the tower and was to have contained the 20-foot-square tower cross section plus a



(Neg. No. W-V-235-1)

Figure No. 2-60. Tower Station 2250 Showing Platform Station 2251.

10-foot extension at each end to form a 20x40-foot platform. A 13-foot-square by 10-foot-high metal shelter was to have been provided near the center of the platform and two baffles, Stations 2252.01 and .04, were to have been included. The platform requirement was deleted prior to erection of the cab and baffles.

The cab structure was originally designed to include a superstructure on the roof (Platform No. 1), but the requirement as well as development of the cab (Platform No. 2) was cancelled. The cab framing structure was required to support the elevator system.

Platform No. 3 was located at the 137½-foot level and was 20x40 feet in plan, including a 10-foot extension on each side of the 20-foot-square cross-section. The steel framing was covered with 1-inch steel grating, and handrails were provided around the perimeter. A steel shelter, 13 feet square by 10 feet high, was provided near the center of the platform. It contained removable metal wall panels on three sides for equipment access to the structure from the elevator and for field of view to the barge sites at Charlie and Fox. The roof of the shelter was tied into the cab floor frame for stability.

Platform No. 4 was located at the 75-foot level; it was 20 feet square, and was covered with steel grating with a removable handrail around the perimeter.

Platform No. 5 was located at the 50-foot level; it was 20 feet square, and was designed to provide a 10-foot-square storage space for lead shapes. A concrete shelter and a two-ton jib crane was installed on this platform. It is described under Station 2251.

Steel plate cable guides were welded to the tower legs up to the 137½-foot level. Coaxial cables packed in place with foam rubber and banded to the column legs by stainless steel straps were located within the guide plates. A concrete elevator pit was located at the base of the tower in the earth fill over Station 2200. The hoist foundation for the elevator was also located on the fill.

Power was provided from two 100-kw utility engine generators inside Station 2200. A 75-kva, 208-440-v, step-up transformer was used to provide power for the elevator. Control of the elevator was by TVL System. Lighting was installed for all platforms and the cab, and floodlighting was installed at the tower base.

Common telephone outlets were provided in the cab and at the base of the tower. Field telephone and intercom outlets were installed at each platform and connected to those in Station 2200. Coaxial cables from the tower were run in conduits to the Optical Room of Station 2200 for connection by the User.

STATION:	2251
SITE:	Sugar
USER:	UCRL
PURPOSE:	Detector Station
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	4.5 psi
CONSTRUCTION:	3-24-58/4-19-58

A concrete shelter was located on the 50-foot level of the tower, Station 2250, and adjacent to the metal shelter. The station was 6x9x5 feet high. The side, end walls, and the floor slab were one inch thick. The front wall was 20 inches thick and contained an 8-inch pipe sleeve. There was no concrete roof on the station, but the interior was lined with lead 6 to 10 inches thick and 8-inch-thick sections of lead covered with plywood formed the top of the structure.

A two-ton capacity jib crane located adjacent to the concrete station was used to hoist lead shapes into place. A canvas-covered, plywood-framed weather shelter was provided over Station 2251. A pair of adjustable saddle supports seated a User-furnished collimator pipe in line with the concrete shelter and aimed toward the Tare barge site.

STATIONS:	2252.01 through .06
SITE:	Sugar
USER:	UCRL
PURPOSE:	Detectors
PARTICIPATION:	None
DESIGN PSI:	0.5 psi
CONSTRUCTION:	None

Stations 2252.01 and .04 were to be large, steel-framed baffles at the 37½-foot foot level of the tower, Station 2250. They were 14 feet wide, 16 feet high, of steel angle frame with canvas facing. Both baffles were to be fastened using bracing angles to the 50-foot level.

Stations 2252.02, .03, .05 and .06 were to be 16-foot-high by 15-foot-wide plywood-covered wood baffles located about 60 feet above grade. Each baffle was to utilize one side of two 25-foot bays of a standard shot tower for support, including ladders and cages. These panels were to be guyed at the 25- and 50-foot levels. Two 6½-foot-square spread footings and four 8x5½-foot-deep concrete anchor blocks were required to support each structure.

All of these stations were cancelled prior to construction.

STATION:	2253
SITE:	Sugar
USER:	UCRL
PURPOSE:	Cerenkov Detector
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	4.5 psi
CONSTRUCTION:	4-7-58/4-18-58

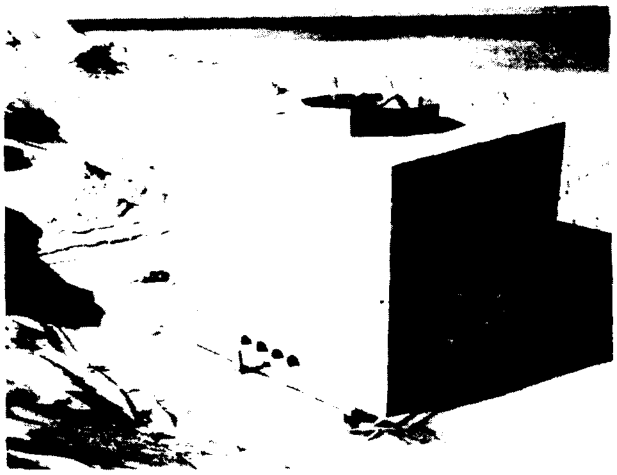
This station was located at the base of the tower, Station 2250, in the earth-barricade over Station 2200. An 8-inch concrete slab, 5½x7½ feet, supported a lead brick structure, 3½x6x2 feet high. Two compartments were formed by exterior walls of 2-inch lead, a front wall of 4 inches, an interior wall of 6 inches, and a roof of 2-inch lead. Wood framing contained and supported the lead. A 6-inch-diameter steel pipe 16 feet long extended from the front wall and was supported on adjustable steel frames on concrete footings. Three feet of sandbags over the structure provided additional shielding.

STATION:	2260
SITE:	Tare
USER:	UCRL
PURPOSE:	Converter Tower
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	None
CONSTRUCTION:	4-7-58/4-26-58

A 10½-foot-square wood frame supported a User-furnished graphite plate. The plate was 4x5½ feet located about the center of the frame and supported by three 4x6-inch timbers. The frame was mounted on a ball joint mechanism for adjustment of the frame in all planes. The assembly rested on a 2½-foot-square wood platform supported on a concrete slab for stability. After the frame was positioned, it was braced to maintain alignment.

STATION:	2270
SITE:	Tare
USER:	UCRL
PURPOSE:	Coax Splice Box
PARTICIPATION:	11, 12, and 13
DESIGN PSI:	600 psi
CONSTRUCTION:	2-6-58/4-26-58

Station 2270 was a concrete structure, 9x10x10 feet, with 3-foot walls and slabs. The top of the structure was set flush with grade and had provision for entry through a domed steel hatch cover in the roof. Sandbags were placed to a height of 3 feet above grade for additional protection. The front wall contained a 4-inch pipe sleeve with special fittings to connect a 4-inch vacuum hose for cables to the barge site.



(Neg. No. W-V-212-4)

Figure No. 2-61. Station 2270 — 80% Complete.

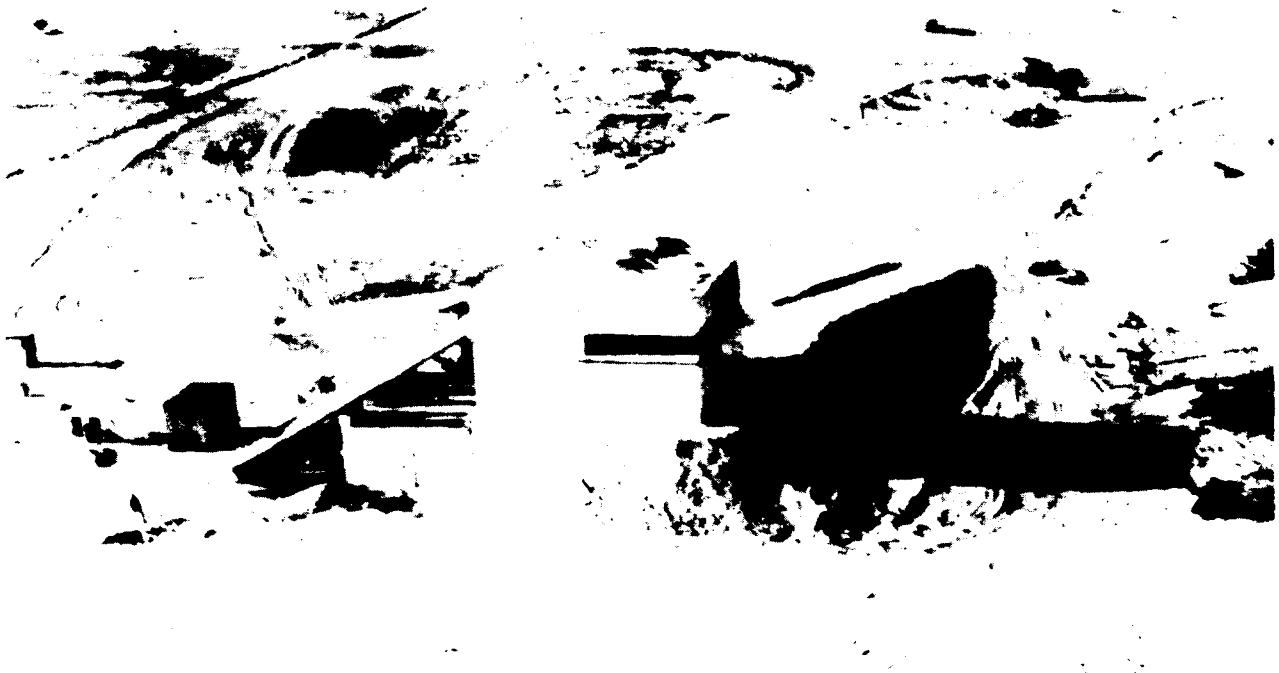
STATION:	2300
SITE:	Peter
USER:	UCRL
PURPOSE:	Scientific Photo Bunker
PARTICIPATION:	All Bikini Events
DESIGN PSI:	None
CONSTRUCTION:	11-15-58/4-26-58

REDWING Station 2300 was used for this bunker station. In addition to the rehabilitation of the station, a 12-foot-long concrete extension of the third floor outside the 20-foot drop door was provided for the width of the building. To insure minimum deflection of the extension and non-expendability, the extended level was designed as the top of a concrete box with front wall, side walls, and two interior cross walls all supported on a mat foundation located on top of an earth fill built up to the second-floor level. The structure was integrally tied to the existing re-inforcing steel of the building. A canvas-covered pipe frame sheltered the exterior third-floor level. The pipe frame was designed to be non-expendable. A ½-ton jib crane was provided at one end of the new extension and was mounted on the structure wall. New access ladders to this extension and the roof were provided. The existing 14-inch steel bracing beams, which supported the top story for horizontal loads, were protected from the sun to minimize deflection of the building caused by temperature change of the steel beams. This was accomplished by installing plywood panels, painted gloss white, over the length of each steel beam. A two-walled timber and pile bulkhead were included at the side of the building to protect a 60-kw generator from possible wave damage from lagoon events. The bulkhead was 22x30 feet constructed of 4-inch timbers braced 5 feet on centers. One wall of the bulkhead terminated at the corner of the generator room in the rear, and the other wall terminated at the toe of the return on the new earth-fill at the front.

Of two existing 35-kw generators originally located in the station, one was installed as standby power. The other unit was replaced by an outside 60-kw generator located in the bulkhead area. The power and existing air-conditioning were shut down by remote timing signal. Mechanical modifications were accomplished to provide a more efficient drop-door snubber system and to provide new salt water pumps for the air-conditioning system.

STATIONS:	2410.01 through .03
SITE:	Fox
USER:	UCRL
PURPOSE:	Phonex Collimators
PARTICIPATION:	8, 9
DESIGN PSI:	None
CONSTRUCTION:	3-9-58/4-18-58

Earth-barricaded timber structures 12x15x8 feet high comprised these stations. The walls and roof were framed with heavy timbers to support the retained earth. A rear entry tunnel of timber construction provided access through the fill. The tunnel was 4 feet wide, 8 feet high, and was L-shaped for lengths of 8x24 feet. A 22-foot-long wood tunnel port provided a view through the front of the fill from the center of the structure. The interior of the tunnel was 20 inches square for a 12-foot length and 36 inches square for a 10-foot length. The floor of the rear access tunnel was a 6-inch slab thickened at the edges. The floor of the main structure was 3 feet thick and contained two troughs for access to vertical lift jacks. These User-furnished jacks adjusted a User-furnished collimator block that was provided with lead brick shielding on the sides and top. Two steel braces were anchored in the floor slab and braced the collimator against movement from overpressure.



(Neg. No. W-913-3)

Figure No. 2-62. Station 2300.

STATIONS: 2420.01 through .02
SITE: Tare
USER: UCRL
PURPOSE: Phonex Collimators
PARTICIPATION: 11, 12, 13
DESIGN PSI: None
CONSTRUCTION: 3-9-58/5-17-58

A 13x15x2-foot concrete slab supported a User-furnished collimator block similar to Stations 2410.01-.03. Shielding of two opposite sides of the block was accomplished by 2-foot-thick concrete and scrap metal walls, 6 feet high and 9 feet long. The two walls were braced against overpressure by three removable steel struts between the top of the walls. About one-half the floor slab was thickened to 3 feet to contain steel bracing members supporting the collimator blocks against overpressure. Lead brick shielding was provided on the top and front wall of the collimator block. Access holes in the slab were provided for the User-furnished vertical lift jacks used for adjustment. The entire structure was earth covered for protection against early events. The fill was later removed and replaced to provide a sand-bagged opening in the fill for line of sight.

STATION: 2430
SITE: George
USER: UCRL
PURPOSE: Phonex Collimators
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 6-6-58/6-6-58

This station consisted of a 6-foot-high earth mound with a sand-bagged forward face. Three 1½-inch-diameter, 8-foot-long pipes were set on existing grade in the fill so that one end was clear of the front face.

STATIONS: 3231.01 through .06
SITE: How
USER: SC
PURPOSE: Rocket Launcher Pads
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: 3-1-58/4-10-58

A stabilized area 40 feet in diameter contained a 6-foot-square concrete slab in the center. A brass cap was provided on the slab, and a survey monument was established 60 feet from the slab.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATIONS: 3240.01 through .03

SITE: Nan, Peter, Uncle

USER: SC

PURPOSE: Midot Stations

PARTICIPATION: None

DESIGN PSI: None

CONSTRUCTION: 2-21-58/4-10-58

Each of these stations consisted of a 450-foot-square cleared area containing five 6-inch-diameter steel pipe posts about 3 feet high. Four antenna support posts were equally spaced along the circumference of a 418-foot-diameter circle. The fifth post was located in the center and was the reference point for the other four posts. Cable trenches were provided from each antenna pole to the center pole.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATION: 3241.01

SITE: Nan

USER: SC

PURPOSE: Telemetry

PARTICIPATION: None

DESIGN PSI: None

CONSTRUCTION: 4-8-58/4-9-58

This station was located on top of the fill over Station 70, Nan, and utilized Room 18 of that station. Two 5-foot-square concrete pedestals were installed about 6 feet high supported on the Station 70 roof siab and rising through the fill over the slab. A concrete pedestal, 1x4½ feet tapered to 3x4-½ feet at the base, was installed between the other two pedestals. Tops of pedestals contained adjustable mounting plates which were grouted in place under User supervision.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATION: 3250

SITE: Mike

USER: SC

PURPOSE: Launching Site for Wind Velocity Measuring Rockets

PARTICIPATION: None

DESIGN PSI: None

CONSTRUCTION: 3-17-58/4-10-58

The launching facility consisted of an 8x14-foot concrete slab, an 8-man tent, and a sandbag revetment. The slab contained a survey monument, and another monument was located about 50 feet away on the high tide line. The sand bag revetment was 6 feet high and was located about 400 feet from the slab.

STATIONS: 3260.01 - .06

SITE: How

USER: SC

PURPOSE: Launching Pads for Instrument Rockets

PARTICIPATION: None

DESIGN PSI: None

CONSTRUCTION: 1-22-58/4-10-58

The stabilized area, 70 feet in diameter, contained a working area 36 feet in diameter. Six concrete survey monuments were placed within a fenced area 18x36 feet located at one end of the outer stabilized area. An additional monument was placed 25 feet from the opposite side of the larger area.

Within the inner stabilized area was a 10-foot-square, 6-inch-thick concrete slab, thickened at one end to 3 feet in a 5-foot-square area. Two additional slabs, 4x12x2 feet deep, were located adjacent to the other slab. Each of the slabs contained threaded inserts or anchor bolts to tie down the launcher which rested on all three slabs. Three tents were provided in the vicinity for storage, assembly, and administrative space for these stations.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATIONS: 3261.01 and .02

SITE: How

USER: SC

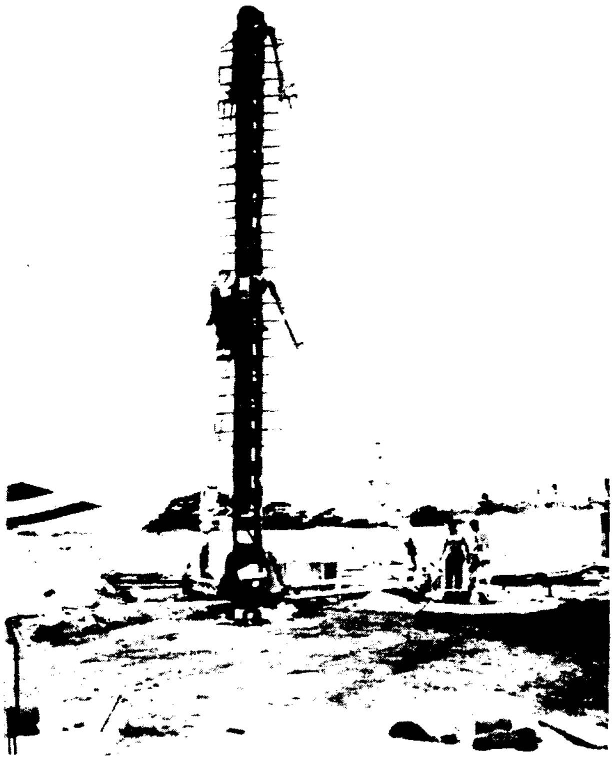
PURPOSE: Launching Pads for Instrument Rockets

PARTICIPATION: None

DESIGN PSI: None

CONSTRUCTION: 1-27-58/4-10-58

Except for the size of the slabs, these sta tions were similar to the 3260 series.. One wa 5 feet square and 2 feet deep; the other two slabs were 3x10x2 feet deep. No tents were provided.



(Neg. No. W-V-234-2)

Figure No. 2-63. Rocket Launcher Station 3261.01 — How — 80% Complete.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATION:	3262
SITE:	George
USER:	SC
PURPOSE:	Photographic Building
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	3-1-58/4-10-58

This wood structure, 12x17x8 feet high, had a double pitched movable roof. Each pitched roof section rolled down guide tracks on rafters on each side of the ridge line. The operation of the sliding roof sections was accomplished by the use of two explosive links actuated by a remote signal. A hand winch was provided on the building to raise the sections again to the closed position. Hinged-down shutters were provided on the two 17-foot walls just under the eave. Nominal lighting and receptacles were also included in the design.

The structure was originally designed to be constructed on the existing concrete slab of REDWING Station 913. However, it was determined in the field that the cost of repairing and removing embedded items in the slab would exceed the cost of a new slab and consequently the building was relocated close by.

With the relocation of the ABMA Program, this facility was abandoned after completion of construction.

STATIONS:	3482.01 through .92
SITE:	Off Yvonne
USER:	SC
PURPOSE:	Lagoon Floating Fall-out Station
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-24-58/8-4-58

Located in the lagoon off Site Yvonne, this series of stations was an array of User-furnished floats. Two marker buoys were placed in the array utilizing two of the Program 2.4 buoys and anchor blocks. One marker buoy was near Station 3482.75 and the other was near Station 3482.81.

STATION:	3401
SITE:	Yvonne
USER:	SC
PURPOSE:	Balloon Release Station
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-21-58/7-24-58

A 20x50-foot stabilized area was covered with a tarpaulin staked to the ground. A concrete beam 1-foot square, 50 feet long, flush with the ground bisected this area. A 2x6-inch timber was shot-pinned to the beam along the center line.

STATIONS:	3402.01 and .02
SITE:	Yvonne
USER:	SC
PURPOSE:	Photo Theodolite Stations
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-21-58/7-24-58

Station 3402.01 was a concrete slab, flush with the ground, 5 feet square in plan and 6 inches thick along the edges. The center section was 3 feet deep. A 4-inch steel pipe was imbedded 2½ feet in the concrete with 4⅔ feet projecting.

Station 3402.02 was a 4-inch pipe, 4⅔ feet long projecting above the roof of Station 1520.

STATIONS:	3440.01 - .07
SITE:	Utirik, Wotho, Kwajalein, Rongelap, Fred, Nan, Ujelang
USER:	SC
PURPOSE:	Microbarograph Station
PARTICIPATION:	All Events, Except 1 and 15
DESIGN PSI:	None
CONSTRUCTION:	Sta. 3440.01, 3-8-58/3-24-58; Sta. .02, 3-7-58/3-20-58 Sta. .03, 2-18-58/3-18-58; Sta. .04, 3-7-58/3-26-58; Sta. .05, 3-8-58/4-23-58; Sta. .06, 4-7-58/4-12-58; Sta. .07, 3-22-58/3-25-58

No Home Office engineering or Jobsite construction. See Chapter II, Section 1, Surveying, for work done on these stations.

STATION:	3480.01
SITE:	Off Yvonne
USER:	SC
PURPOSE:	Control Shack
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-20-58/8-2-58

A 10x10x7-foot wood shack was constructed on the west end of a Navy-type YCV Barge anchored off Site Yvonne. One 3x7-foot door, two plywood shutters, and one work bench were provided in the structure.

Power was supplied to lights and receptacles in the shack from a 10-kw, 120/208-v, 3-phase generator mounted on the barge deck. Two floodlights were located on the corner of the facility to provide deck illumination. Power was furnished to Stations 3488.01 and .02 from this station.

STATION:	3481
SITE:	Yvonne
USER:	SC
PURPOSE:	Snatch Block
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-20-58/7-26-58

This station was a concrete deadman, 3x3x3 feet, with two ¾-inch lifting lugs and one ¾-inch hairpin anchor.

STATIONS:	3483.01 through .42
SITE:	Yvonne
USER:	SC
PURPOSE:	Monitoring Stations
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-21-58/7-24-58

Each station was a 2x2-inch wood stake 54 inches long with 24 inches embedded below grade.

STATIONS:	3484.01 through .08
SITE:	Yvonne
USER:	SC
PURPOSE:	Sticky Pan
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-21-58/7-25-58

A 2-foot-square, ½-inch-thick plywood panel supported at an an Elevation of +8 by a 2-inch-diameter, Schedule 40 pipe, was erected for each station. The 2-inch pipe was grouted in a 6½-inch-diameter by 18-inch-deep hole in the reef.

STATIONS:	3485.01 through .14
SITE:	Yvonne
USER:	SC
PURPOSE:	Continuous Monitoring Stations
PARTICIPATION:	1 and 15
DESIGN PSI:	None
CONSTRUCTION:	7-20-58/7-31-58

Stations 3485.01 through .08 were eight 2x2-inch wood stakes 5 feet long with 2 fee driven below grade. Stations 3485.09 througl .14 were six 2x2-inch wood stakes 3 inches long fastened to the deck of a YCV barge moored off Site Yvonne by an angle iron bracket.

STATIONS: 3486.01 through .15
SITE: Yvonne
USER: SC
PURPOSE: Sticky Pan
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-21-58/7-30-58

Each station was a 2x2-foot plywood panel supported on a 2x2-inch wood stake 30 inches above grade. The wood stake was set 24 inches into the ground.

STATIONS: 3487.01 through .61
SITE: Yvonne
USER: SC
PURPOSE: Sticky Pan
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-19-58/7-31-58

Stations 3487.01 through .16 were ½-inch steel pipes set 24 inches in the ground with 30 inches above grade. The remainder of the stations were ½-inch standard pipes 30 inches long welded to the deck of the four barges anchored off Site Yvonne.

STATIONS: 3488.01 through .05
SITE: Yvonne
USER: SC
PURPOSE: Air Samplers
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-20-58/7-31-58

Each of these stations was a User-furnished air sampler fastened to the deck of a barge moored in the lagoon off Site Yvonne. Stations 3488.01 and .02 were located on YCV 9. Stations 3488.03, .04, and .05 were located on the YCV barges 1415, 1416, and 1417 respectively.

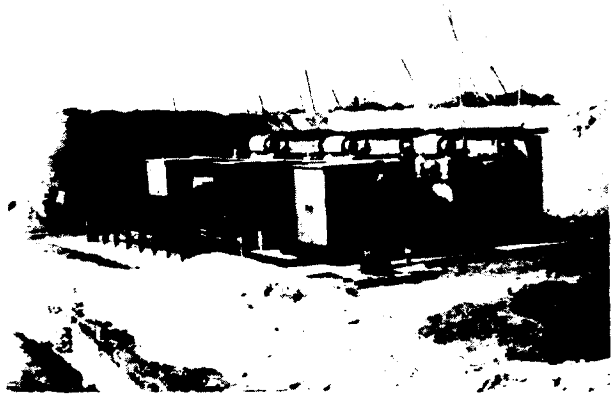
Power for Stations 3488.01 and .02 was supplied from the power panel in Station 3480.01.

STATION: 3489
SITE: Yvonne
USER: SC
PURPOSE: Sled Shelter
PARTICIPATION: 1 and 15
DESIGN PSI: None
CONSTRUCTION: 7-20-58/8-2-58

This station consisted of a concrete deadman 3 feet on a side set with the top 1 inch above grade; a ditch 4 feet deep by 8 feet long; and a 10-inch-diameter log 8 feet long on the crest of a berm 1½ feet above grade 10 feet forward at the ditch.

STATION: 6001
SITE: How
USER: ABMA
PURPOSE: Rocket Firing Pad and Tower
PARTICIPATION: None
DESIGN PSI: 8 psi
CONSTRUCTION: 10-21-57/4-9-58

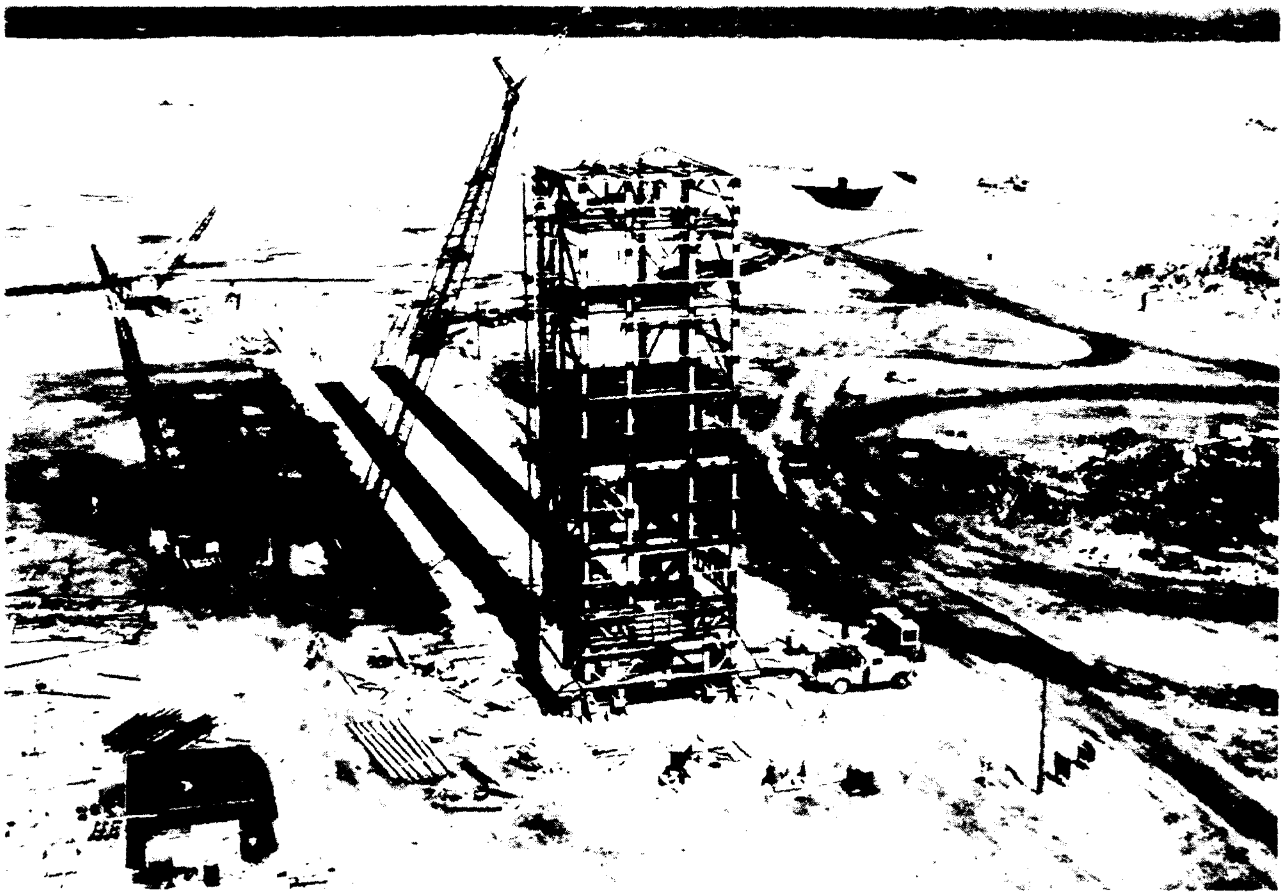
An enclosed mobile tower, an auxiliary pad, and a firing pad area comprised this station. The tower was of bolted steel frame construction, 24 feet square and 90 feet high, covered with corrugated galvanized steel roofing and siding. There were six platform levels, each framed with steel and covered with aluminum grating, designed to allow the tower to be moved to enclose the missile in a vertical position.



(Neg. No. W-877-1)

Figure No. 2-64. Power Plant for Station 6001 — How.

A platform at the 4-foot level was utilized for access to the ladder and elevator to the upper level platform. The plan opening in this platform was 15x17 feet, and the remaining portions were covered with grating. An extension, 5x24 feet, was provided at this level, outside the siding, on each of two opposite sides. The extensions were used to support concrete ballast blocks which stabilized the tower.



(Neg. No. W-864-8)

Figure No. 2-65. Stations 6001 and 6002 — How.

Platforms at the 12-foot, 41-foot, 50-foot, and 64-foot levels contained a 6⅔-foot-diameter opening in the center, and the portion of the deck from the front edge of the platform to the opening was designed as a pair of hinged platform sections which were counterweighted for manual operation. Additional cutouts were made in the grating around the opening at the 12-foot level to allow clearance for the missile fins and pods.

A platform was provided at the 77-foot level to seat the elevator-hoisting equipment. Checkered plate flooring covered an area 8x24 feet. Louvers, 3x5 feet, were installed on four sides of the tower at each of four levels. A pair of swing doors, 7 feet high, provided a 14-foot-wide opening on the bottom of the front face of the tower. A 9-foot-wide rolling door hung from mechanically operated trollies. The door extended from the top of the swing doors to the top of the tower and was supported laterally at the 12-foot, 41-foot, and 64-foot platform levels.

A personnel elevator, 4 feet square, operated to all levels. Interlocked safety gates were provided at each platform level as well as other standard safety featurs. An access ladder extended the full height of the tower on the inside.

The tower was supported on four 4-wheel trucks equipped with hydraulic brakes. Movement of the tower was effected by a simple winch and cable system between the firing and auxiliary pads located 400 feet apart. The winch was located just beyond the auxiliary pad but was controlled from within the tower.

Power was supplied from three 150-kw diesel generators located about 600 feet from the firing pad. The power connection was made through a cord located on the tower and plugged into a receptacle on the firing pad. The elevator, however, was operated from a separate generator to alleviate the high starting current required to drive the elevator motor. Lights and receptacles were provided at all the platform levels.

The firing pad was a 200-foot-square stabilized area with the tower located in the center. The foundation for the tower at the firing and auxiliary pads consisted of 12-inch steel bearing pile clusters with concrete caps 8x11x4 feet deep. Provision was made to tie down the tower to its foundation when it was subjected to hi winds or overpressure. This was accomplished through the use of bolts connecting the tower wheel trucks to metal plates embedded in the foundation.

Two pairs of rails were laid between the firing and auxiliary pad for moving the tower. The tracks were laid on wood ties and gravel ballast. Two concrete revetments for trailers were located about 125 feet from the firing pad and about 90° apart. They were 14 feet high with one 25 feet long and the other 30 feet long. Each had 12-foot-long wing walls and about 5 feet of earth fill in front. Each of two small concrete revetments were located in diagonally opposite corners of the firing pad area about 120 feet from the pad centerline. They were 12 feet long, 6½ feet high, with 10-foot-long wing walls and were to be used to house fire protection water nozzles. The nozzles were subsequently relocated to the 25-foot-long trailer revetment to furnish water to the center of the firing pad in the event of a fire. Two salt water wells and diesel-driven pumps provided the water.

Concrete cable trenches were located between the firing pad and 30-foot-long revetment, between the two revetments, and from the first trench to the diagonally opposite corner of the pad. These trenches were 2 feet wide, 1½ feet deep, and were provided with steel cover plates.

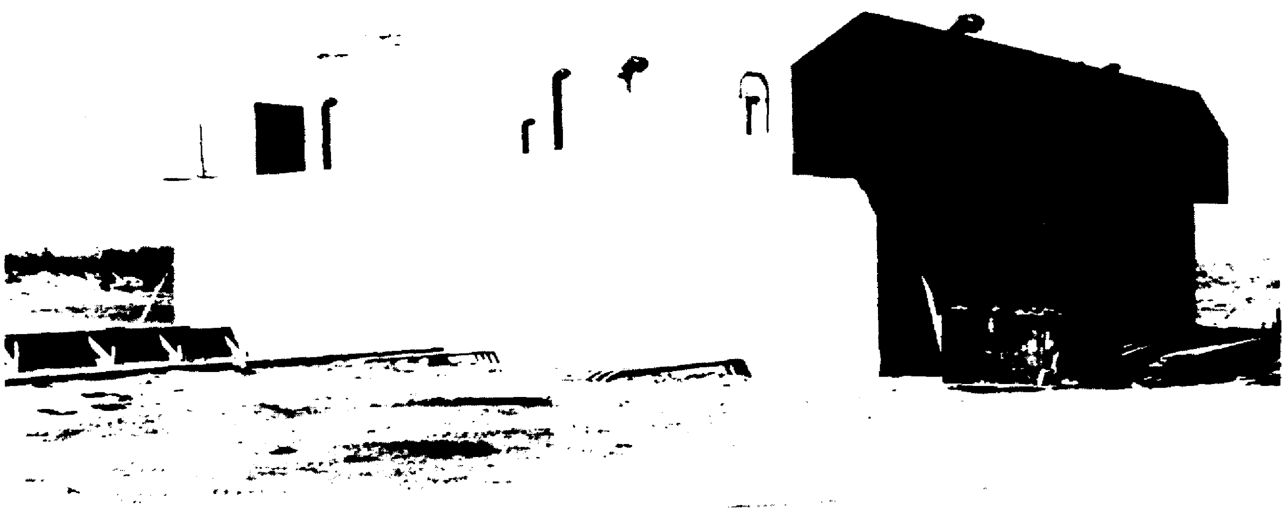
Close to the firing pad a timber personnel shelter, 24x26x8 feet high, was placed. The shelter was skid-mounted and contained receptacles and lights circuited to a portable plug, which connected to a power receptacle on the pad.

A skid-mounted portable wood shelter was provided for use as weather protection during a possible horizontal check-out of the missile. The shelter was 16x35x17 feet high with open ends and plywood roof and sides. The entire firing pad area and the railway between it and the auxiliary pad were illuminated by floodlights. Receptacles were provided throughout the pad area for trailers and miscellaneous equipment.

With the relocation of the ABMA Program, this facility was dismantled and moved to the new site at Johnston Island.

STATION:	6002
SITE:	How
USER:	ABMA
PURPOSE:	Control Bunker
PARTICIPATION:	None
DESIGN PSI:	1.5 psi
CONSTRUCTION:	10-18-57/4-10-58

An earth-covered, reinforced concrete structure, 43x53x10 feet high, had 12-inch walls, a 14-inch roof, and a 6-inch floor. The forward wall was 14 inches thick. The walls were supported on spread footings. There were four rooms within the building, two instrument rooms, a stand-by room, and an equipment room. There were 1x1½-foot cable trenches with steel cover plates along the interior perimeter of both instrument rooms and along two walls in the stand-by room and one wall in the equipment room. A concrete cable duct extended out of the building through the fill from the interior cable trenches. Cables



(Neg. No. W-V-175-1)

Figure No. 2-66. Station 6002 — How — 48% Complete.

from the bunker extended from the trench to the firing pad by means of wood, cross-stake cable hangers.

The ceilings and upper half of the walls of the building were soundproofed through the use of acoustical tile nailed to furring strips. Entry to the structure was through a steel blast door and access to the top of the roof fill was accomplished by means of a wooden stair. A 3-foot-wide by 1-foot-high double-plate glass window on the forward wall afforded a sight of the firing pad 400 feet away. by the use of a mirrored wood periscope up through the fill.

The building was air-conditioned and dehumidified. Salt water was provided by means of two wells and electric driven pumps located just outside the entry. The fresh water was stored in a small tank in the equipment room.

Electrical receptacles were provided along the cable trenches as well as on the walls, and lighting of the rooms was accomplished with fluorescent fixtures. The fire protection system at the firing pad was operated by a control located in the bunker adjacent to the window on the front wall. Steel rack supports were provided for 25 instrument racks and were located adjacent to the cable trenches in the building.

With the relocation of the ABMA Program, this facility was cancelled.

STATIONS:	6003.01 through .03
SITE:	How
USER:	ABMA
PURPOSE:	Beat-Beat Station
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	1-27-58/3-28-58

Each station utilized a cleared stabilized area 100 feet square. At Station 6003.02 a generator shelter was provided which was 5 feet square, 4 feet high constructed of steel frame with removable plywood panels.

A 30-kva, 120/208-v transformer for Station 6003.02 and a 3-kva transformer for .01 and .03 stations, supplied from the three 150-kw diesel generator plant on the island, was provided at each station as well as a trailer receptacle signal and telephone lines. User-furnished coax cables were installed between the .01 and .02 stations and between the .02 and .03 stations.

With the relocation of the ABMA Program, this facility was cancelled.

STATION:	6004
SITE:	How
USER:	ABMA
PURPOSE:	Dovap Transmitter
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	2-17-58/3-28-58

A cleared area 100 feet square was supplied with signal and telephone lines. Power was supplied from the three 150-kw diesel generator plants on the island.

With the relocation of the ABMA Program, this facility was cancelled.

STATIONS:	6005.01 through .03
SITE:	How, Nan
USER:	ABMA
PURPOSE:	Dovap Receiver
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	1-27-58/3-26-58

Each station consisted of a cleared and stabilized area 100 feet square. Stations 6005.01 and .02 on Site How were provided with 9-kva 120/208-v transformers supplied with power from the three 150-kw diesel generator plants.

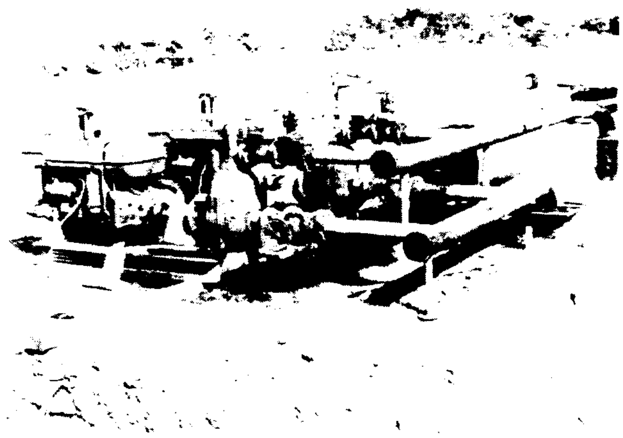
Station 6005.03 on Site Nan was supplied power from the main distribution line to a 9-kva 120/208-v transformer. Signal and telephone lines were also provided.

With the relocation of the ABMA Program, this facility was cancelled.

STATIONS:	6006.01 - .02
SITE:	How
USER:	ABMA
PURPOSE:	LOX Plant
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	10-8-57/4-8-58

Both of these stations consisted of a 50x100-foot cleared area to be utilized for siting a LOX plant. Power was supplied from the three 150-kw diesel generator plants through a 30-kva transformer. Fire protection was provided by use of a pair of wells with diesel driven pumps which supplied water to a hydrant.

With the relocation of the ABMA Program, this facility was cancelled.



(Neg. No. W-877-3)

Figure No. 2-67. Well and Pumps for Station 6006 Fire Protection System — How.

STATION:	6007
SITE:	How
USER:	ABMA
PURPOSE:	Alcohol Storage
PARTICIPATION:	None
DESIGN PSI:	None
CONSTRUCTION:	12-14-57/4-8-58

A 50x100-foot cleared area was used for missile fuel storage. A 30-kva, 120/208-v transformer powered by three 150-kw diesel generator plants furnished power for two trailer receptacles. A wood frame with canvas cover weather shelter was provided for drum storage. The fire protection system for Stations 6006.01 and .02 also served for Station 6007.

With the relocation of the ABMA Program, this facility was cancelled.

STATION:	7410
SITE:	Nan
USER:	AFOAT
PURPOSE:	Seismic Project
PARTICIPATION:	All Events, Except 1, 2, 15, 16 and 25
DESIGN PSI:	None
CONSTRUCTION:	2-24-58/4-19-58

This station occupied Room 29 of the reinforced concrete structure utilized in previous operations as Timing Station 70. New construction consisted of adding a 6-pair signal cable and terminal cabinet from Room 1 and one telephone.

STATION:	7420
SITE:	Bruce
USER:	AFOAT
PURPOSE:	Electromagnetics
PARTICIPATION:	All Events, Except 1, 2, 10, 15 through 17, 22 through 25, 27 and 37
DESIGN PSI:	None
CONSTRUCTION:	3-22-58/4-19-58

An antenna used as a REDWING station was rehabilitated. New construction included three 25-kw diesel generators which supplied power to four trailer outlets and an operational tent. Signals and telephone were provided.

STATION:	7421
SITE:	Elmer
USER:	AFOAT
PURPOSE:	Communications with Johnston Island
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	6-5-58/7-14-58

Four User-furnished antennas were provided with four 2-foot-cube concrete foundations. The tower cables were attached to 1½-inch-diameter by 5-foot-deep steel rods.

STATION:	J-70
SITE:	Johnston Island
USER:	EG&G
PURPOSE:	Timing Station
PARTICIPATION:	J-40, J-41
DESIGN PSI:	1.5 psi
CONSTRUCTION:	6-5-58/6-12-58
OCCUPANCY:	6-24-58

Special requirements for Station J-70 consisted of a signal terminal box, a wood cope tray 12 feet long, and 20-kva service at a junction box. In addition, foundation and anchor blocks were provided for each of two User-furnished "crank-up" antenna towers located at the westerly portion of the island. The foundations were 3-foot concrete cubes, and each tower had three 2-foot concrete cube guy anchor blocks.

This station was located in Station J-6002.

STATIONS: J-172.01, .02 .03

SITE: Johnston Island, Sand Island

USER: DOD/BRL

PURPOSE: Pressure Time Measurement

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 6-2-58/6-20-58

Station J-172.03 consisted of a User-furnished ground gage on Johnston Island. Stations J-172.01, Johnston Island, and .02 on Sand Island each consisted of a User-furnished pipe tower 10 feet high which was embedded in a concrete footing 6 feet deep.

STATION: J-260

SITE: Johnston Island

USER: DOD/NRL

PURPOSE: Telemetering Receiving Station

PARTICIPATION: J-40, J-41

DESIGN PSI: 1.5 psi

CONSTRUCTION: 4-24-58/7-7-58

This station was located in the Station J-6002 Equipment Room and in Room II. Special requirements were 12-kva power service and extension of the cable duct on the floor.

STATION: J-261

SITE: Johnston Island

USER: DOD/NRL

PURPOSE: Electronic and Shop Trailers

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 4-29-58/6-27-58

The trailer-loading dock at this station was about 45x35 feet in plan, and T-shaped to receive two trailers. The dock was constructed of timber and provided with an access ramp 13 feet long on one end. Two 16x32-foot tents were constructed, and power was supplied to the tents and two trailer receptacles.

STATION: J-540

SITE: Sand Island (Johnston Island)

USER: DOD/WADC/NASWF

PURPOSE: MSQ and M33 Radar Installation

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 5-8-58/5-15-58

This station consisted of User-furnished trailers and generators located on a cleared and level area, 150x60 feet, near the beach.

STATION: J-600.02

SITE: Sand Island (Johnson Island)

USER: DOD/AFCRC

PURPOSE: Ionospheric Recorder and Transmitter

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 6-13-58/6-13-58

A User-furnished trailer and an antenna array, placed along the diagonals of an area 60x50 feet comprised this station. A 35-foot wood pole set 5 feet in concrete provided one corner of the antenna wire support. A 6-foot-high pole set 2 feet in concrete was located in each of two corners while the trailer provided the fourth corner. Antenna wire extended from the top of the 35-foot pole to each of the other three corners and from the trailer to the two shorter poles.

STATION: J-611.01

SITE: Johston Island

USER: DOD/AFCRC

PURPOSE: Absorption of Cosmic Noise Signals

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 5-15-58/6-2-58

This station consisted of a User-furnished shelter and antenna. Scientific line power of 5-kw was provided to the site.

STATION: J-612

SITE: Johnston Island

USER: DOD/ESL

PURPOSE: Rocket Launcher

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 5-12-58/5-29-58

(Neg. No. W-899-1)

Figure No. 2-68. Rocket Launchers, Stations J-612 and J-910.

Station J-612 shared a 10-inch concrete slab 28x125 feet with Station J-910. The slab was utilized as a launching pad and contained numerous projecting anchor bolts.

STATION: J-613

SITE: Johnston Island

USER: DOD/ESL

PURPOSE: Recording Station

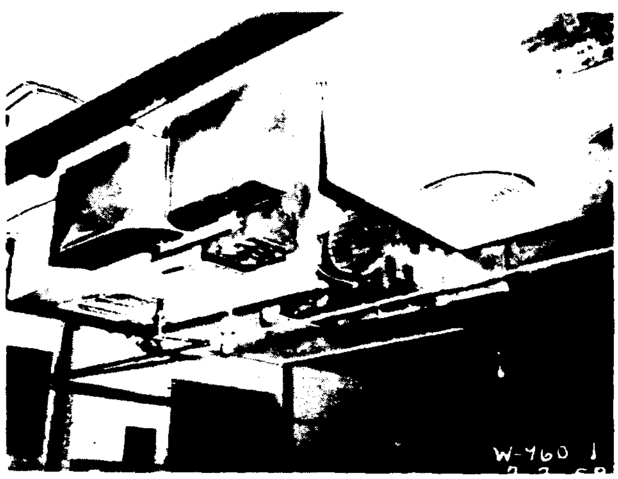
PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 5-1-58/7-7-58

The concrete basement of Building T-249 with the superstructure previously removed was used for this station. The basement was utilized also for Stations J-3230.01, J-3241.01, and J-3440.01. It was 21x72x10-feet-deep with the concrete roof about flush with grade. Concrete stairs located on one end and on ane side provided entry. The building was partitioned into four new rooms. The end wall stairway led to the equipment room, 21x24 feet. This room division was provided by an insulated wood stud partition across the 21-foot width. A 16-ton-capacity compressor and a receiver were located in this room.

Station J-613 was located in an area, 21x-11½ feet, adjacent to the equipment room. The insulated wall of the equipment room and a plywood-covered stud wall opposite enclosed the area, and each wall contained 6-foot double doors. A ceiling-hung unit provided the air-conditioning. New lights and power receptacles were also included.



(Neg. No. W-960-1)

Figure No. 2-69. Dehumidifiers and Air Conditioners — Station J-613.

STATION: J-660.03
SITE: Johnston Island
USER: DOD/ESL
PURPOSE: Radar Set
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 5-9-58/7-7-58

This radar station occupied the waiting room of the existing underground hospital, Building P-405. The buildilng was a concrete structure, 34x106 feet, with additional portions, 24x28 feet and 24x45 feet, at one end. Three concrete tunnel ramp entries provided access. The building had been previously partitioned into several rooms and areas. The waiting room was 14x16 feet and was modified for use as the station. Power from the existing panel in the room was carried to a new junction box. The door openings were sealed, and the room was air conditioned by a new 1200-cfm unit located outside the building on the ground surrface. A 3½-foot-square concrete block was placed outside the building to support a User-furnished antenna.

STATION: J-831
SITE: Johnston Island
USER: DOD/EG&G
PURPOSE: Zenith Tracking
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 6-2-58/6-21-58

The 10-foot-square concrete slab at this station had clear lines of sight to Stations 40 and 41. A 20x10-foot area behind the slab was stabilized. Scientific line power was furnished to the area.

STATION: J-910
SITE: Johnston Island
USER: DOD/CDC
PURPOSE: Rocket Station
PARTICIPATION: J-40
DESIGN PSI: None
CONSTRUCTION: 5-12-58/5-29-58

This station originally utilized the slab for the Station 612 and is described under Station 612. However, prior to the TEAK event, this station was relocated to the extreme southwest end of the island.

STATIONS: J-930.01, .02, .03
SITE: Johnston Island
USER: DOD/EG&G
PURPOSE: Photo Station
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 6-1-58/6-5-58

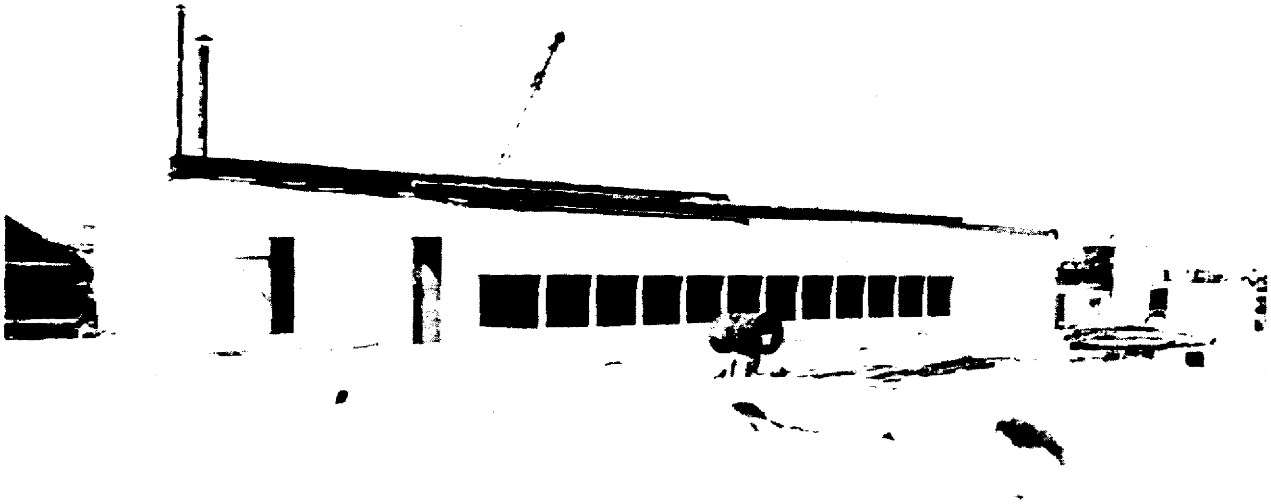
Each station consisted of a 10-foot-square stabilized area located on each of three sides of the Station 6001 working point.

STATIONS: J-947.01 and .02
SITE: Johnston Island
USER: EG&G/DOD
PURPOSE: Photo Station
PARTICIPATION: None
DESIGN PSI: None
CONSTRUCTION: None

These 8-foot-square support areas were designed to support camera equipment. Station J-947.01 was to be a concrete slab on the west end of the island. Station J-947.02 was to be an 8-foot-square steel plate placed on the proposed barge, Midot Station 3240.03, but with the cancellation of the barge station, both J-947 stations were subsequently cancelled.

STATION: J-1030
SITE: Johnston Island
USER: LASL
PURPOSE: Optic and Recording Station
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 5-8-58/7-7-58

This station utilized a new structure in joint occupancy with Station J-1810. The building was 48x64 feet, varying in height from 8 to 12 feet. A 12-inch-thick concrete slab supported the timber framed structure. The roof was insulated with sheets, and the exterior walls were covered with plywood on the outside. Station J-1030 occupied an area 23x54 feet and was divided into six rooms, all air-conditioned. The two collimator rooms "A" and "B" were located along the front of the building; Room "A" was 10x27 feet, Room "B" was 10x15 feet. Collimator Room "A" was insulated with Celotex, contained a double 6-foot door and 36 feet of 4x4-inch plywood cable duct. The front wall contained 4-foot-square hinged-down plywood shutters. Two sliding panels, 8x10 feet and 8x15 feet, were located in the roof over the room.



(Neg. No. W-902-7)

Figure No. 2-70. Stations J-1030 and J-1810 — 75% Complete.

(Neg. No. W-915-12)

Figure No. 2-71. Equipment Shelter — Stations J-1030 and J-1810.

The roof section in this area was placed on a 2:1 slope with framing members extending down to the ground to provide track support for the sliding roof panels. These roof panels were released by a mechanism utilizing wire signals to a solenoid for each panel. Hand-operated winches were fastened on the roof to reposition the panels. The room was grounded using copper screening on the walls, ceiling, and floor. The floor screen was protected with plywood cover.

Collimator Room "B" was separated from Room "A" by an open stud partition which had a double door. The wall was used to support the screen of Room "A." Collimator Room "B" was not screened, but it was insulated with Celotex throughout. Hinged-down shutters on the front wall and an 8x14-foot sliding roof panel were included similar to that provided in Collimator Room "A."

The Spectrograph Room 12x17 feet, was located directly behind Collimator Room "B." It was separated from Room "B" by a 2-foot-high, 1-foot-thick concrete wall with 1½-foot-high insulated plywood panels above and stud wall above the panels. The wall was insulated only on the Collimator Room side. The wall opposite was not insulated. A door was provided in the wall containing the concrete.

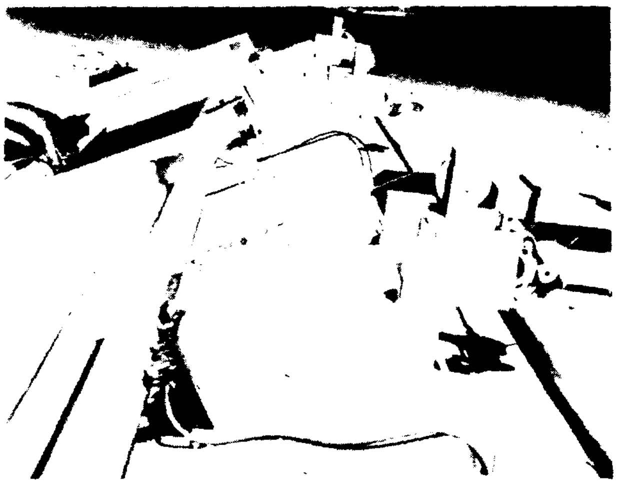
Adjoining the Spectrograph Room and Collimator Room "B" was the Photometric Room, 10x22 feet, with double-door access to the Spectrograph Room. This room was air-conditioned, but no insulation was provided. The walls were covered with plywood, and the roof rafters were exposed. The room had a 6-foot double-door entry from the outside and a workbench, 22 feet long.

Located behind Collimator Room "A" and adjacent to the Spectrograph Room was Electronics Room "B," 12x15 feet. The room was grounded by use of aluminum sheet placed over plywood for the floor and three walls and over Celotex insulation for the ceiling. The fourth wall utilized copper screen on open studs to complete the ground system.

The Electronics Support Room was 10x12 feet and was also located behind Collimator Room "A" but adjacent to Electronics Room "B." No insulation was provided on the walls, but the ceiling utilized Celotex. Entry was provided from the outside of Collimator Room "A" and Electronics Room "B." The room was air-conditioned with large units necessitated by the heat load from electronics equipment; although these units were located in the support room, they exhausted into Electronics Room "B." Since the wall separating the two rooms was screened on open studs, both rooms were cooled. A small workbench was also provided in the room.

A User-furnished motor generator set was located under a shed roof outside but adjacent to the building. This unit, as well as two compressors and two pumps for the air-conditioning units, was placed outside to reduce vibration to the building. The electrical power and lighting panels were located on exterior building wall under the same shed roof as the eqipment.

A personnel shelter was provided outside the building. The shelter was 5x6x7 feet high and was constructed of re-inforced concrete. About one-half of the building was below grade. It contained only a bench and a light and served as an emergency shelter for two people.



(Neg. No. W-957-1)

Figure No. 2-72. Sliding Hatch Mechanism — Stations J-1030 and J-1810.

STATION: J-1711

SITE: Johnston Island

USER: LASL

PURPOSE: Generator Shed and Trailer

PARTICIPATION: J-40, J-41

DESIGN PSI: None

CONSTRUCTION: 5-2-58/7-7-58

A User-furnished trailer and three antenn were all placed in line, and a User-furnishe motor generator set was located in a shelter. Two 100-kw, 3-phase generators supplied the power. The motor generator shelter was 8x8: feet high and of wood construction. The thr trailer receptacles provided were located on the exterior of the building. Instrument power in the trailer was supplied from the motor generat set which in turn was supplied power from t 100-kw generators. User-furnished starter and regulator were installed for the motor generator set.

STATION:	J-1810
SITE:	Johnston Island
USER:	NRL/LASL
PURPOSE:	Recording Shelter
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-8-58/7-7-58

This station utilized a new structure in joint occupancy with Station J-1030. The building was 48x64 feet, varying in height from 8 to 12 feet. A 12-inch-thick concrete slab supported the timber framed structure. The roof was insulated with fiberboard sheets, and the exterior walls were covered with plywood on the outside. Station J-1810 occupied an area 25x64 feet and one additional room. The room, Electronics Room "A," was 10x23 feet located adjacent to the Photometric Room of Station J-1030. It contained a double door at each end, one to the outside and one to the Camera Room. The framing was exposed on two walls, but insulation board was placed on the two exterior walls. The room was air-conditioned.

The remainder of Station J-1810 was divided into two 64-foot-long rooms. The room adjacent to and behind Station J-1030 and Electronics Room "A" was the Camera Room. The walls and ceiling of the room were covered with insulation board. The room behind was the Tracker Room, and the wall separating the two rooms was constructed of 12-inch thick concrete to a height of 5 feet. The wall contained thirteen 14-inch steel pipe sleeves 4 feet 1½ inches on centers with flanges on one end. Three sleeves had flanges on both ends. A stud wall above the concrete was sloped 1:1 toward the Camera Room. This was done to provide sight from points within the Tracker Room through the roof to Stations 40 and 41. A light-tight entry from outside was provided in one end of the Camera Room, and the Camera Room was made light-tight.

The Tracker Room floor was 1½ inches lower than the remainder of the building. The walls and ceiling consisted of exposed framing. The roof included a series of removable panels over 4x9-foot openings which were lined with 14-inch pipe sleeves of the concrete wall. Wood shutters, 3x4 feet, were placed in the rear wall of the Tracker Room to provide sight alignment from the mirrors in the Tracker Room to Station J-1812 light array on Sand Island. A track assembly was provided on the floor of the room to support User-furnished mirrors. The track was constructed of steel angles the length of the room. Entry to the Tracker Room was provided at each end from the outside. This was the only room of the building that was not air-conditioned.

STATION:	J-1811
SITE:	Johnston Island
USER:	NRL/LASL
PURPOSE:	Thermal Radiation Measuring
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-11-58/5-30-58

This 6-inch-thick concrete slab was 20 feet square. User-furnished shelters and motor generator sets were located on the slab.

STATION:	J-1812
SITE:	Sand Island (Johnston Island
USER:	NRL/LASL
PURPOSE:	Aiming Light
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	4-14-58/7-7-58

A 13-light array was placed 15 feet above grade. It was utilized to provide a light source for aligning the mirrors in Station 1810. The array was mounted on three guyed wood poles. Power was supplied from a 10-kw generator placed at the station.

STATION:	J-3230.01
SITE:	Johnston Island
USER:	SC
PURPOSE:	Recording Station
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-1-58/7-7-58

Occupying a portion of existing Building T-249, this station was located within the same area as Stations 3241.01 and 3440.01. The space was adjacent to that occupied by Station 613 and was 21x25 feet. Work benches were provided along the walls for a length of 46 feet. Power receptacles were located over the benches 2 feet on centers. The room was air-conditioned by a ceiling-hung unit which also fed air through a duct passing Station 613 and into the equipment room on the other end of the building. The end room adjacent to the 21x25-foot room was 21x11 feet in size and was used to house instrument racks. Existing wood studs in the area were removed, and three power receptacles were added, as well as lights in this and other rooms of the building.

STATIONS:	J-3231.01 through .08
SITE:	Johnston Island
USER:	SC
PURPOSE:	Rocket Launcher Pads
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-3-58/6-20-58

Each of these stabilized launching areas were 20 feet in diameter. In the center of each area a 6-foot-square concrete pad was placed with a survey monument. An additional survey monument was placed 60 feet in front of the pad. No power was supplied to these pads but a screened shelter was provided on the west end of the island where Stations J-3231.01 and .02 were located apart from the other launcher pads.

The screened room was 15x20x8-foot-high with a trussed rafter roof that was sheathed. Copper screen was fastened to the lower chords, and the walls were exposed studs covered on the inside with copper screening. The structure was skid-mounted with no floor and was grounded to rods at two corners.

STATIONS:	J-3240.01 through .03
SITE:	Sand Island (Johnston Island)
USER:	SC
PURPOSE:	Midot Station
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-26-58/7-7-58

Stations J-3240.01 on Johnston Island and .02 on Sand Island each consisted of a cleared level area 450 feet square with antenna support poles. Each station had nine 8-inch-diameter steel poles about 2 feet high. Four poles were located 90° apart, 209 feet from the center, four poles were located on the same lines but 139 feet from the center, and one pole was located at the center. User-furnished cable was placed from each pole to the center, and a protective barrier fence was provided along the cable runs for Station J-3240.02 only.

Station J-3240.03 was designed to be placed in the reef area east of Johnston Island with a similar installation. However, since the area was presumed to be in shallow water, the poles were higher and the User-furnished instrument trailer was to be placed on a sunken barge to be located near the center of the antenna area. Field investigation of the reef area indicated the construction was not feasible, since only isolated coral heads

(Neg. No. W-915-7)

Figure No. 2-73. Midot Station J-3240.01.

existed, none large enough to suitably site the facility. Consequently, Station 3240.03 was cancelled.

STATION:	J-3241.01
SITE:	Johnston Island
USER:	SC
PURPOSE:	Telemetry
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	4-14-58/7-7-58

This station occupied the same space as Stations J-3230.01 and J-3440.01 in Building T-249. Details of the modification are discussed under Station J-3230.01. In addition, two 5½ foot-square by 15-inch-thick pads were placed on the roof over the station room below. These pads contained adjustable antenna support base

STATIONS:	J-3260.01 through .06
SITE:	Johnston Island
USER:	SC
PURPOSE:	Launching Pad for Instrument Rockets
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-19-58/6-9-58

Each of these 70-foot-diameter stabilized areas contained a working area 36 feet in diameter. Six concrete survey monuments were placed within a fenced area, 18x36 feet, located at one end of the outer stabilized area. An additional monument was placed 25 feet out from the opposite side of the larger area.

Within the inner stabilized area was a 10-foot-square, 6-inch-thick concrete slab, thickened at one end to 3 feet for the 5-foot-square area. Two additional slabs, 4x12x2 feet deep, were located adjacent to the other slab. Each of the slabs contained threaded inserts or anchor bolts to tie down the launcher that rested on all three slabs.

STATIONS:	J-3261.01 and .02
SITE:	Johnston Island
USER:	SC
PURPOSE:	Launching Pad for Instrument Rockets
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-19-58/6-4-58

Except for the size of the slabs, these stations were similar to the J-3260 series. One slab was 5 feet square and 2 feet deep; the other two were 3x10x2 feet deep.

STATION:	J-3262
SITE:	Johnston Island
USER:	SC
PURPOSE:	Photographic Building
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	4-21-58/7-7-58

A wood structure, 12x17x8 feet, with attached storage room, 10x12x8 feet, was required for this station. The pitched roof of the main portion of the building was removable in two sections, each section sliding down tracks from either side of the roof ridge. The operation of the sliding roof sections was accomplished by the use of two explosive links actuated by a single remote signal. A hand-winch was provided on the building to raise the sections again to the closed position. Hinged-down shutters were provided on the two 17-foot walls just under the eave. Nominal lighting and receptacles were also included in the design.

STATION:	J-3440.01
SITE:	Johnston Island
USER:	SC
PURPOSE:	Microbaragraph Recording Station
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-1-58/7-7-58

This station occupied the same space as Stations J-3220.01 and J-3241.01 in Building T-249. Details of the modification are discussed under Station J-3230.01.

STATION:	J-6001
SITE:	Johnston Island
USER:	ABMA
PURPOSE:	Missile Firing Pad and Tower
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	4-14-58/7-7-58

This station consisted of a mobile tower, an auxiliary pad, and a firing pad. The tower had been previously erected on Site How, but was dismantled and relocated with modifications. It was of bolted steel frame construction 24 feet square and 84 feet high, The existing roof structure, roofing and siding, wall louvers, girts, sliding and swing doors were not re-installed. There were six platforms, each framed with steel and covered with aluminum grating on which plywood was placed to close the grating spaces. The platforms had been designed to allow the tower to be moved so as to encompasss the missile in a vertical position.

The platform at the 4-foot level was utilized as access to the other platforms and the elevator. The plan opening in this platform was 15x17 feet, and the remaining portions were covered with grating. An extension, 5x24 feet, was provided at this level outside the main tower framing on each of two opposite sides. The extensions were used to support concrete ballast blocks which stabilized the tower.

The platforms at the 12-foot, 41-foot, 50-foot, and 64-foot levels contained a 6⅔-foot-diameter opening in the center, and the portion of the deck from the front edge of the platform to the opening was designed as a pair of hinged platform sections which were counterweighted for manual operation. The existing 6⅔-foot-diameter opening in the 12-foot level platform was increased to 9 feet because a new orientation of the missile fins necessitated additional clearance cut-out. The plywood on top of the grating at this level was field cut to fit the contour of the missile and fins. A platform was provided at the 77-foot level to seat the elevator hoisting equipment. Checkered floor plate covered an area 8x24 feet. Because the siding was not re-installed, all platform levels were provided with pipe posts and cable handrails.

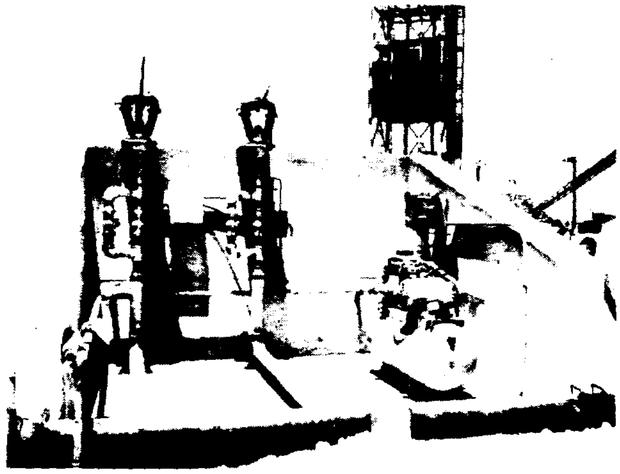
A personnel elevator, 4 feet square, operated to all levels, Interlocked safety gates were provided at each platform level, as well as other standard safety features. An access ladder extended the full height of the tower on the inside of the framing.

The tower was supported on four 4-wheel trucks equipped with hydraulic brakes. Movement of the tower was effected by a simple towing winch and cable system between the firing and auxiliary pads located 150 feet apart. The winch was located just beyond the auxiliary pad but was controlled from within the tower.

Power was supplied from a generator plant located near the site. The power connections to the tower was made through a cord located on the tower and plugged into a receptacle on the firing pad. Lights and receptacles were provided at all platform levels.

The foundation for the tower at the firing and auxiliary pads consisted of a concrete mat 36 feet square and 2¼ feet thick. Provision was made to tie down the tower to its foundation when it was subjected to high winds. This was accomplished through the use of bolts connecting the tower wheel trucks to metal plates embedded in the foundation. Approximately one-half the number of connector bolts proposed for use at Site How was used because the removal of the tower siding reduced the uplift. Each pair of tower rails between the two foundations was set on concrete 8 feet wide and 1¼ feet thick. The tracks were placed on 8x8 timber seats spaced 8 feet on centers, then concreted in place. Two sandbag revetments for trailers were located about 100 feet from the firing pad and about 40° apart. They were 13 feet high, with one 20 feet long and the other 30 feet long. Each had 12-foot-long wing walls. Each of two small concrete revetments were located 80 feet from the firing pad and 50° apart on the windward side of the pad. They were 12 feet long, 6½ feet high, with 10-foot-long wing walls and were used to house fire protection water nozzles.

The fire protection system for this station was supplied with sea water from two vertical turbine diesel engine-driven fire pumps mounted on an intake structure located at the edge of the lagoon with intake lines extending into the lagoon. Each of these pumps had a capacity of 1000 gpm at a discharge pressure of 100 psi which gave a total fire-fighting capacity of 2000 gpm with both pumps operating. The pumps were manually started and operated continuously while fire protection was required, maintaining a constant pressure in the fire lines. Ample diesel fuel storage and supply for the engines were provided. The discharge from the pumps was run through a surface-installed fire line terminating at the two concrete fire protection revetments. Two fixed monitor type fire nozzles were mounted on each revetment to direct the water stream



(Neg. No. W-958-12)

Figure No. 2-74. Fire Protection Revetment at Station J-6001.

directly on the firing pad at the base of the missile.

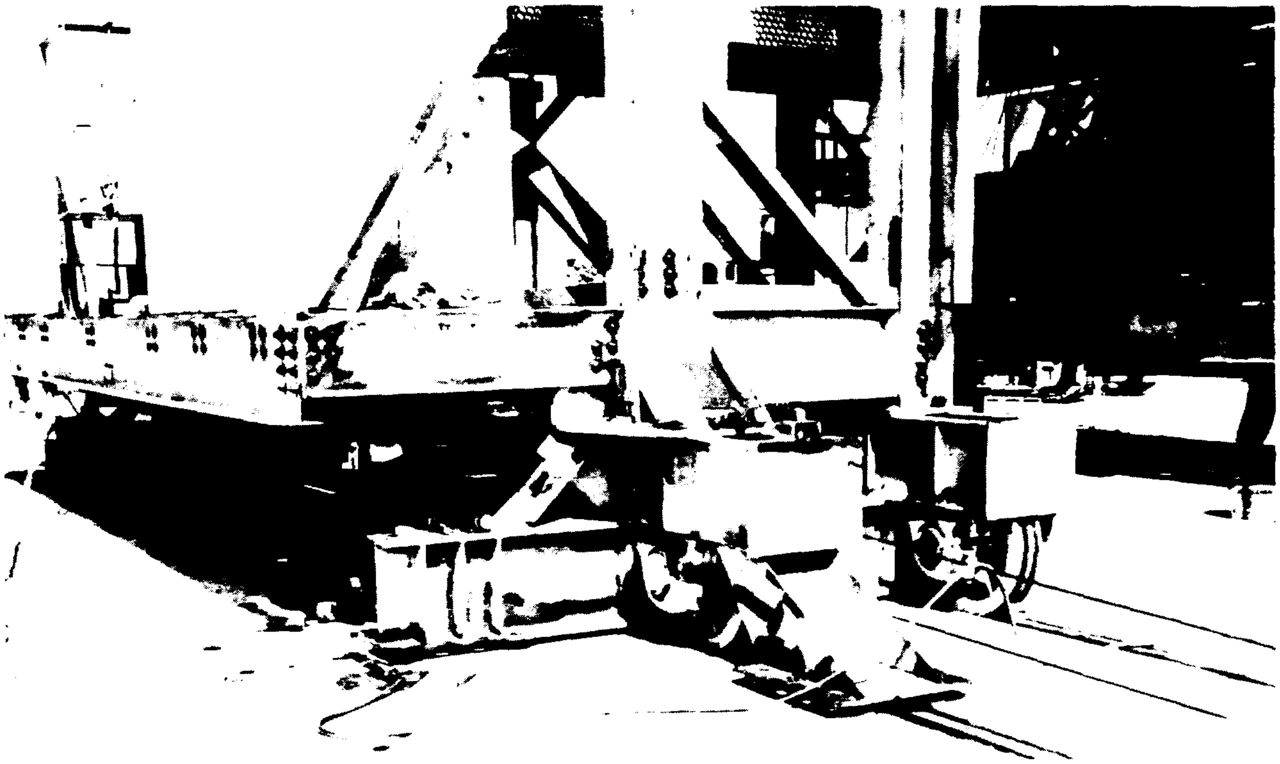
Water was supplied to these nozzles by remote control with the operating switch located in the Bunker, Station J-6002. This switch energized an electric solenoid air pilot which supplied air to pneumatic valve operators. Air for the valve operators was supplied by an automatic air compressor installed behind one of the concrete revetments.

Additional fire protection was provided by a fire hydrant installed in the area with an adjacent hose house containing required hose, nozzles, and other necessary fire fighting equipment.

Cable ditches were provided between the trailer revetments, between the firing pad and the 30-foot trailer revetment, and to Station J-6002. Pipe sleeves were placed in the concret track support where the ditches crossed th tracks. A concrete pull box was provided to the end of the cable ditch at the edge of the firing pad tower foundation. Three 12-inch-diamete pipes extended from this pull box to three quad rants of the foundation. An 8-inch pipe conduit was placed from the 20-foot trailer revetment to one of the 12-inch pipes at the tower founda tion.

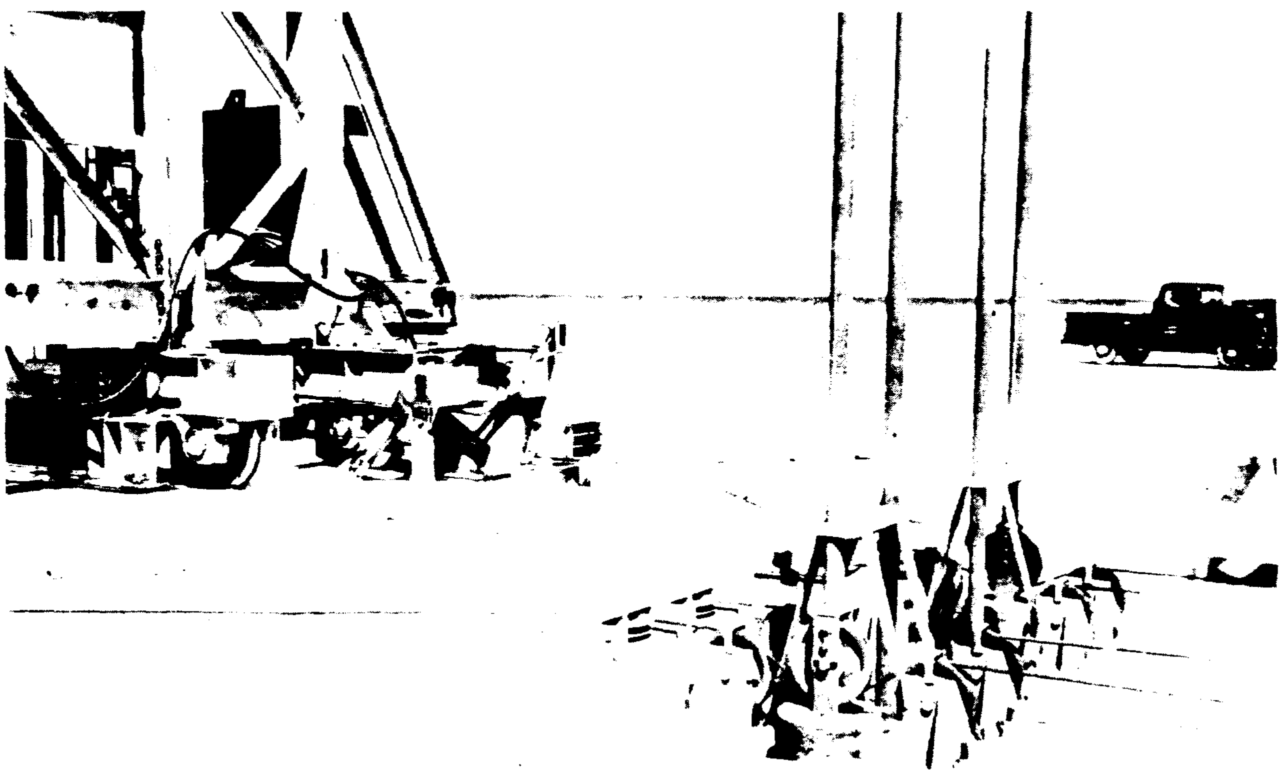
A skid-mounted timber personnel shelter, 12 feet square and 7 feet high, was placed close to the firing pad. It contained receptacles an lights circuited to a portable plug which connec ed to a power receptacle on the pad.

The entire firing pad area was illuminate by floodlights, as well as the railway between and the auxiliary pad. Receptacles were provided throughout the pad area for trailers and miscellaneous equipment.



(Neg. No. W-903-3)

Figure No. 2-75. Tower Tie-down Detail — Station J-6001.



(Neg. No. W-915-11)

Figure 2-76. Transfer Cable Arrangement — Station J-6001.

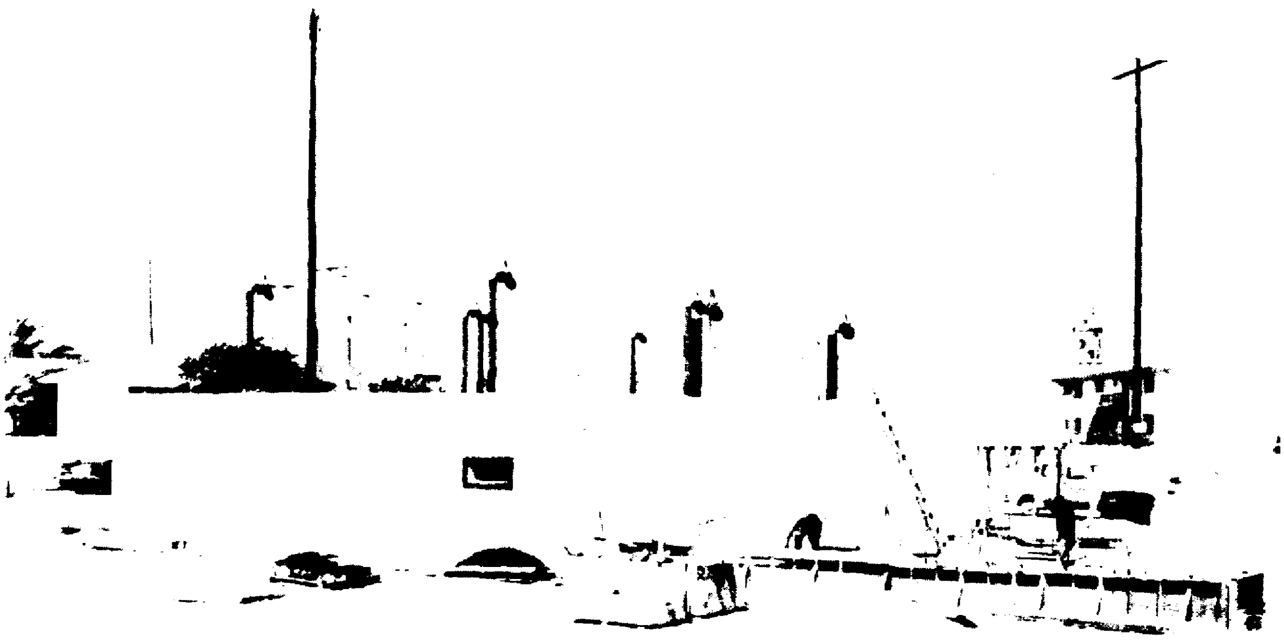
STATION:	J-6002
SITE:	Johnston Island
USER:	ABMA
PURPOSE:	Control Bunker
PARTICIPATION:	J-40, J-41
DESIGN PSI:	1.5 psi
CONSTRUCTION:	4-21-58/7-7-58

An earth-covered, re-inforced concrete bunker structure, this station was 43x53x10-feet high and had 12-inch thick walls, a 14-inch roof, and a 6-inch floor slab. The forward wall was 14 inches thick. The walls were supported on spread footings. There were four rooms within the building: two instrument rooms, a stand-by room containing Station J-70, and an equipment room containing Station J-260 and a latrine. There were cable ducts on the floor along three walls of each instrument room, along two walls of the stand-by room, and one wall of the equipment room. The ducts were formed by placing increments of 3½-inch-high angles on the floor to contain cables and to support continuous plywood covers. A concrete cable duct extended out of the building through the fill from the interior cable ducts. Cables from the bunker extended from the duct to the firing pad and were laid in an earth ditch.

The ceilings and upper half of the walls of the building were soundproofed through the use of acoustical tile nailed to wood strips embedded in the walls and ceilings. Entry to the structure was through a steel blast-resistant door existing in stock at Jobsite. The design of the concrete at the door was modified to allow utilization of this door to expedite construction and door fabrication time. Access to the top of the roof fill was accomplished by means of a wooden stair. A 3-foot-wide by 1-foot-high double-plate glass window on the forward wall provided sight to the firing pad. The earth-cover in front of the wall was sloped out of the line of sight.

The building was air-conditioned and dehumidified. Salt and fresh water required for the system was obtained from the existing water distribution system nearby and was piped into the structure.

Electrical receptacles were provided along the cable ducts as well as on the walls. Lighting of the rooms was accomplished with fluorescent fixtures. The fire protection system at the firing pad was operated by a remote control located in the bunker adjacent to the window at the front wall. Steel rack supports were provided for 25 instrument racks and were located adjacent to the cable ducts in the building.



(Neg. No. W-978-3-J)

Figure No. 2-77 Station J-6002 — 55% Complete.

(Neg. No. W-900-8)

Figure No. 2-78. Equipment Room — J-6002.

STATIONS: J-6003.01 through .04
SITE: Johnston Island
USER: ABMA
PURPOSE: Beat-Beat Station
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 4-15-58/6-5-58

Stations J-6003.01, .02, and .03 each utilized a generator shelter 5 feet square, 4 feet high constructed of steel frame with removable plywood panels. A survey monument was provided at each end of the four stations, but Station J-6003.04 was not used.

STATION: J-6004
SITE: ABMA
USER: Johnston Island
PURPOSE: DOVAP Transmitter
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 5-15-58/6-2-58

This station consisted of a User-furnished trailer. Signal and telephone cables were placed to the station as well as power from a trailer receptacle fed from a 60-kw generator which also served Stations J-6007.01 and .02.

STATIONS: J-6006.01 and .02
SITE: Johnston Island
USER: ABMA
PURPOSE: LOX plant
PARTICIPATION: J-40, J-41
DESIGN PSI: None
CONSTRUCTION: 4-15-58/7-7-58

Station J-6006.02 consisted only of a parking area for two User-furnished trailers. The trailers were to be utilized as stand-by units for two trailers of Station J-6006.01.

Station J-6006.01 consisted of parking for seven trailers used in the production and storage of liquid oxygen. The area was lighted by four floodlight arrays. Power was provided for two trailers by distribution from the 150-kw generator power plant.

(Neg. No. W-955-11)

Figure No. 2-79. Fog Nozzles at Station J-6006.

The fire protection system for Station J-6006.01 was supplied with sea water from two vertical, turbine diesel engine-driven fire pumps mounted on a structure built out from the main Cargo Pier with the pumps taking suction directly from the lagoon. Each pump had a capacity of 1000 gpm at a discharge pressure of 100 psi, which gave a total fire-fighting capacity of 2000 gpm with both of the pumps operating. The pumps were manually started and operated continuously while fire protection was required, maintaining a constant pressure in the fire lines. Ample diesel fuel storage and supply for the engines were provided. The discharge from the pumps was run through a steel surface installed fire line to the LOX Plant area to supply four overhead-mounted fog nozzles arranged for complete coverage of the LOX generating and storage trailers.

Water to the four fog nozzles was remotely controlled by a switch which energized an electric solenoid air pilot which supplied air to pneumatic valve operators. Air for these operators was supplied from an automatic air compressor installed at a safe distance from the LOX plant.

Additional fire protection was provided by a fire hydrant installed adjacent to the LOX Plant area with an adjacent hose house containing required hose, nozzles, and other necessary fire-fighting equipment.

STATIONS:	J-6007.01 and .02
SITE:	Johnston Island
USER:	ABMA
PURPOSE:	Alcohol and Fuel Storage
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	4-16-58/6-26-58

Station J-6007.01 was a canvas-covered wood-frame shelter for the storage of six 55-gallon drums, and power for the mixing of alcohol. The power was fed from the 60-kw generator which supplied Stations J-6007.02 and J-600[illegible] as well.

Station J-6007.02 consisted of a canvas covered, wood-framed shelter for 146 fuel drums A shelter was provided also over the User-furnished trailer on the site.

STATION:	J-7410
SITE:	Johnston Island
USER:	AFOAT
PURPOSE:	Seismic Project
PARTICIPATION:	J-40, J-41
DESIGN PSI:	None
CONSTRUCTION:	5-5-58/7-7-58

Located in existing Building P-233, this station was an underground concrete structure about 20x90x7 feet. Four 12-foot-long workbenches were provided in the portion of the building occupied by the Station. A wood-stud partition was located across the building width allocating 45 feet to Station J-7410. The area was air-conditioned by a unit placed on top of the fill with inside ductwork throughout the length of the structure. New lighting was included for the entire building.

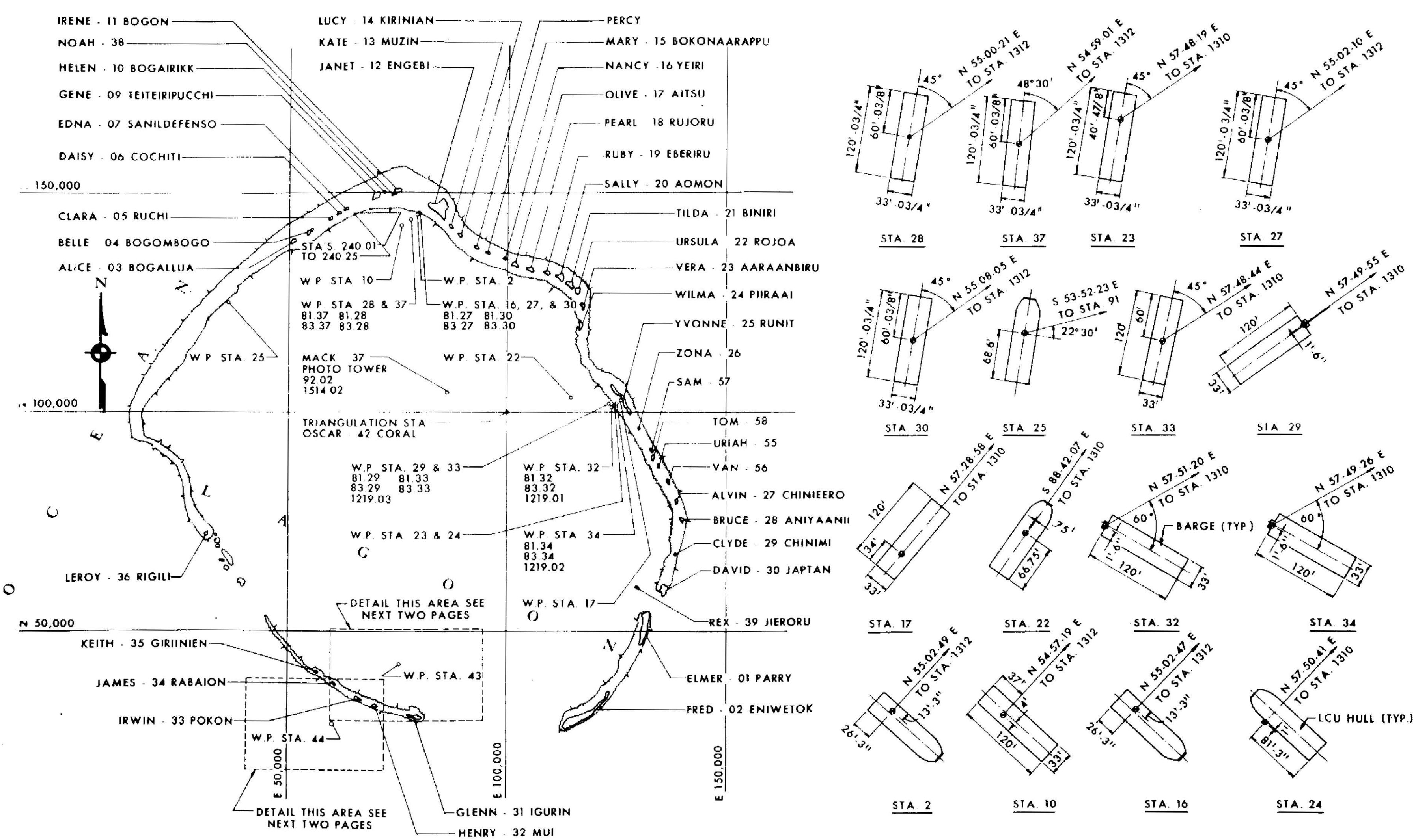


Figure No. 2-80. Scientific Stations — Eniwetok Lagoon.

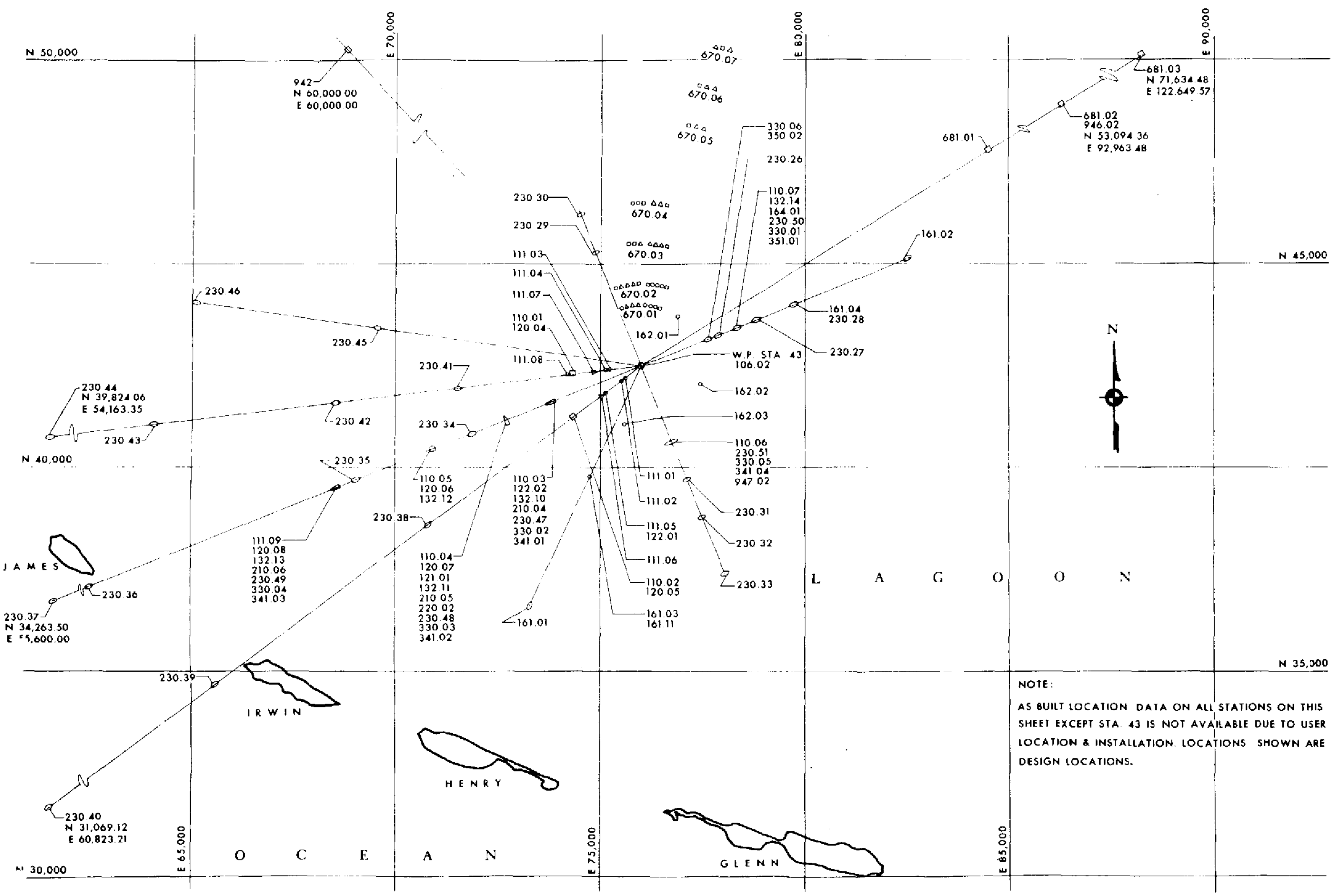


Figure No. 2-81. Station 43 Layout — Eniwetok Lagoon.

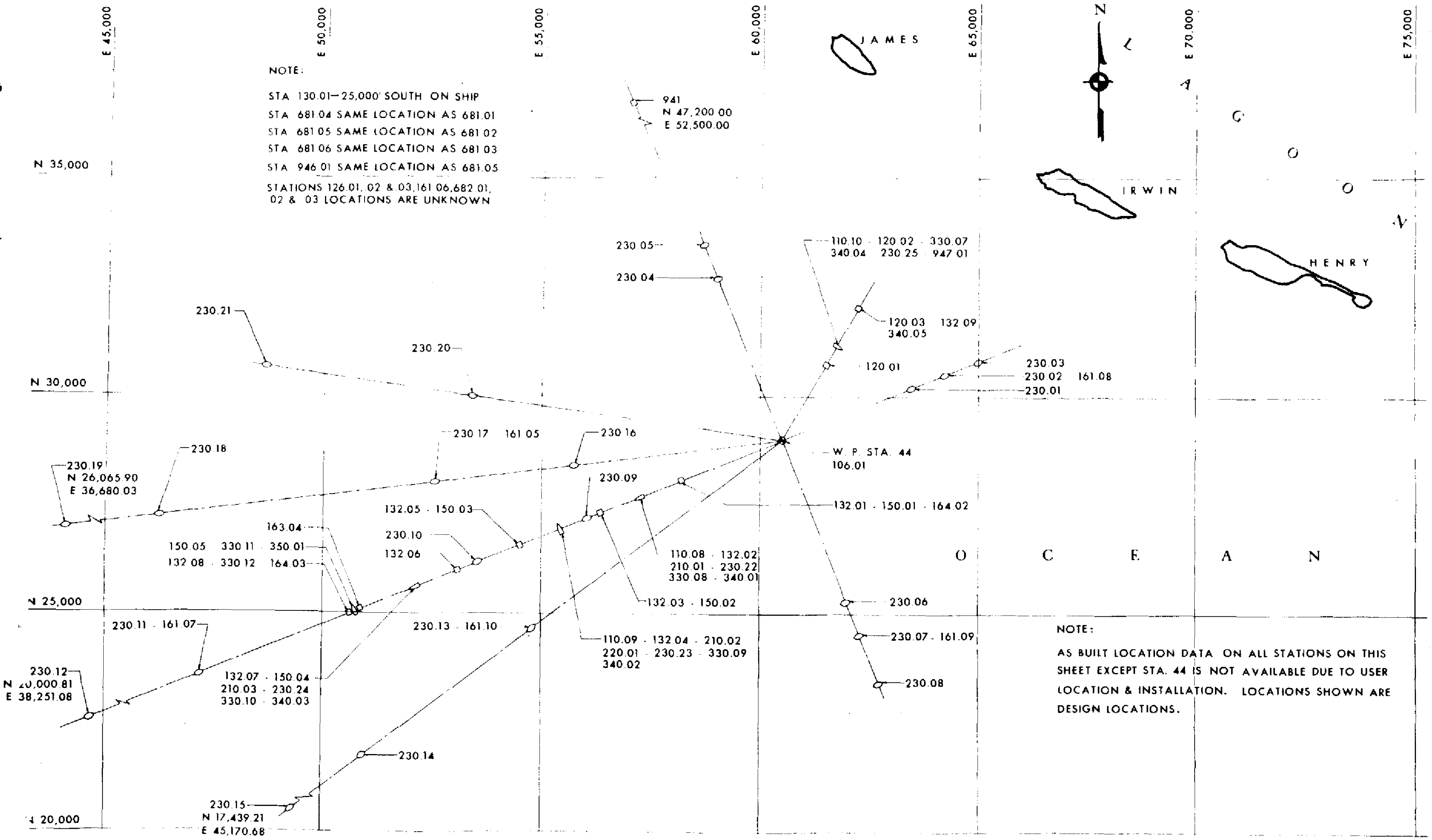


Figure No. 2-82. Station 44 Layout — Eniwetok Ocean.

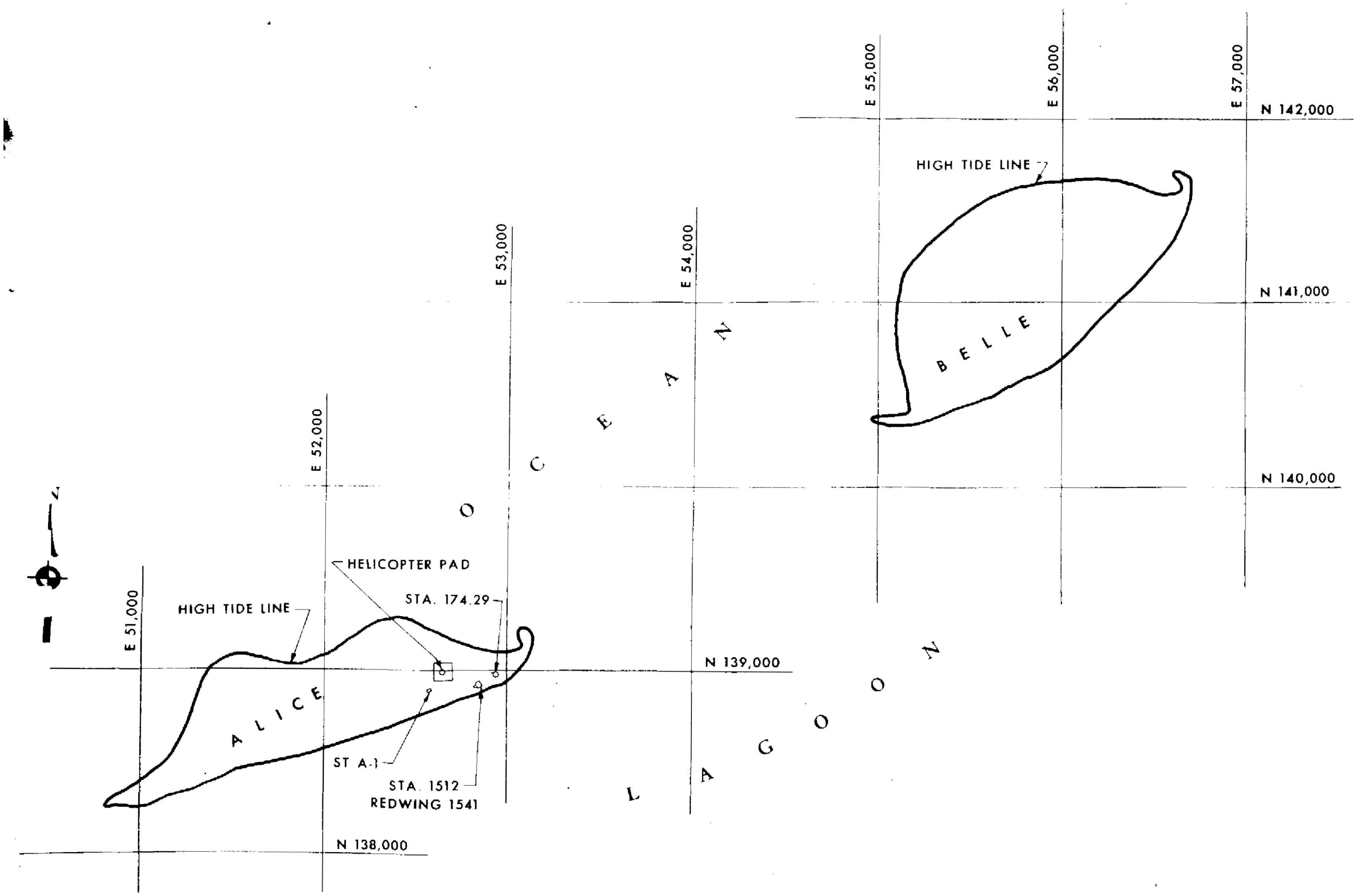


Figure No. 2-83. Scientific Plot Plan — Alice — Belle.

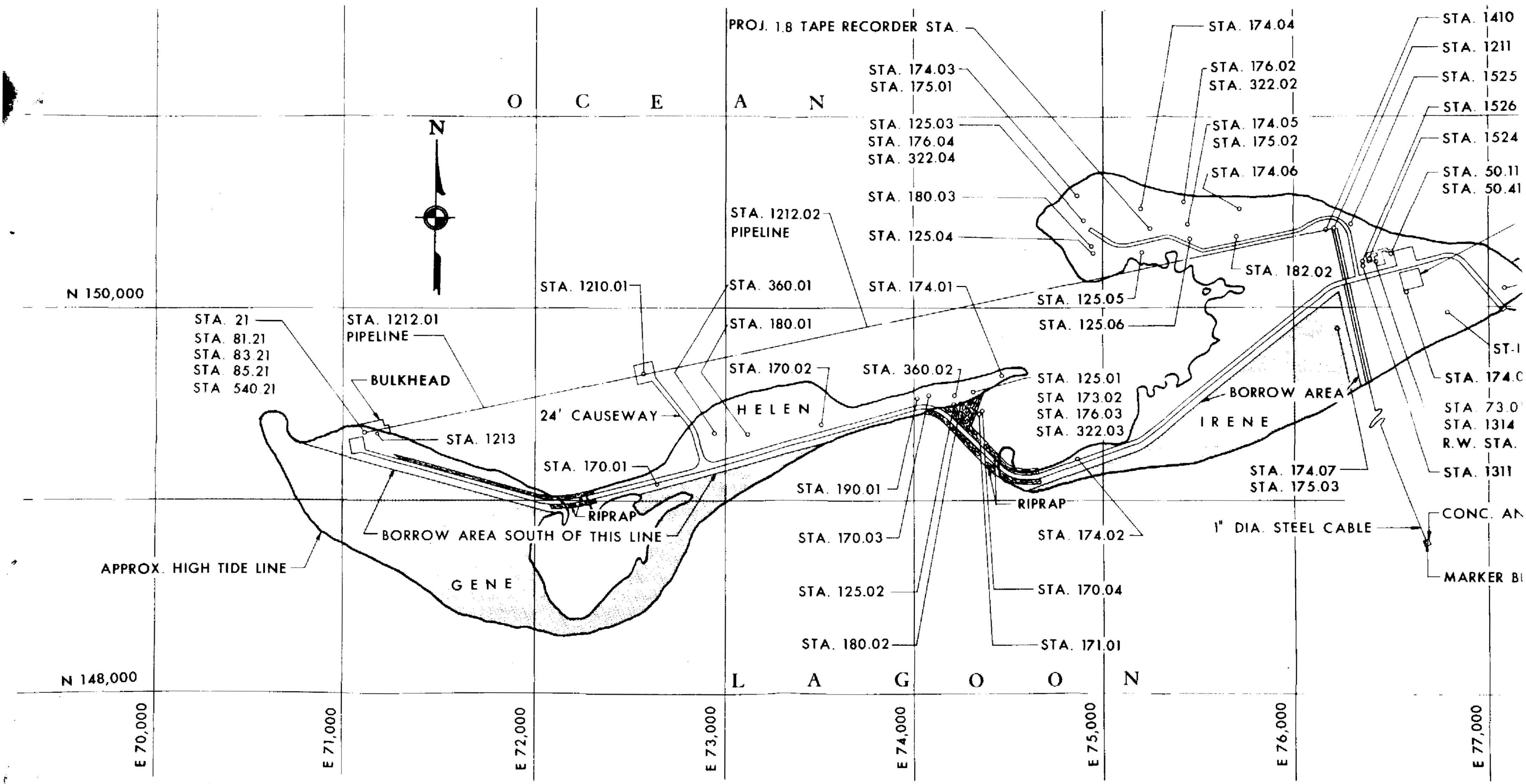
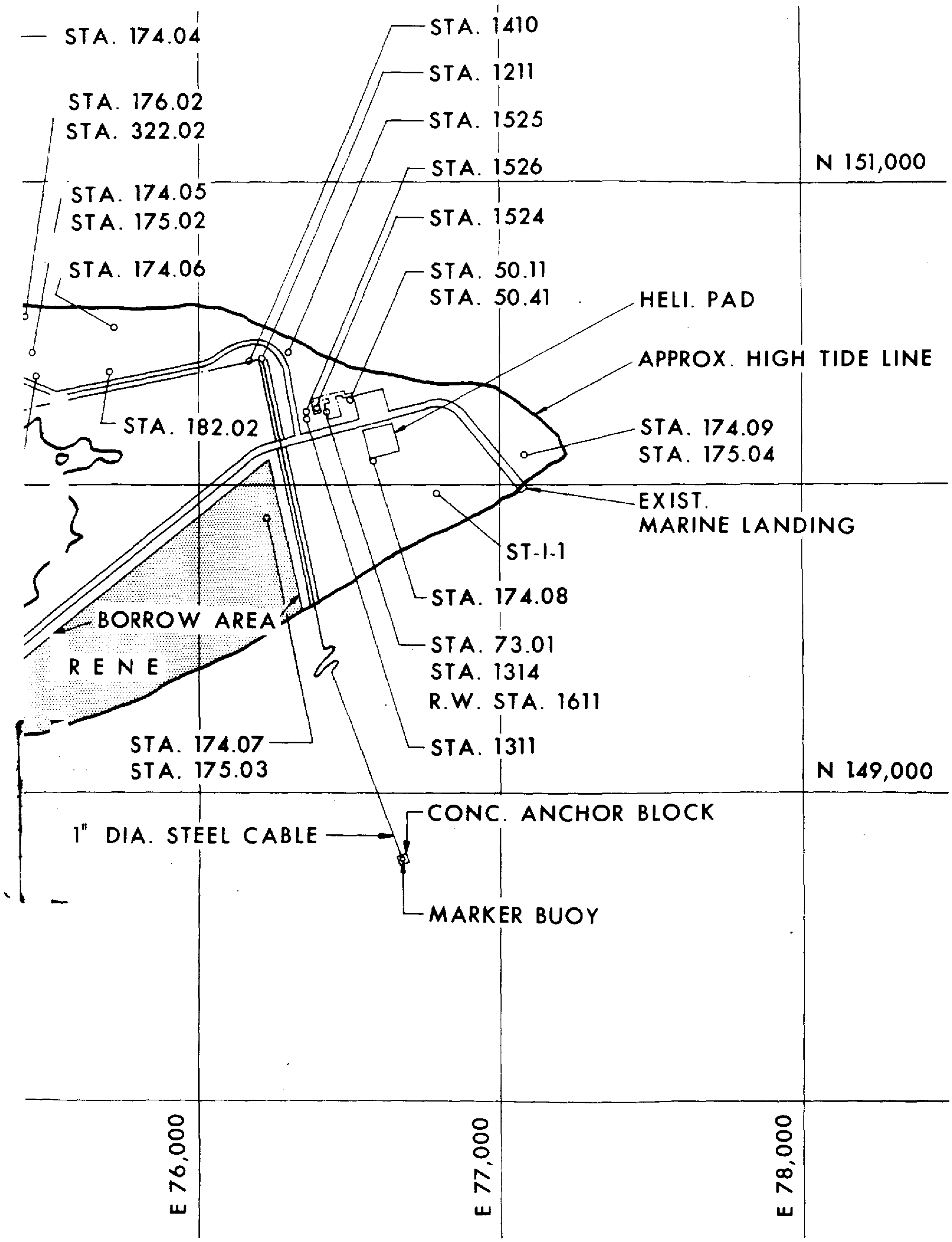


Figure No. 2-84. Scientific Plot Plan — Gene — Helen — Irene.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STA. 182.02
STA. 174.09
STA. 175.04
EXIST.
MARINE LANDING
ST-I-1
STA. 174.08
BORROW AREA
STA. 73.01
STA. 1314
R.W. STA. 1611
RENE
STA. 174.07
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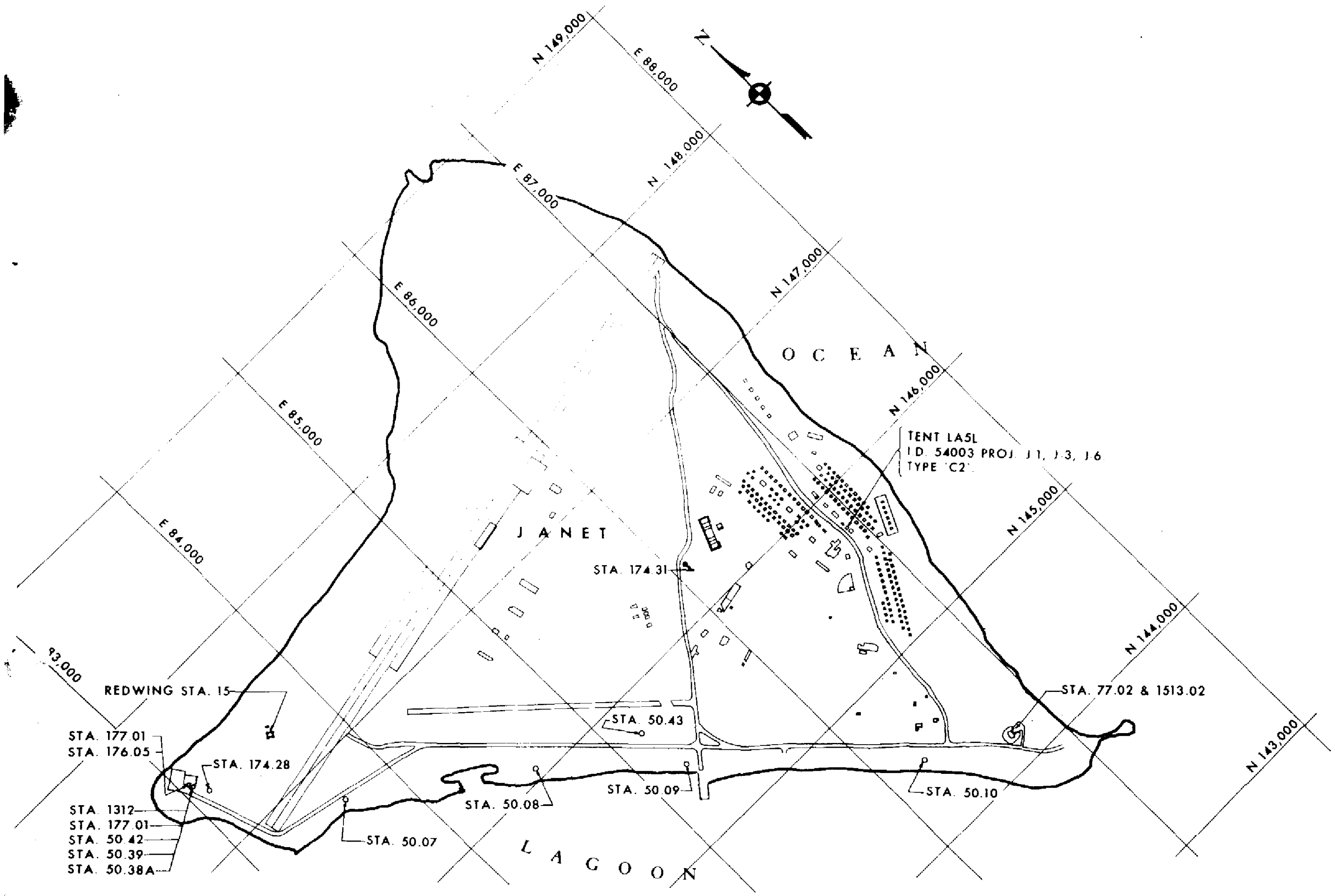


Figure No. 2-85. Scientific Plot Plan — Janet.

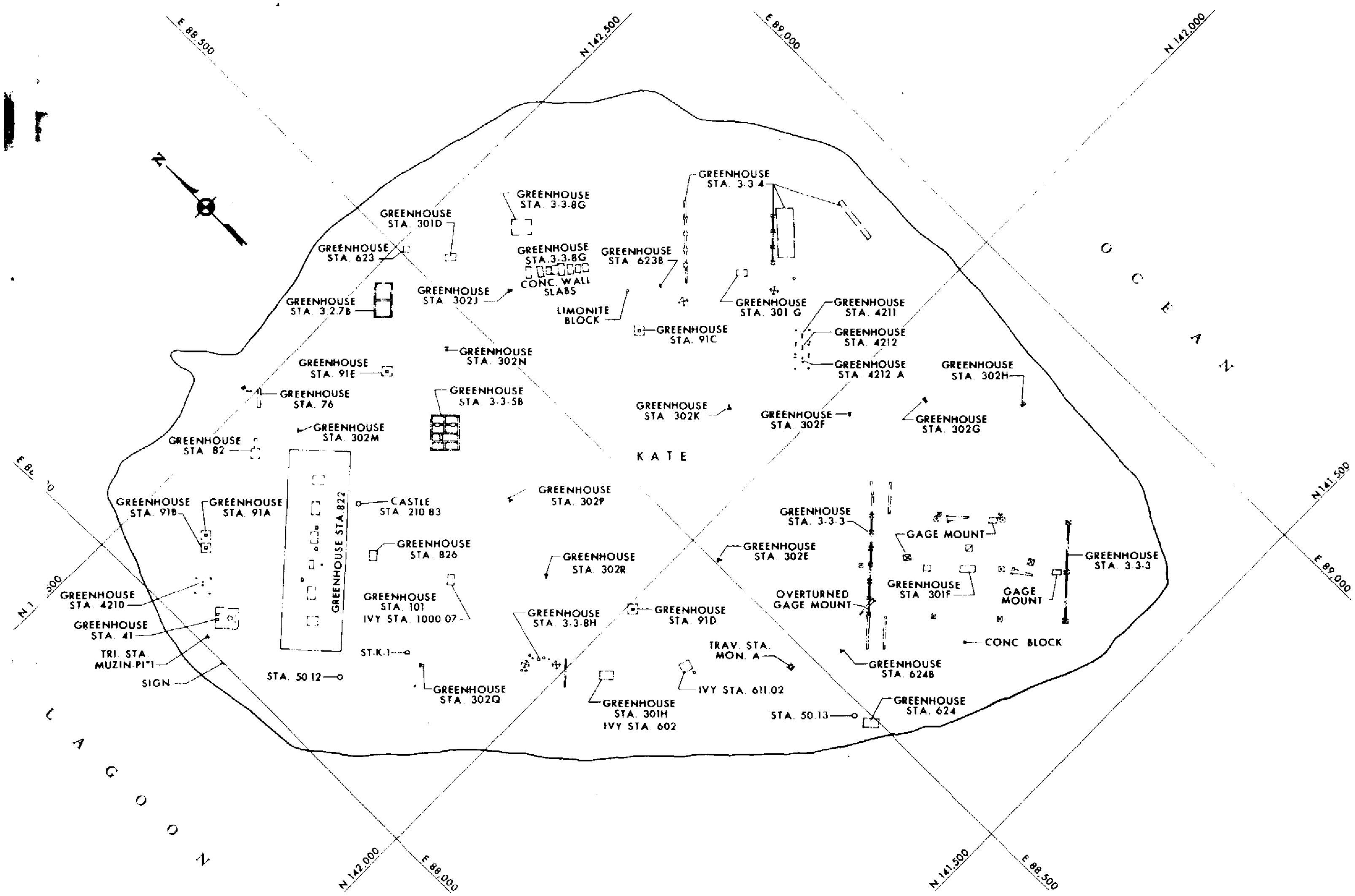


Figure No. 2-86. Scientific Plot Plan — Kate.

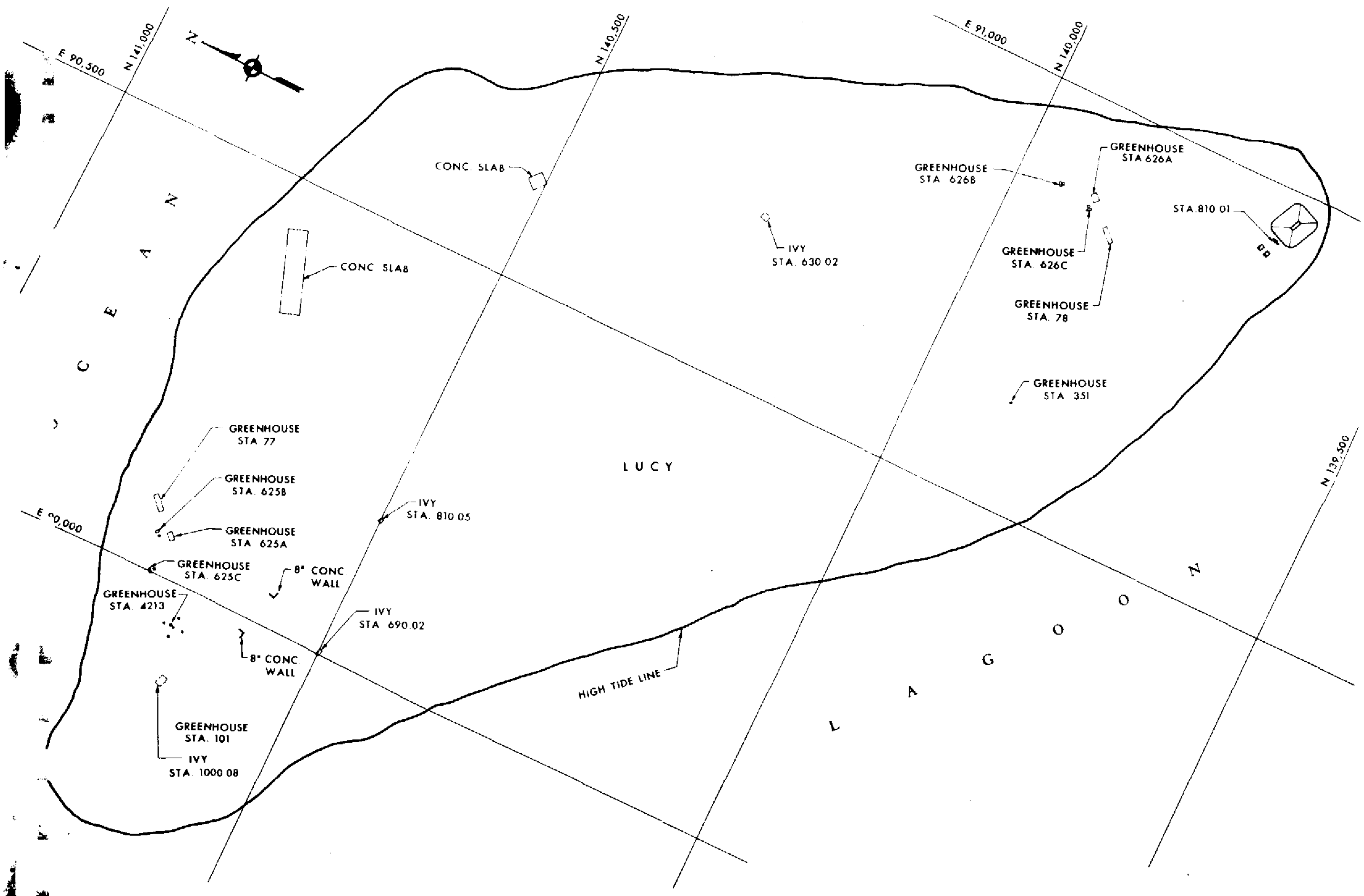


Figure No. 2-87. Scientific Plot Plan — Lucy.

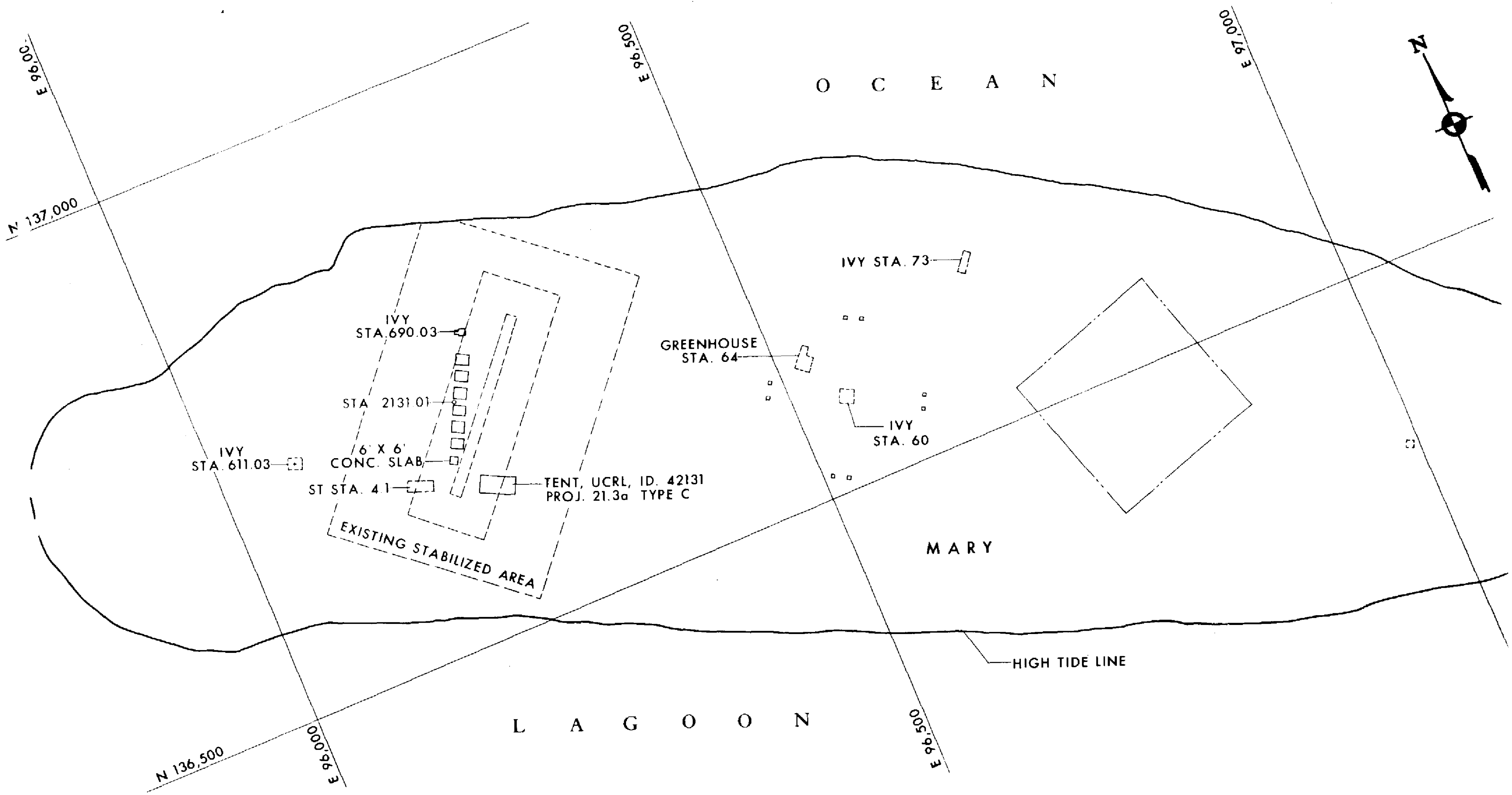
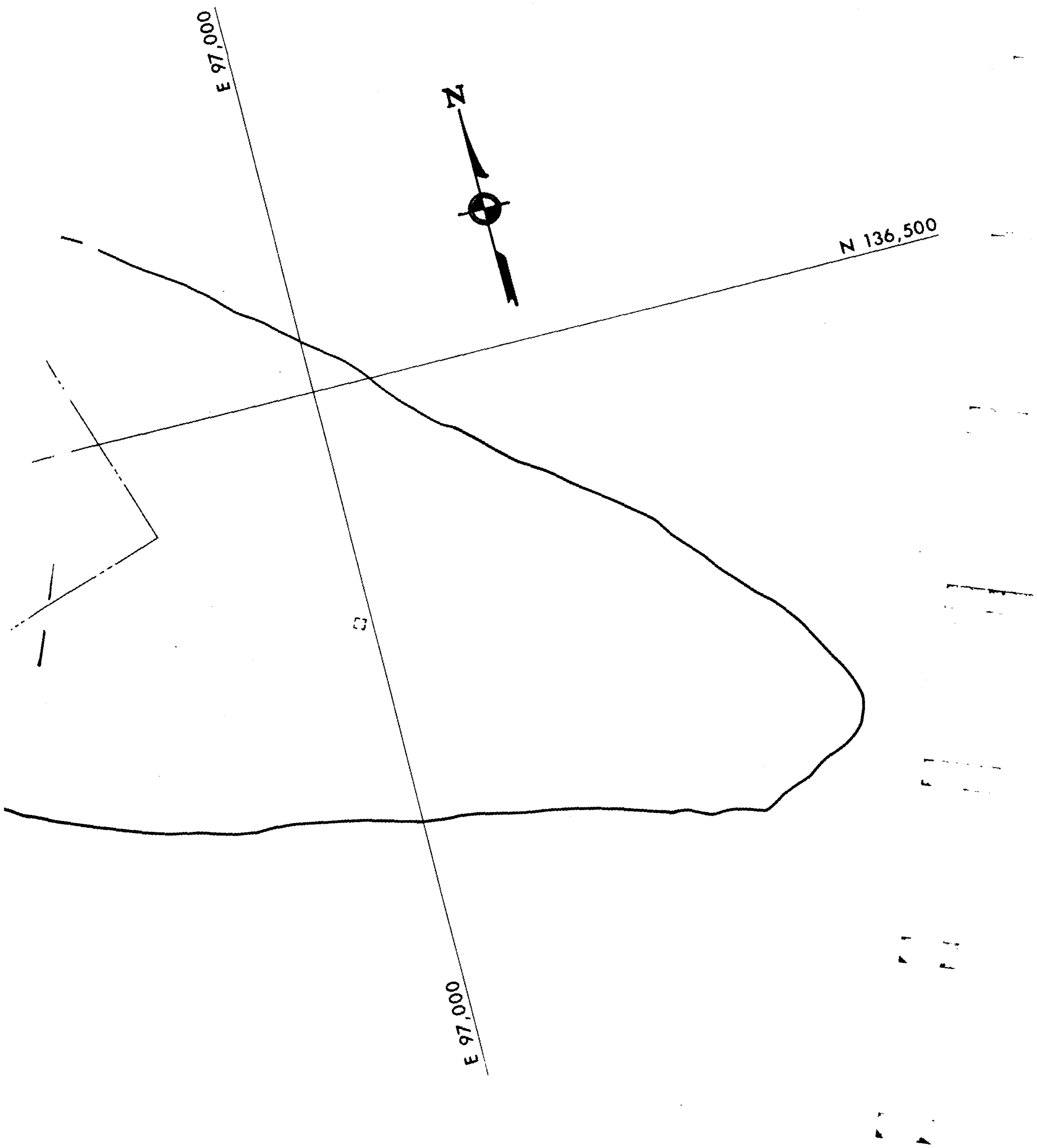


Figure No. 2-88. Scientific Plot Plan — Mary.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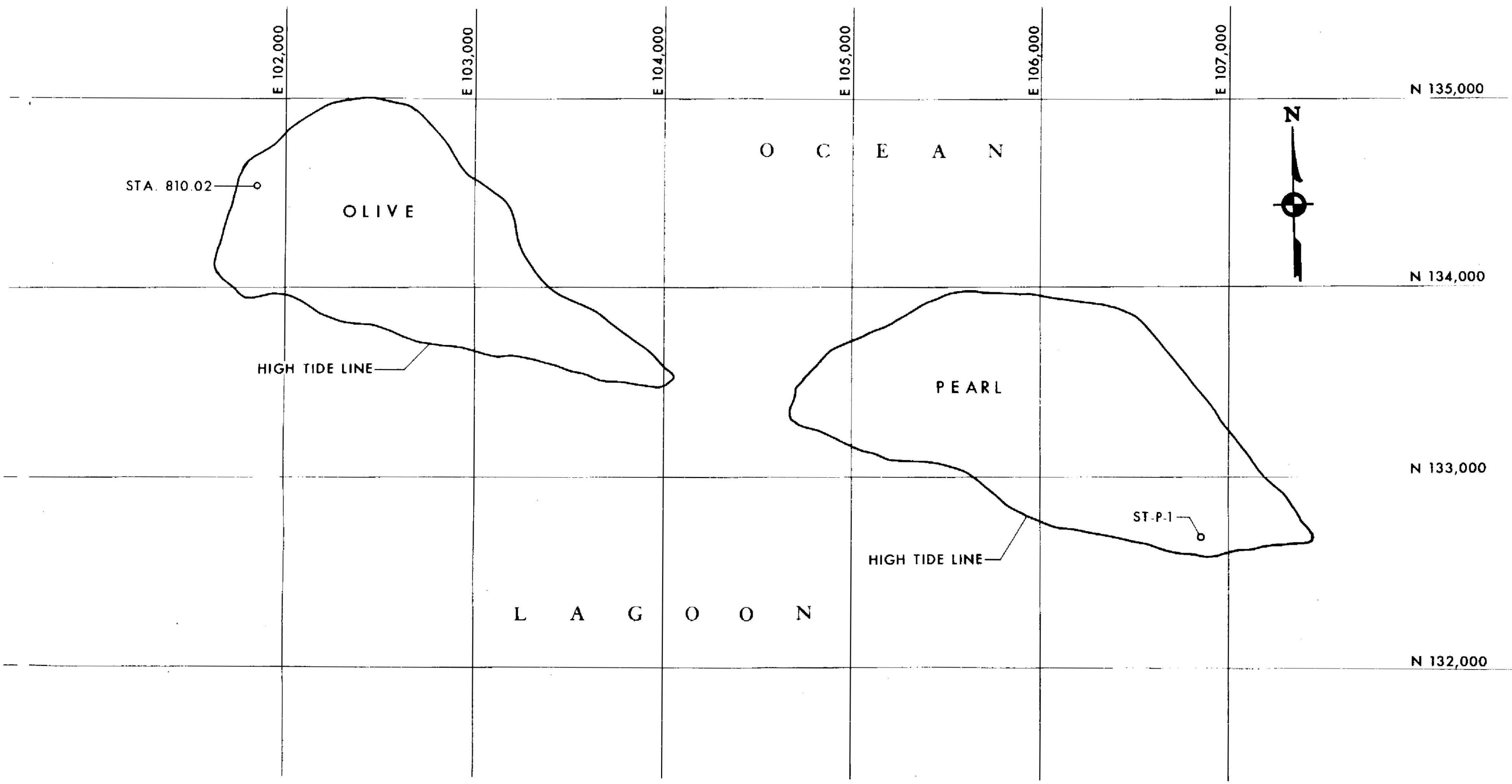
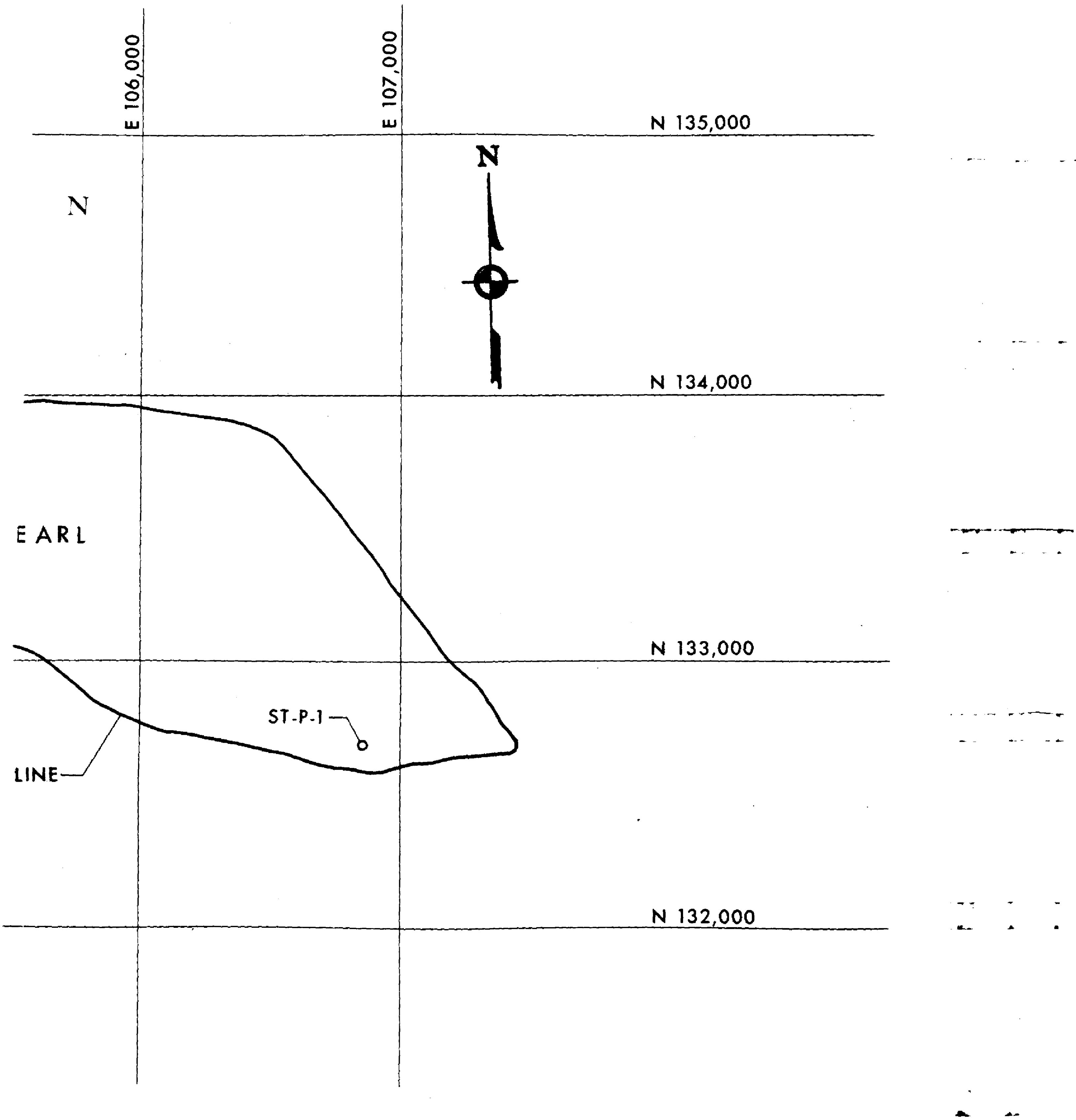


Figure No. 2-89. Scientific Plot Plan — Olive — Pearl.



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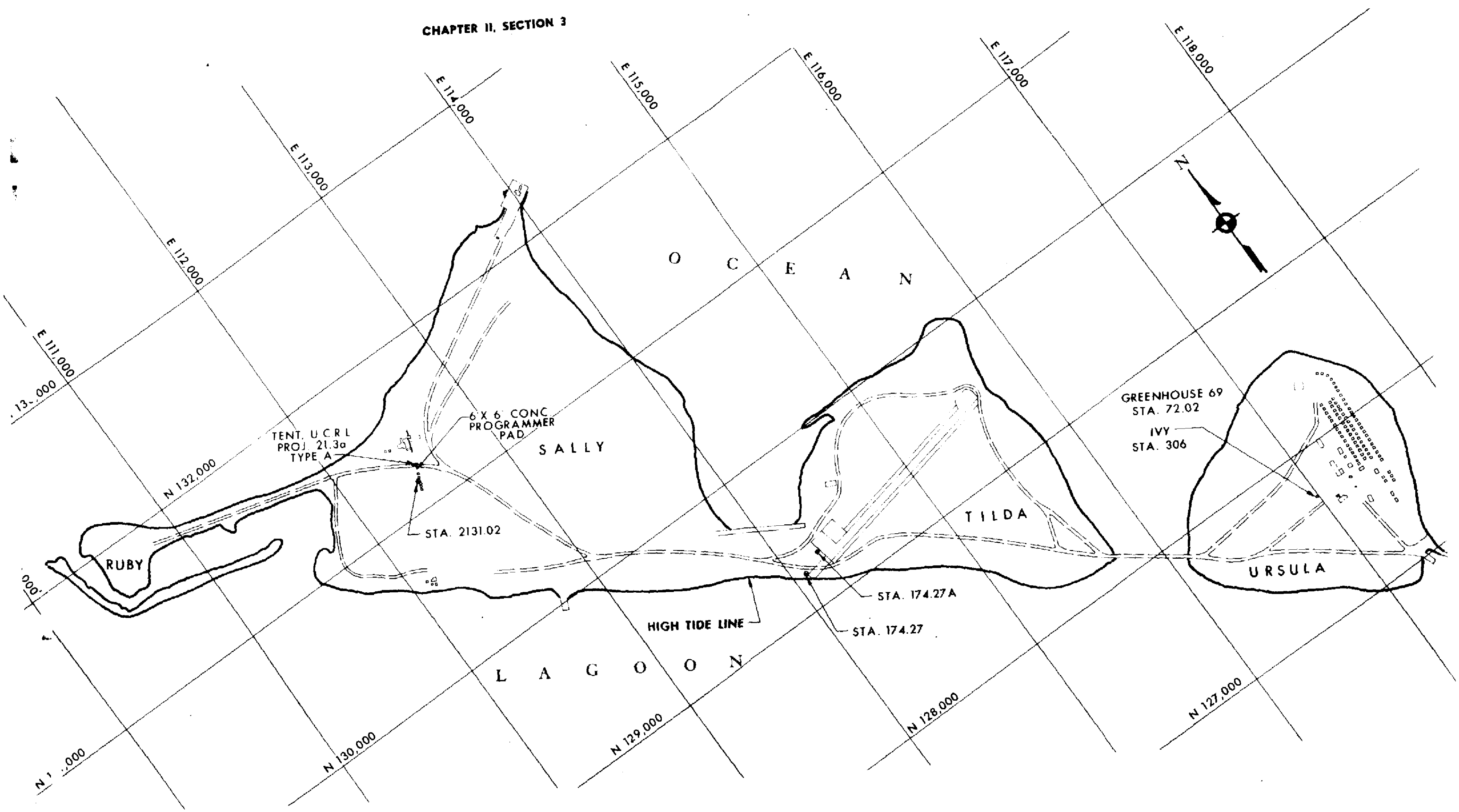


Figure No. 2-90. Scientific Plot Plan — Ursula Complex.

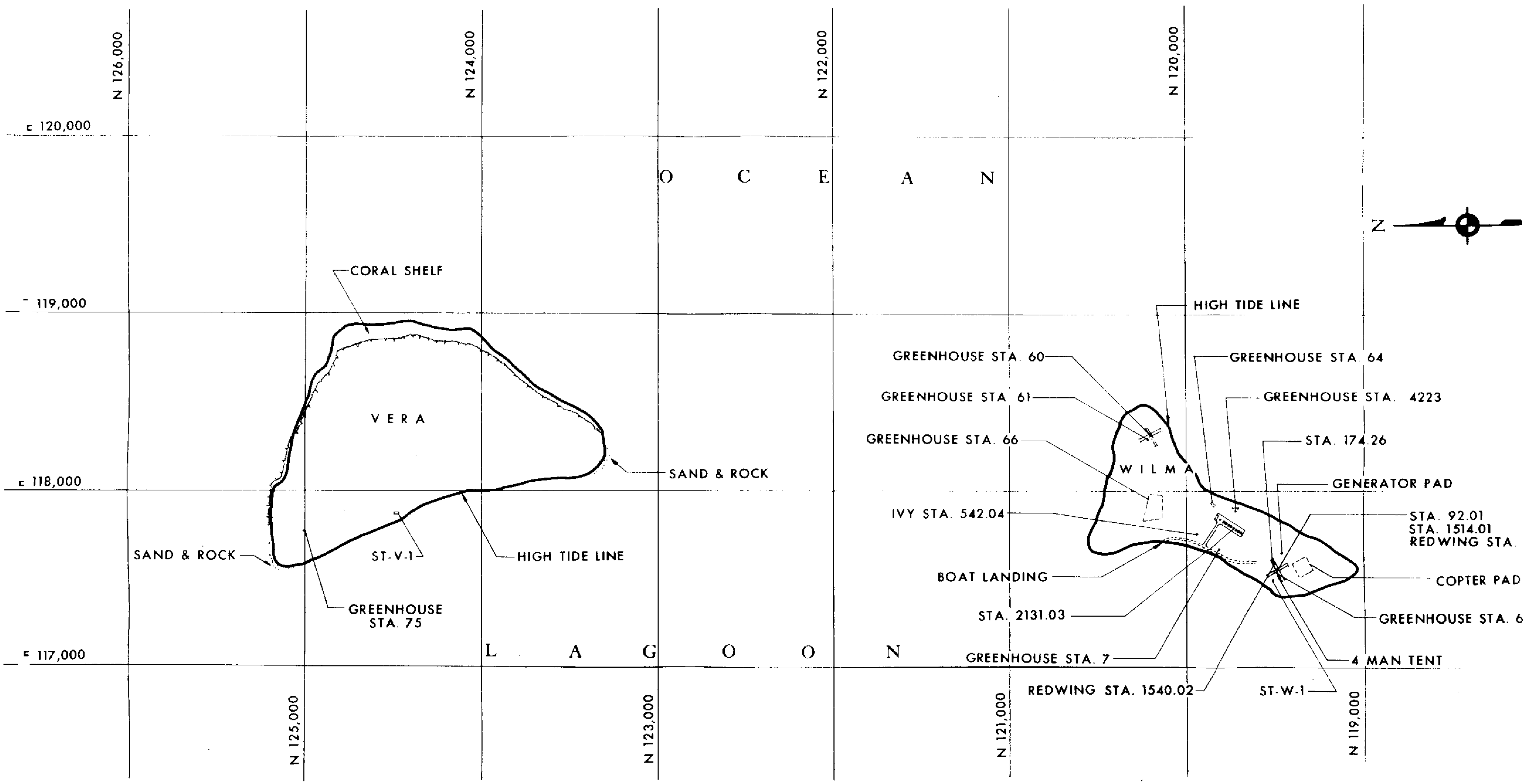


Figure No. 2-91. Scientific Plot Plan — Vera — Wilma.

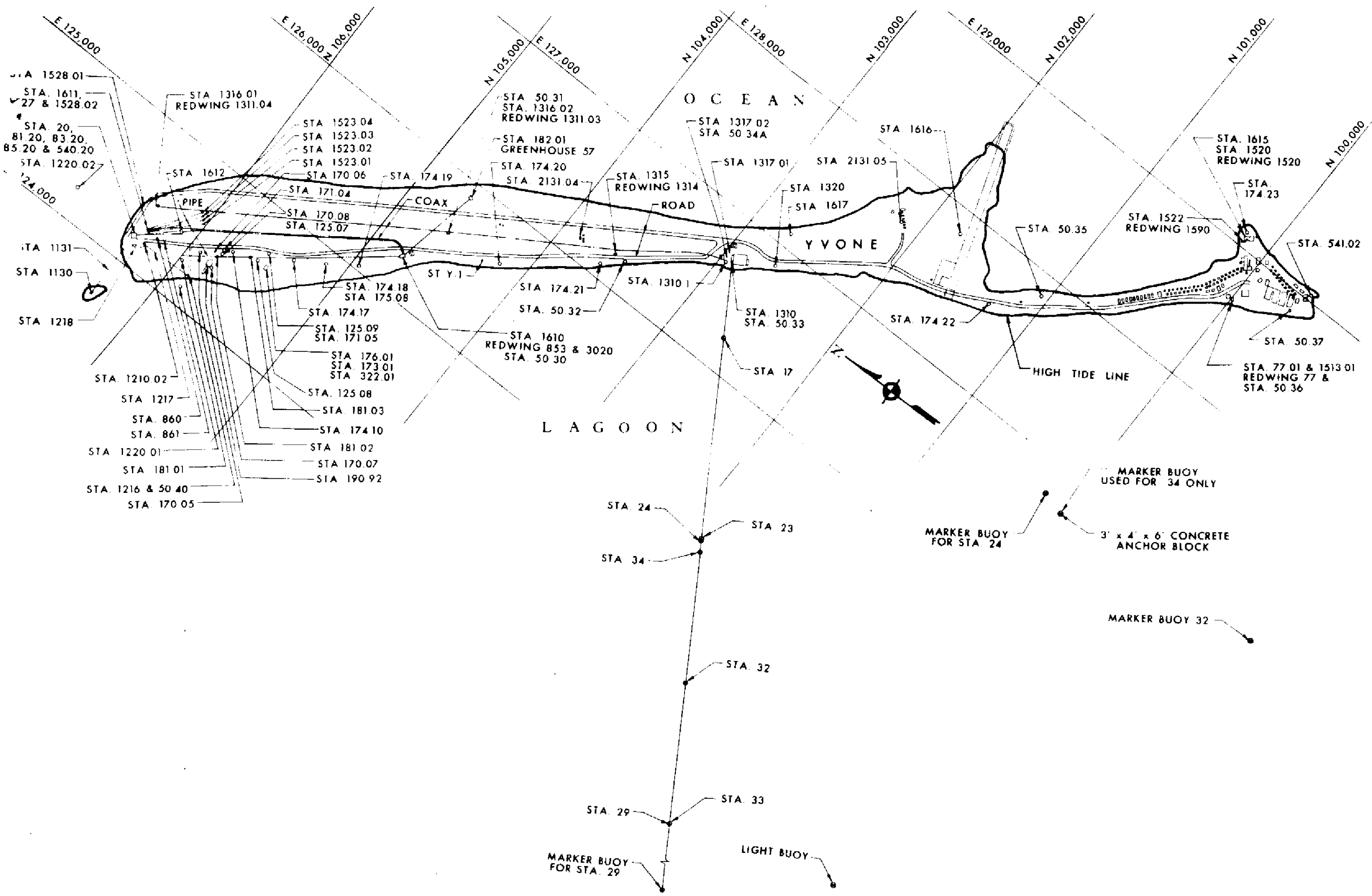
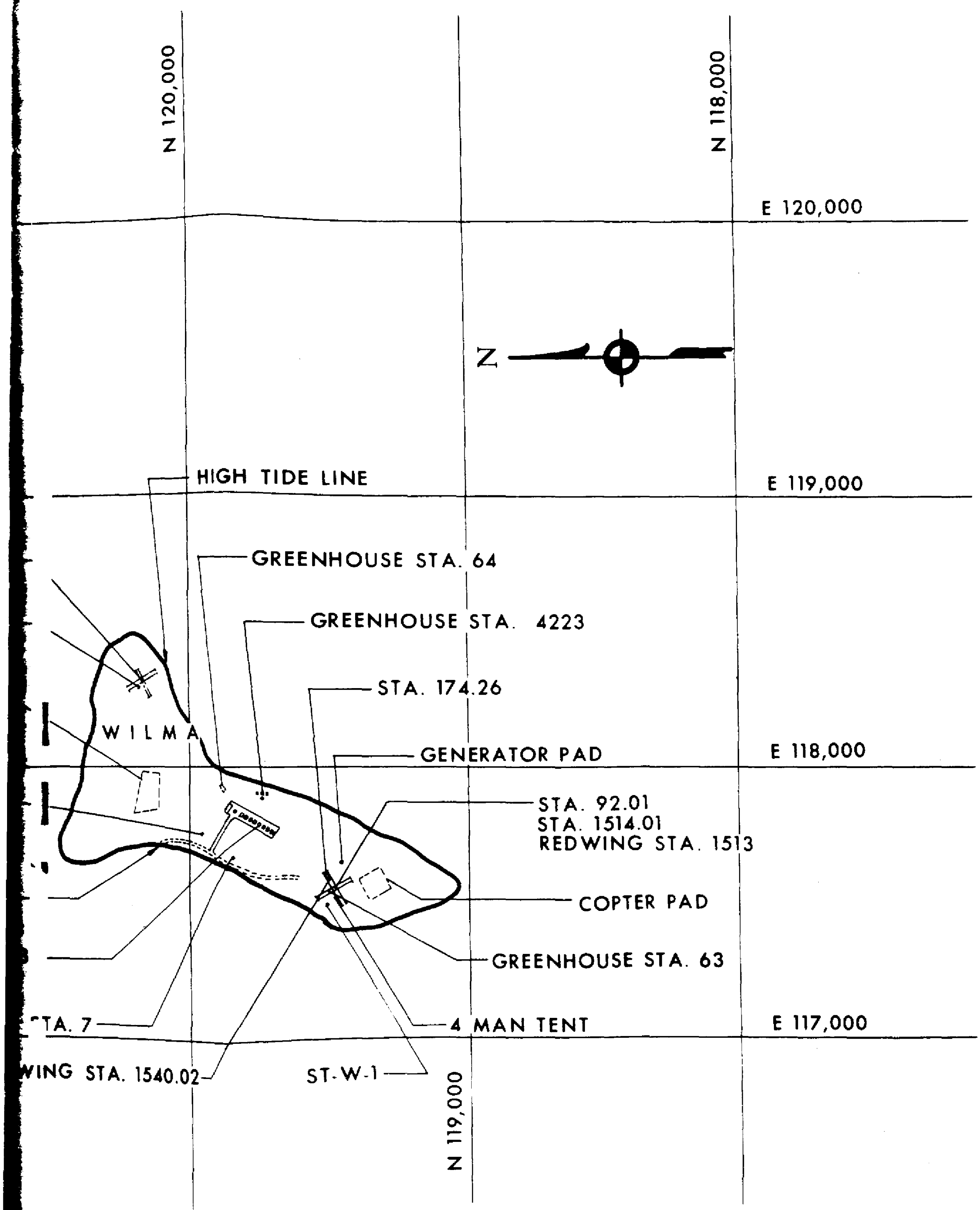


Figure No. 2-92. Scientific Plot Plan — Yvonne.



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GREENHOUSE STA. 4223
STA. 174.26
WILMA
GENERATOR PAD
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STA. 92.01
STA. 1514.01
REDWING STA. 1513
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WING STA. 1540.02
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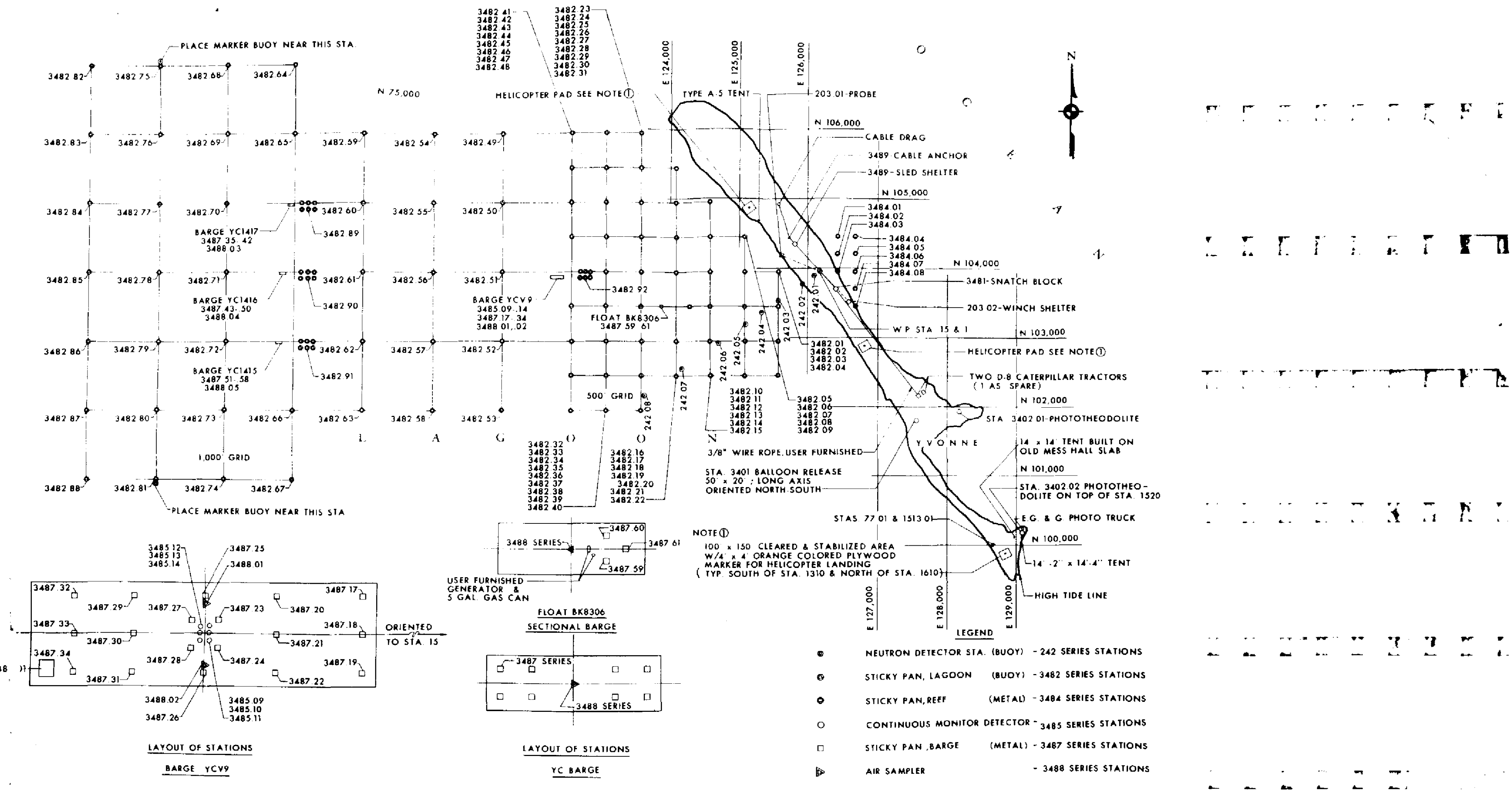


Figure No. 2-93. Scientific Station Locations for QUINCE and FIG Events — Yvonne — (Off-shore).

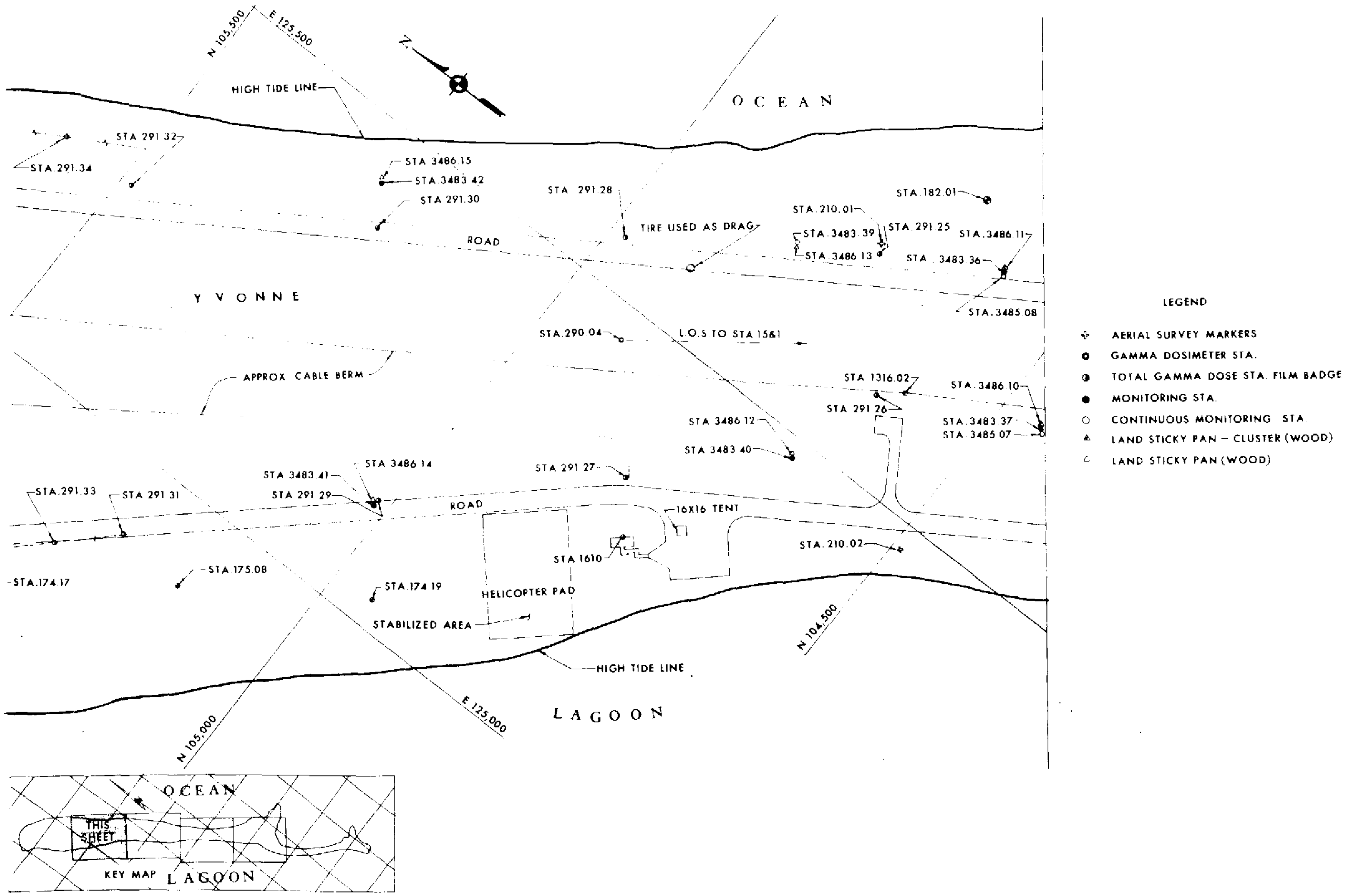


Figure No. 2-94. Scientific Station Locations for the QUINCE and FIG Events — Yvonne — (On-shore) Sheet 1 of 4.

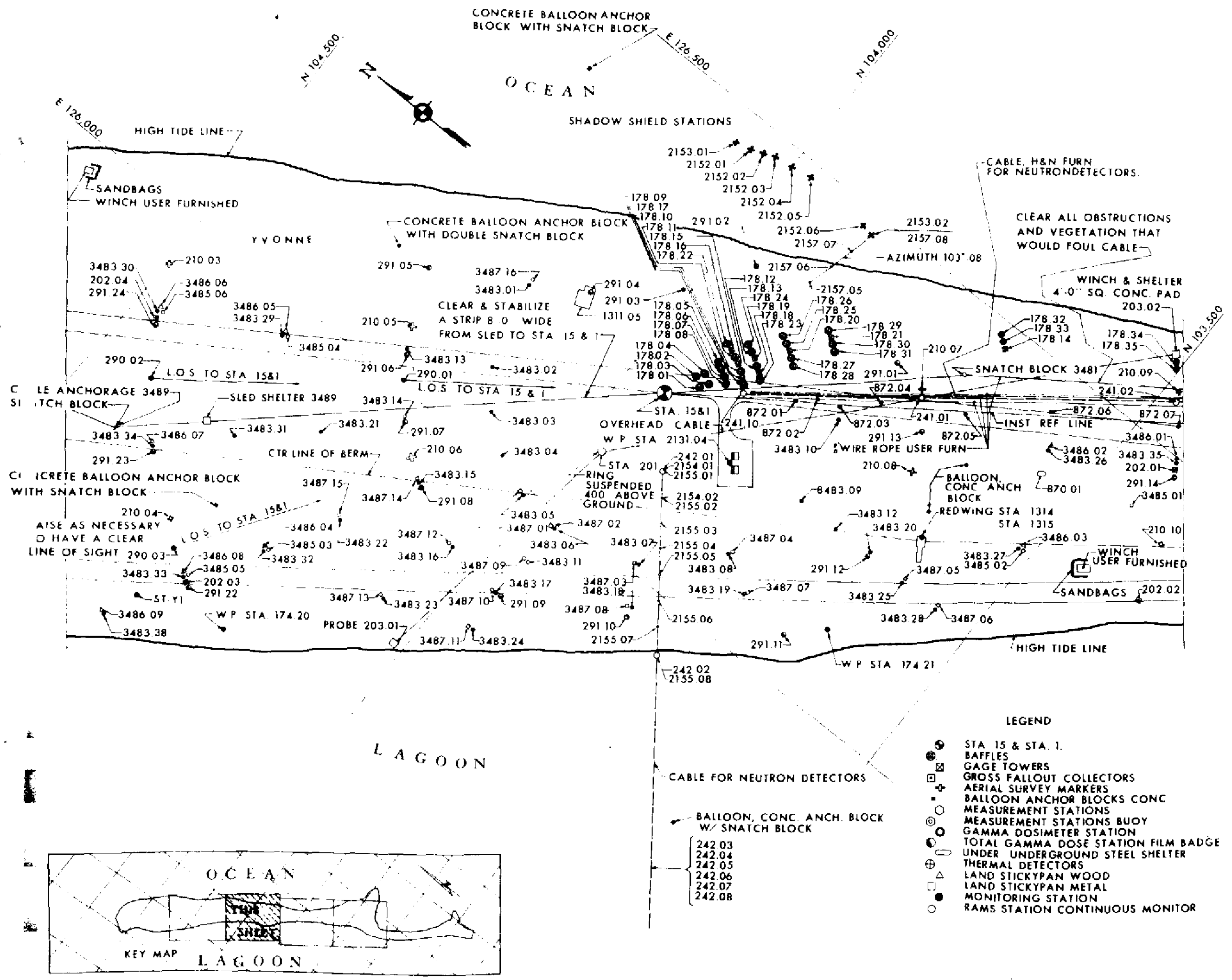


Figure No. 2-94-A. Scientific Station Locations for the QUINCE and FIG Events — Yvonne — (On-shore) Sheet 2 of 4.

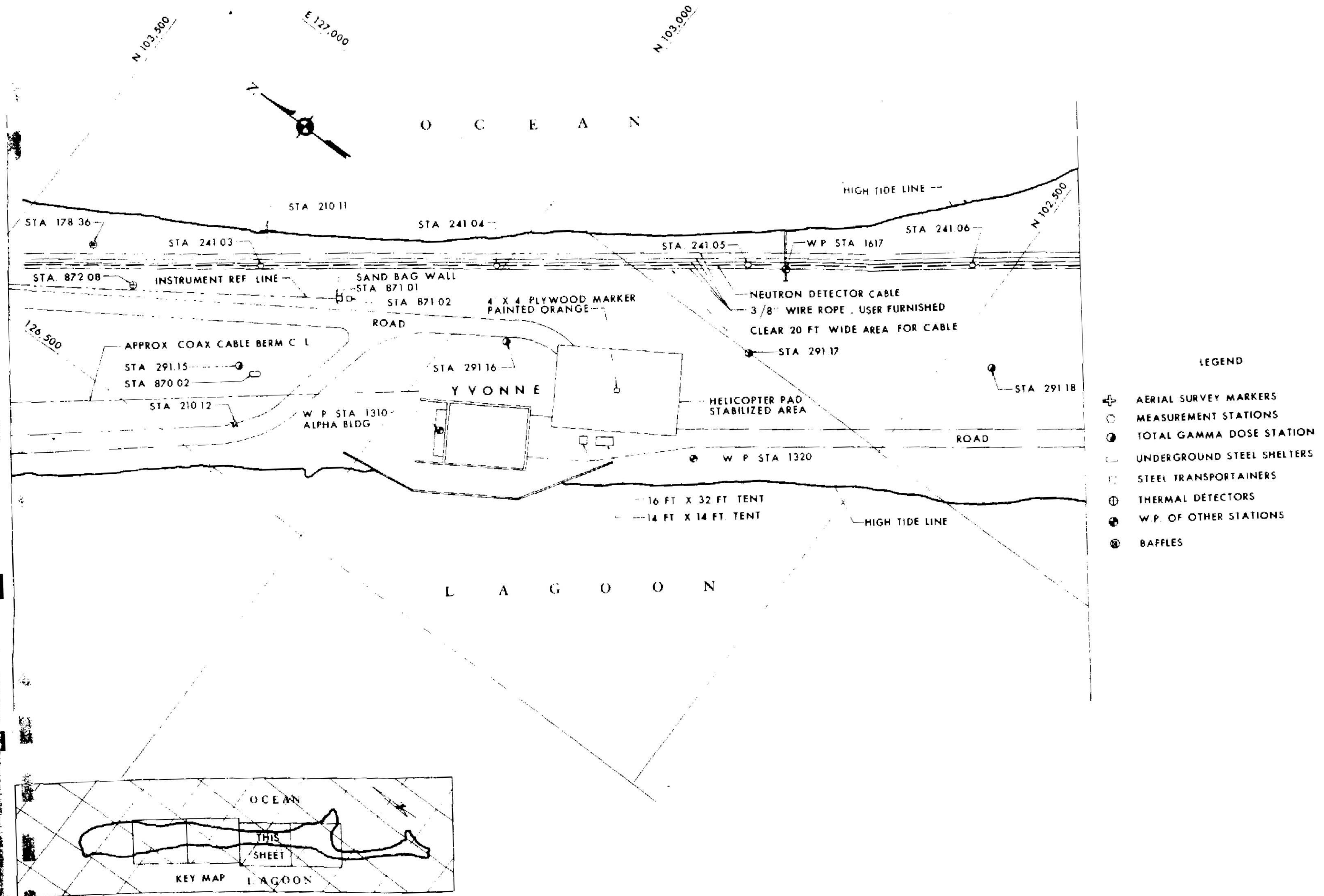


Figure No. 2-94-B. Scientific Station Locations for the QUINCE and FIG Events — Yvonne — (On-shore) Sheet 3 of 4.

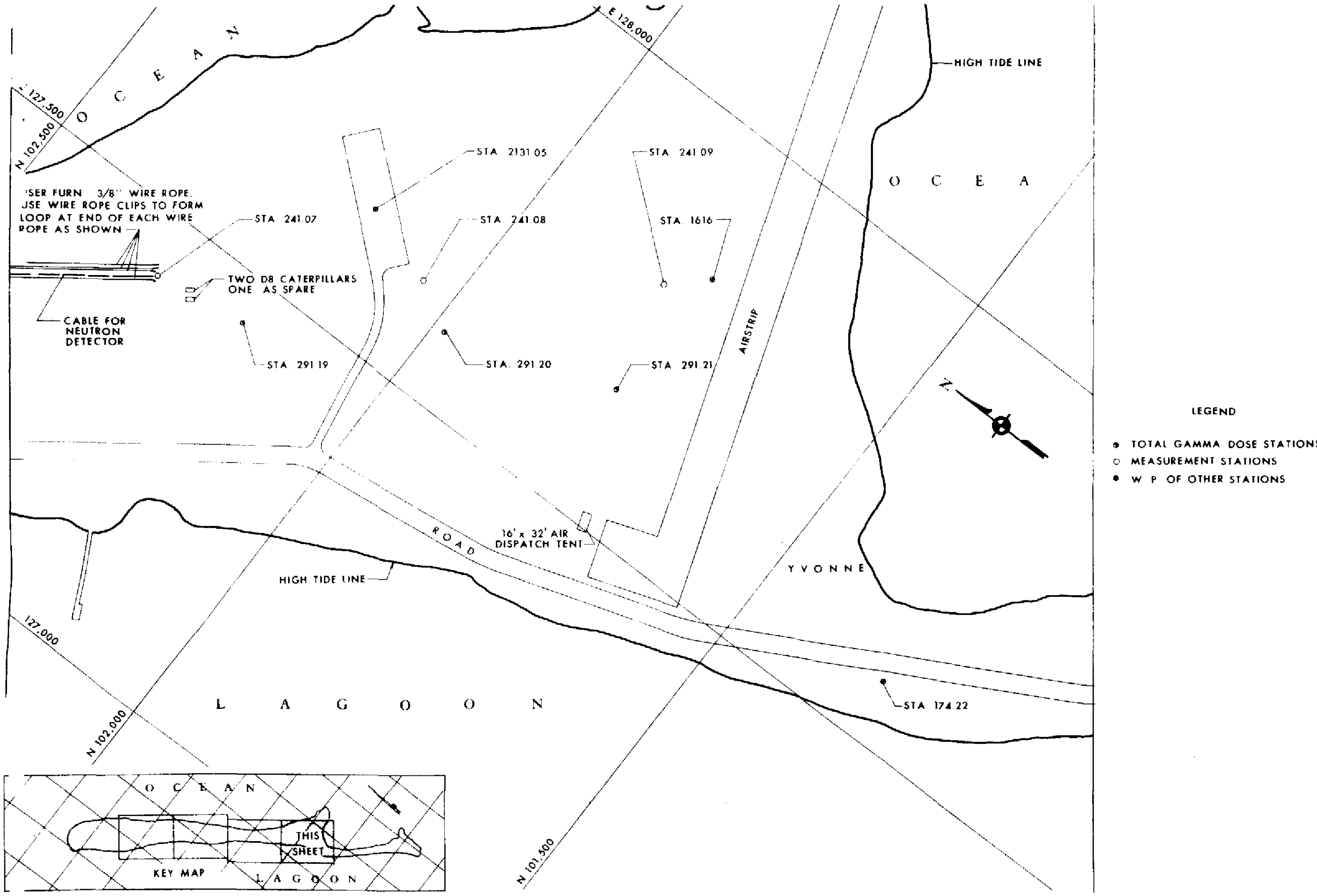


Figure No. 2-94-C. Scientific Station Locations for the QUINCE and FIG Events — Yvonne — (On-shore) Sheet 4 of 4.

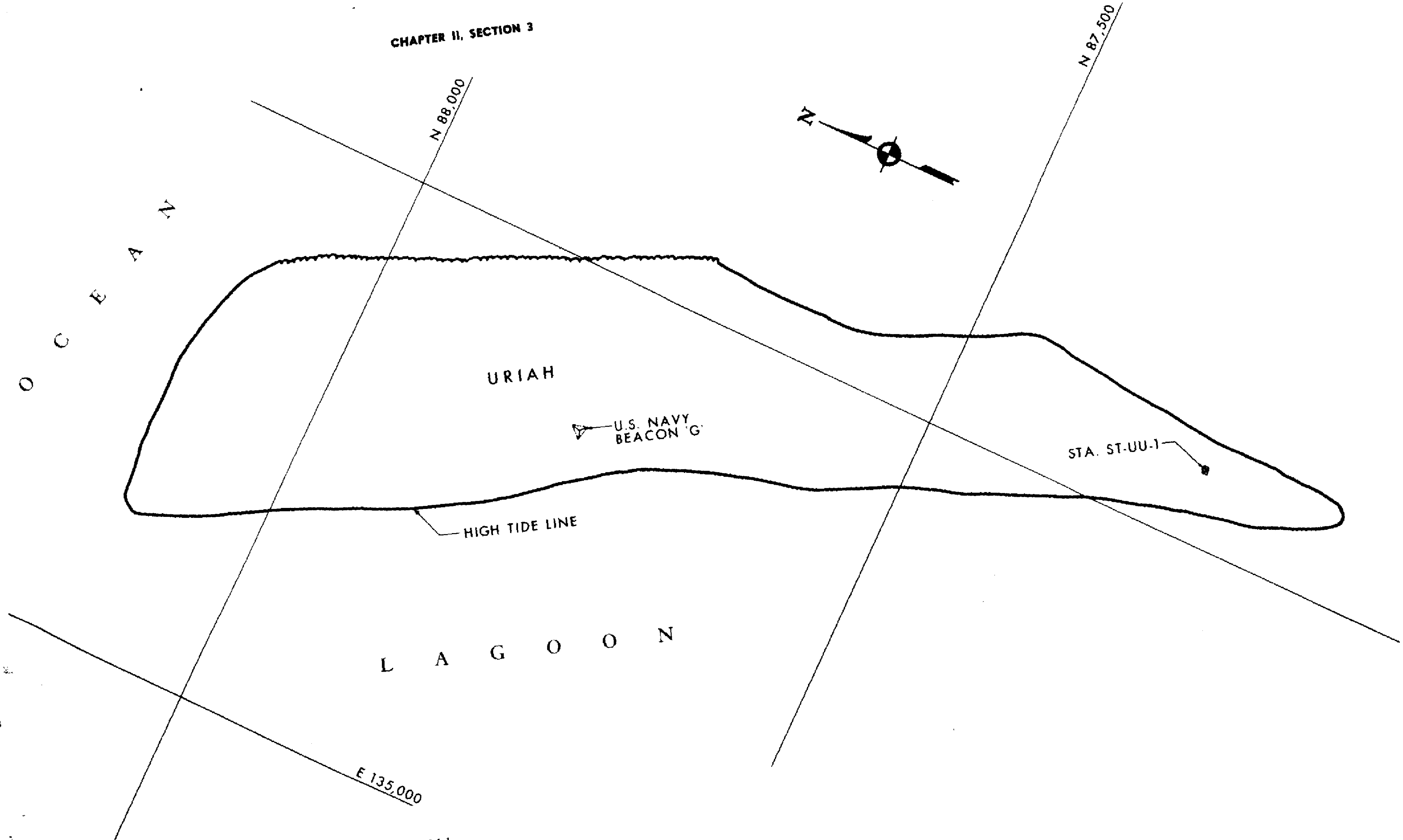


Figure No. 2-95. Scientific Plot Plan — Uriah.

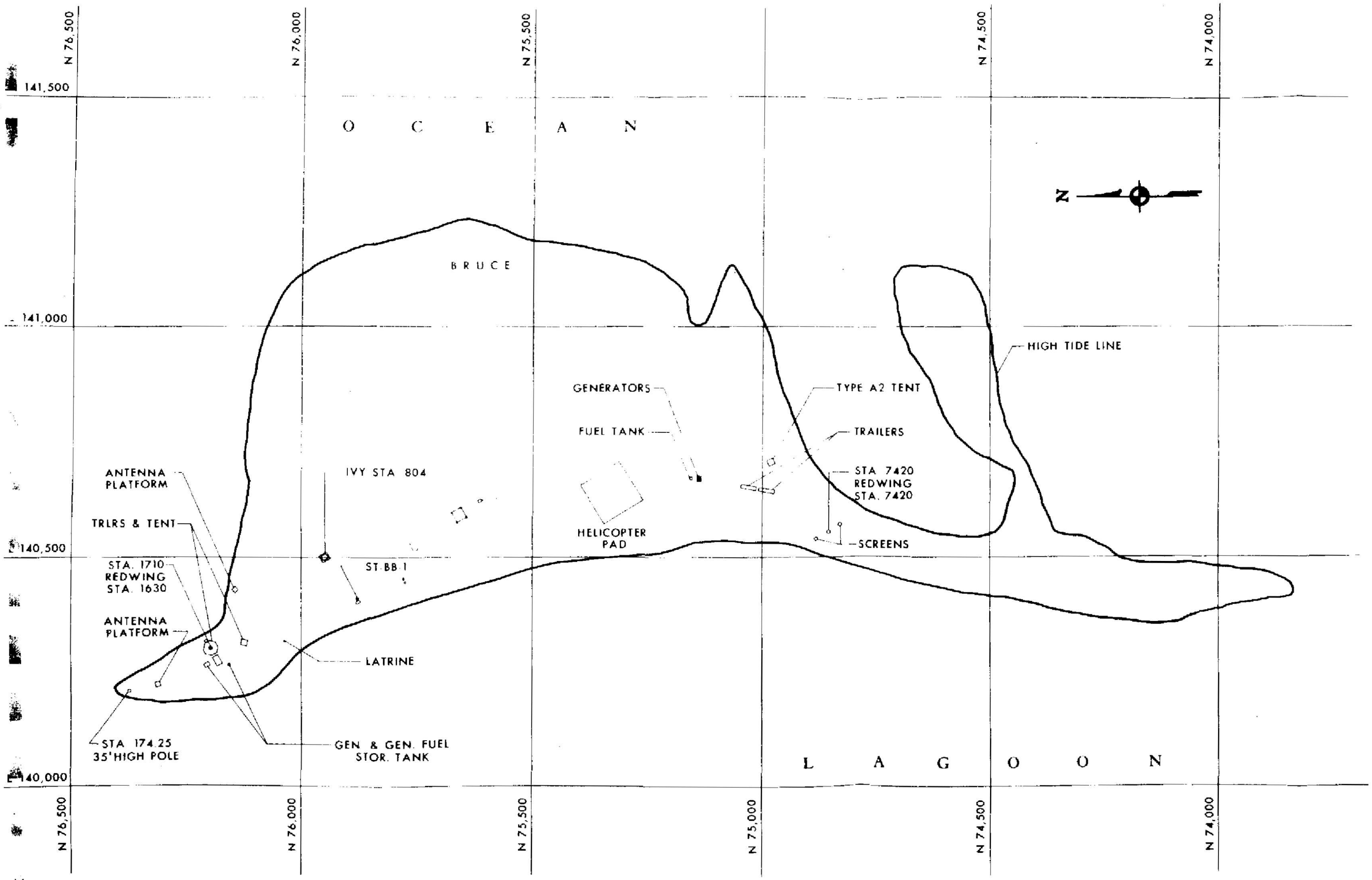


Figure No. 2-96. Scientific Plot Plan — Bruce.

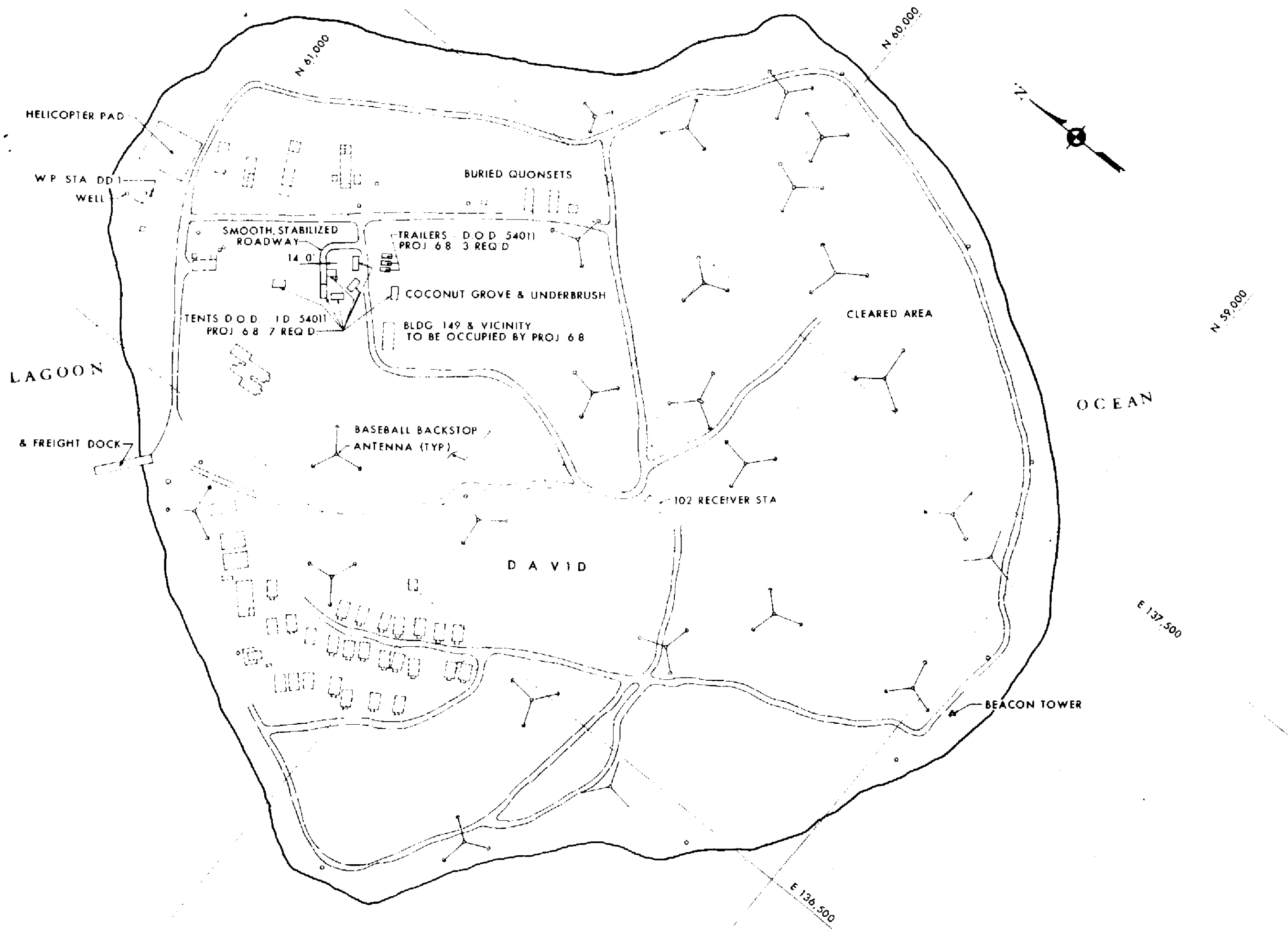


Figure No. 2-97. Scientific Plot Plan — David.

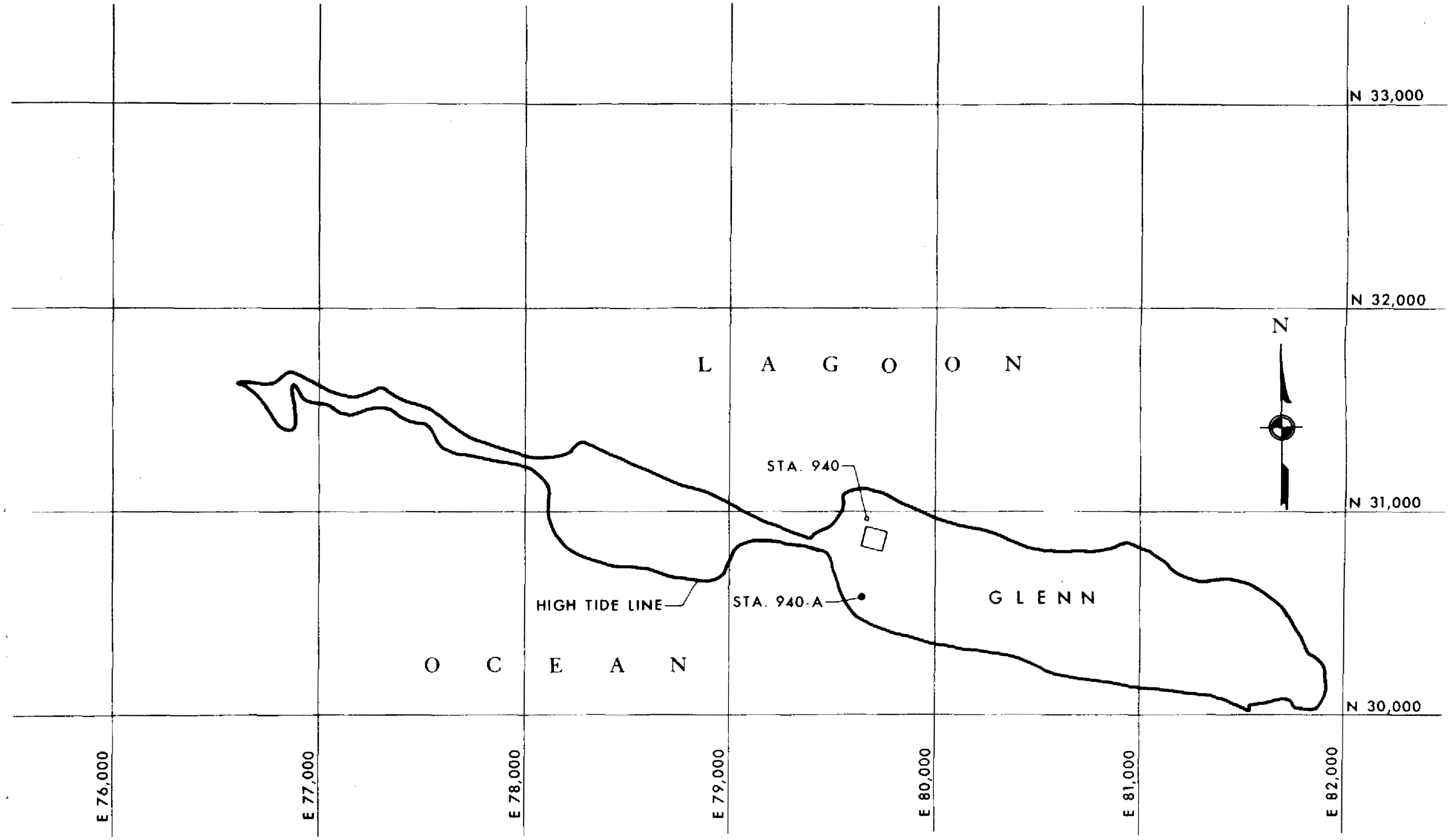


Figure No. 2-98. Scientific Plot Plan — Glenn.

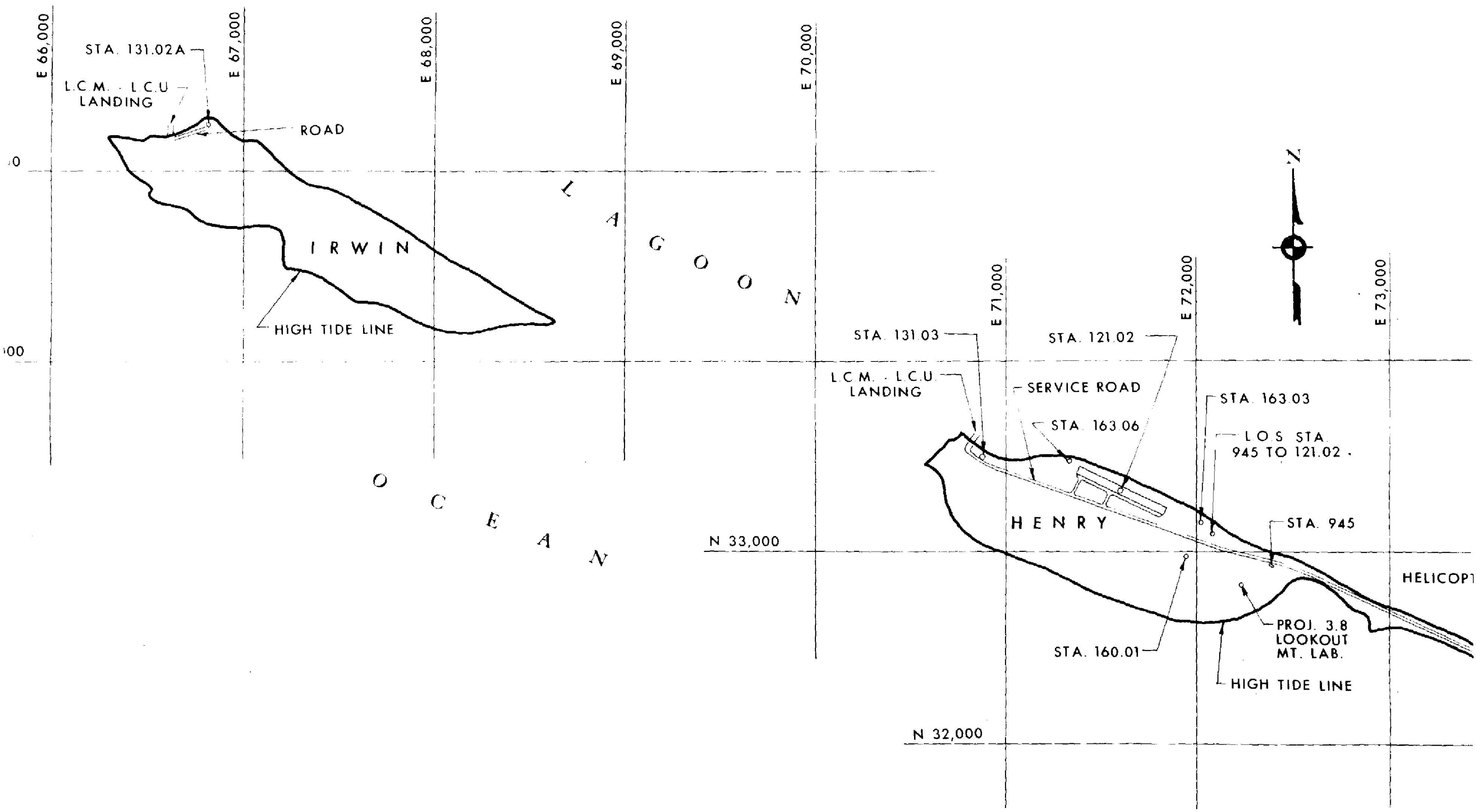


Figure No. 2-99. Scientific Plot Plan — Henry — Irwin.

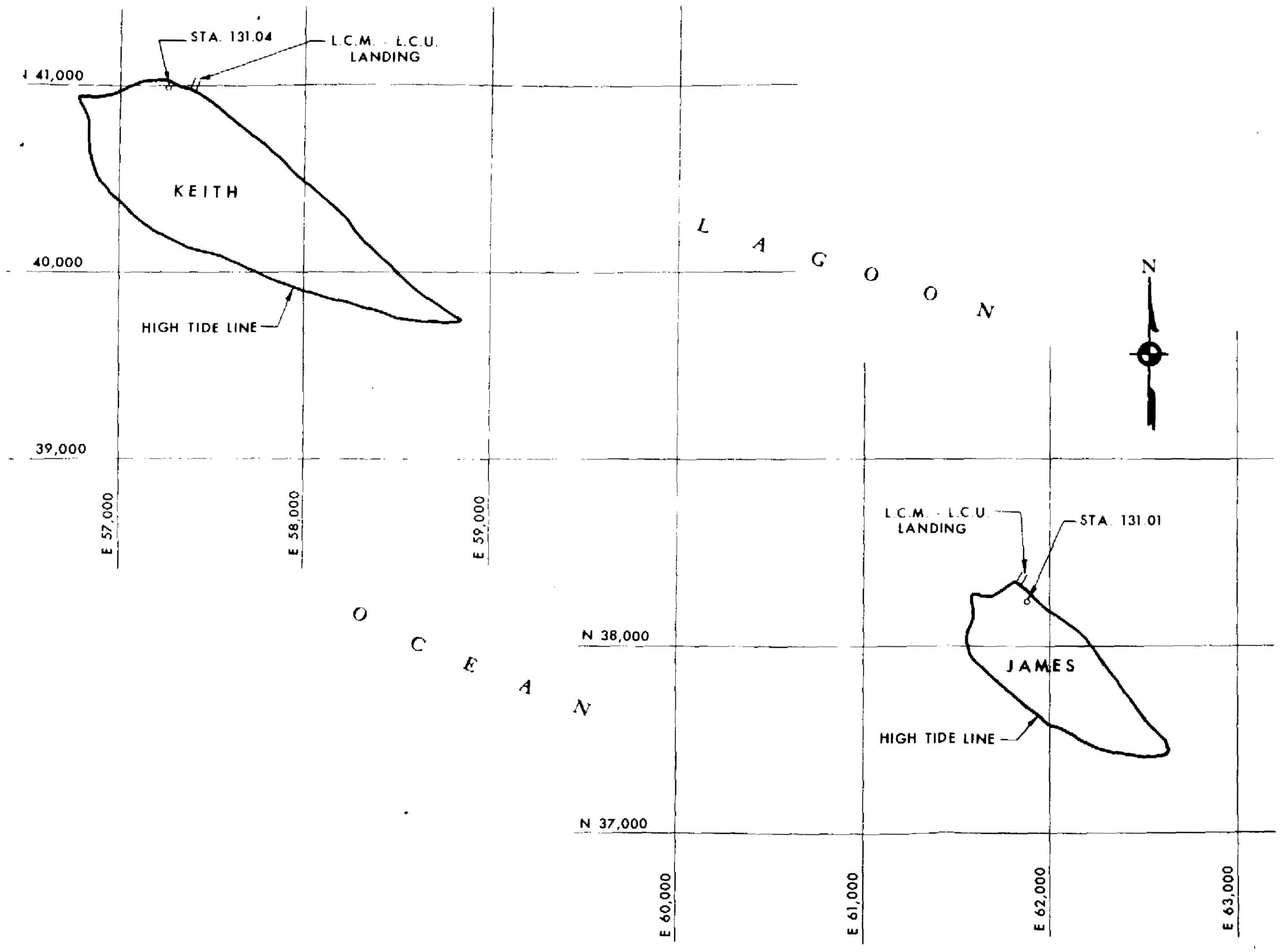


Figure No. 2-100. Scientific Plot Plan — James — Keith.

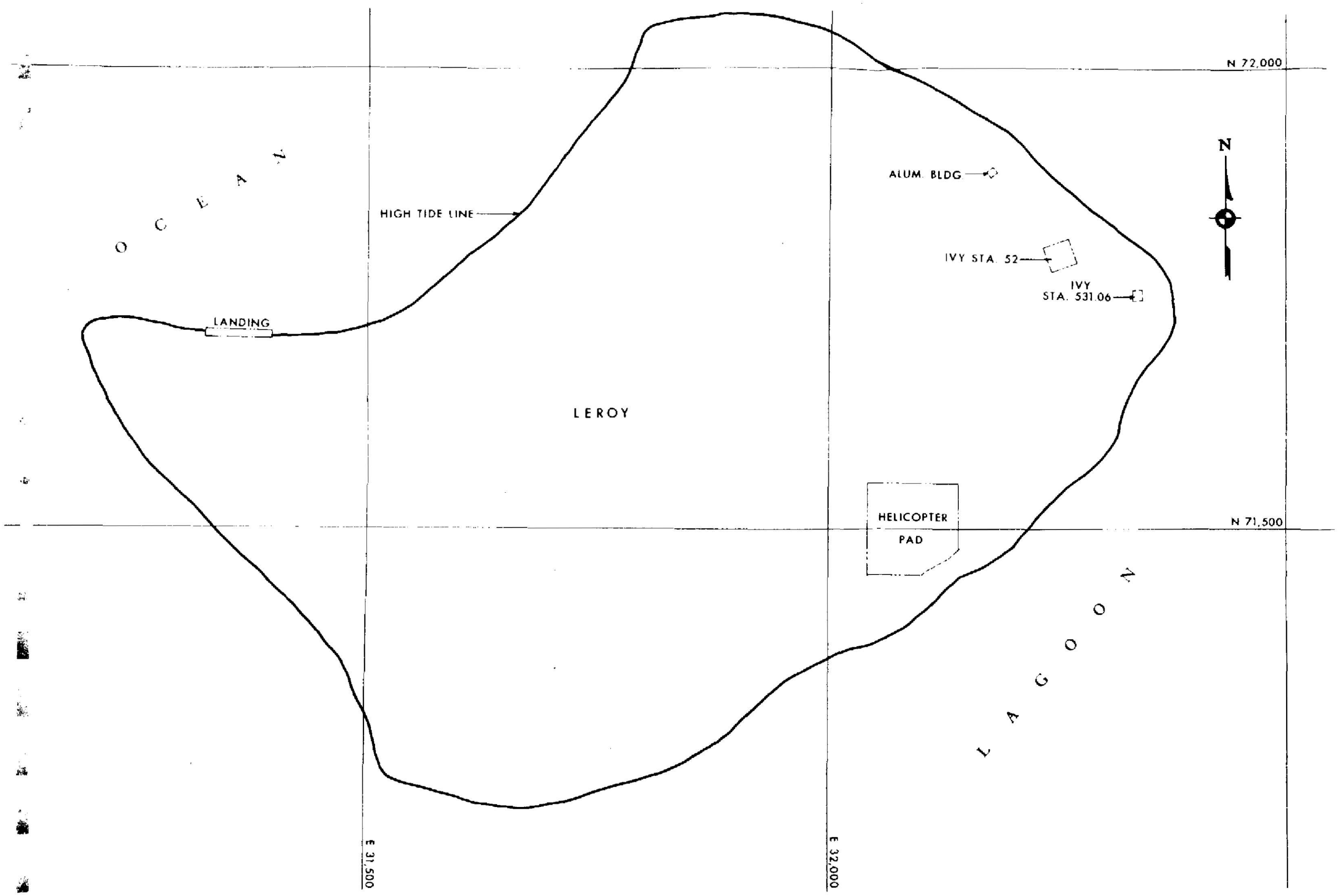


Figure No. 2-101. Scientific Plot Plan — Leroy.

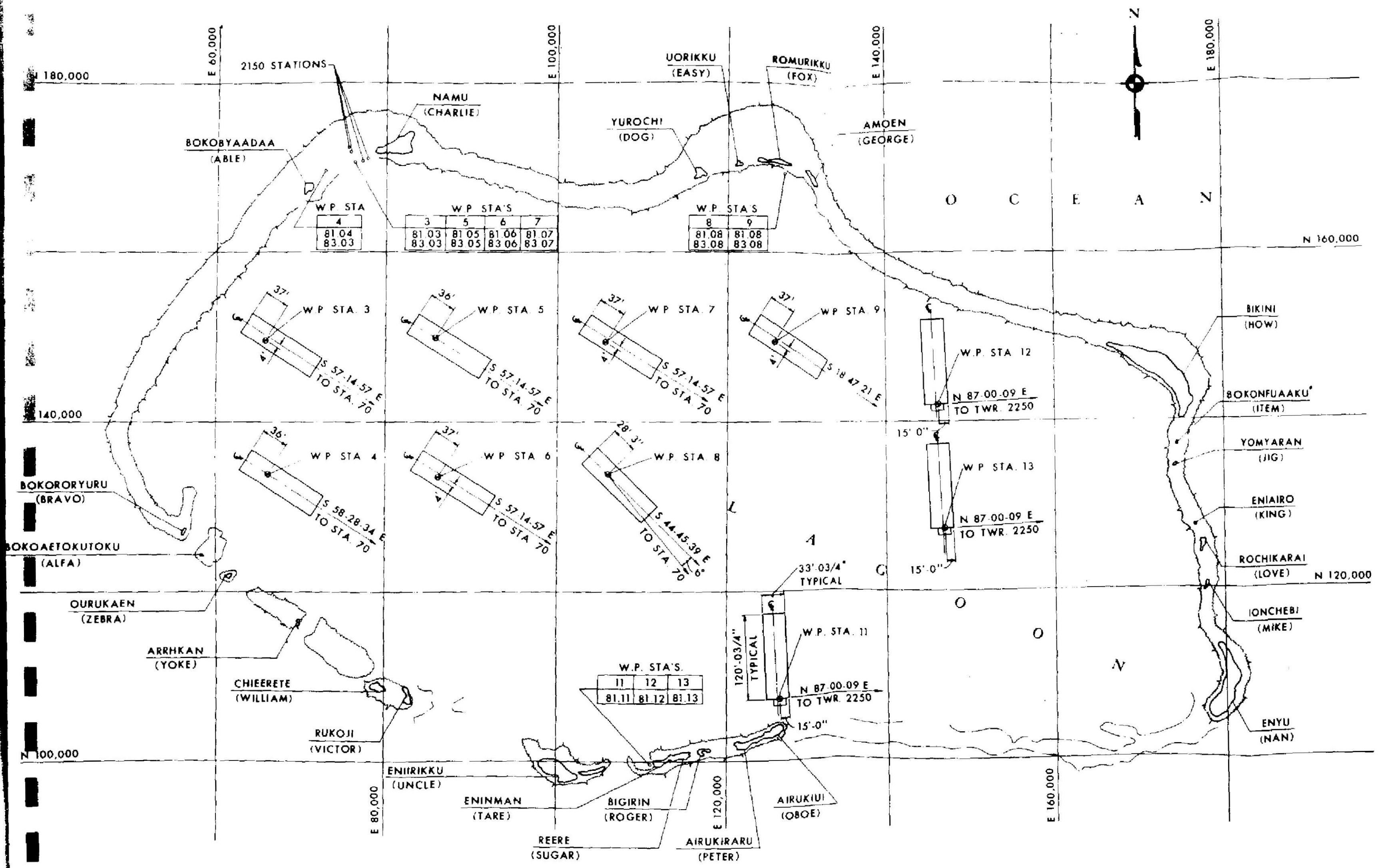


Figure No. 2-102. Scientific Stations — Bikini Lagoon.

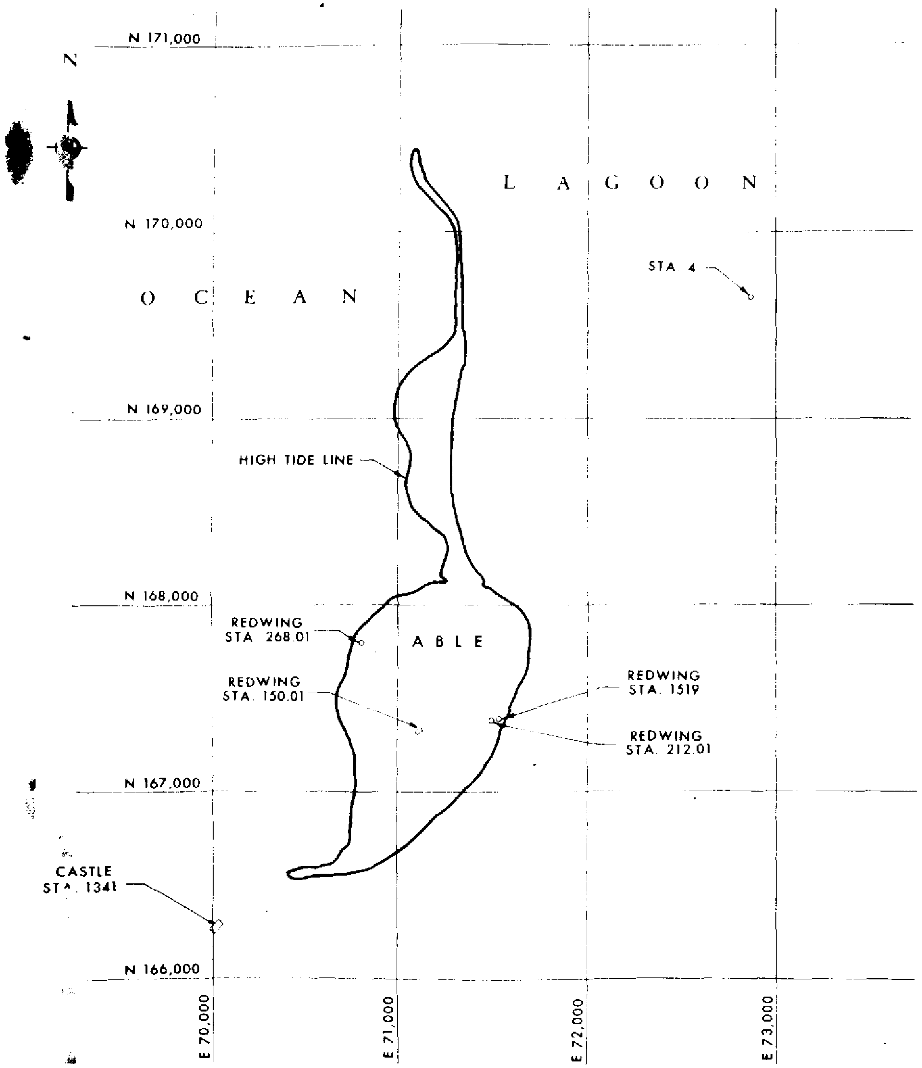


Figure No. 2-103. Scientific Plot Plan — Able.

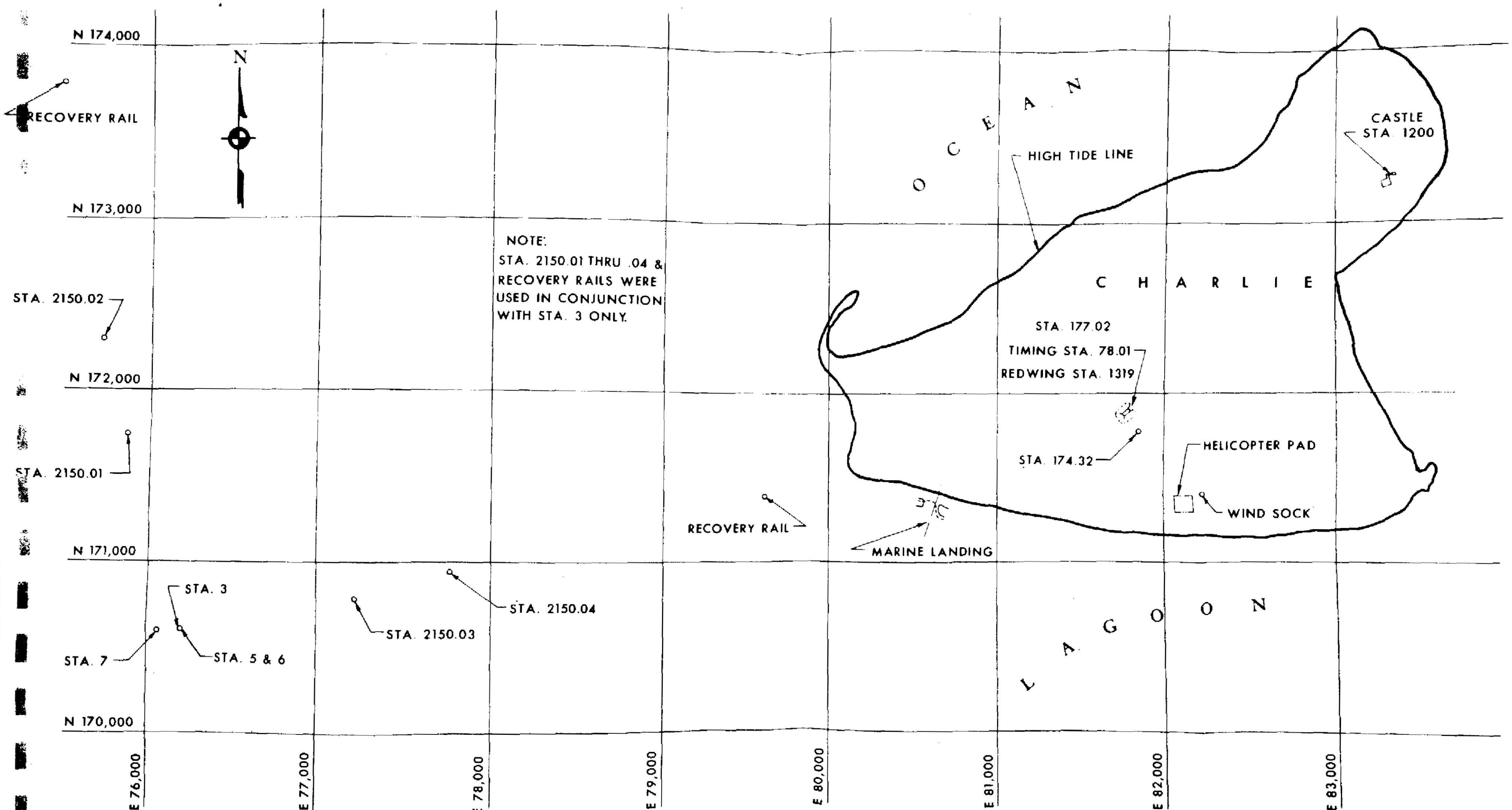


Figure No. 2-104. Scientific Plot Plan — Charlie.

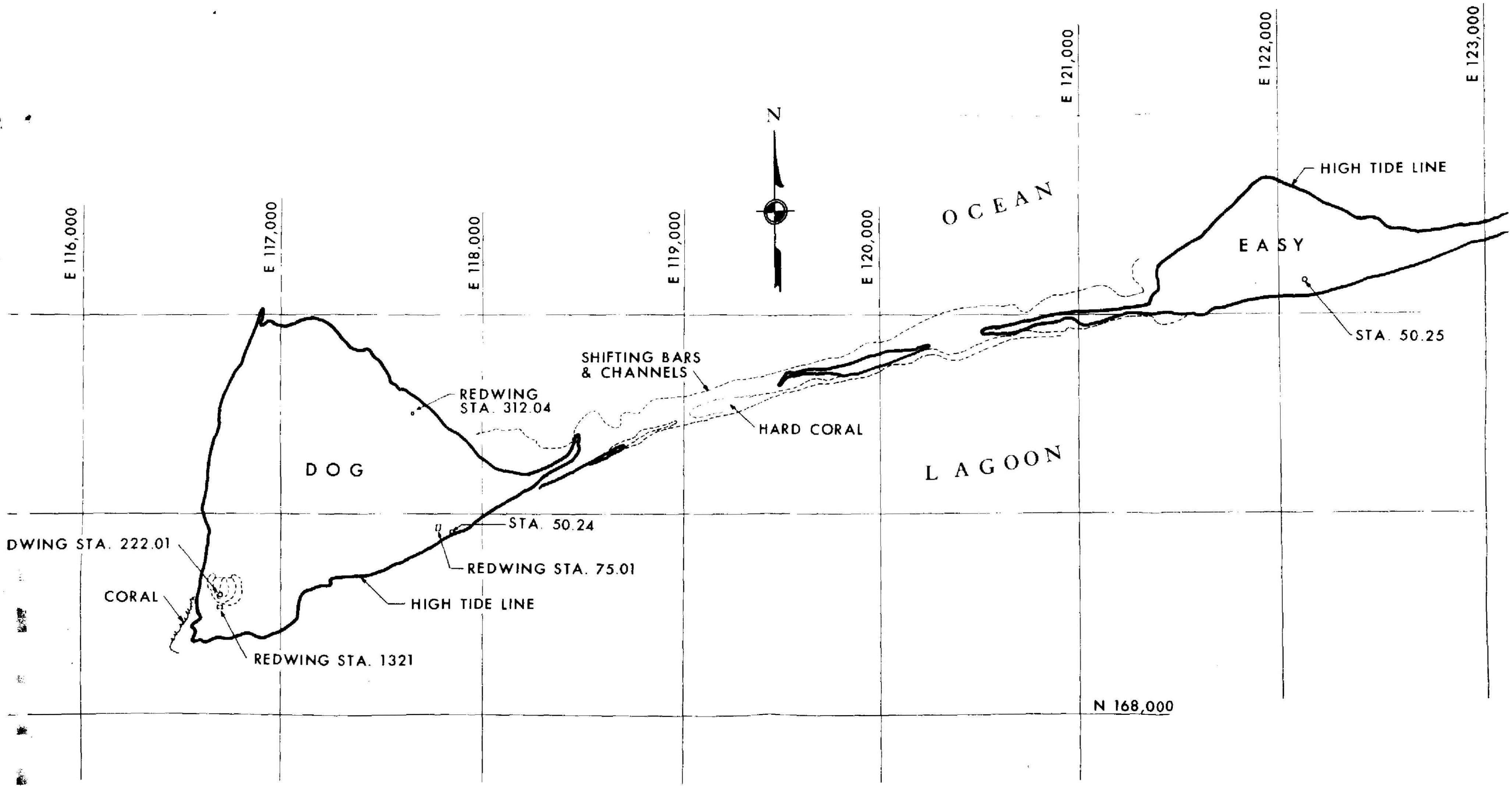
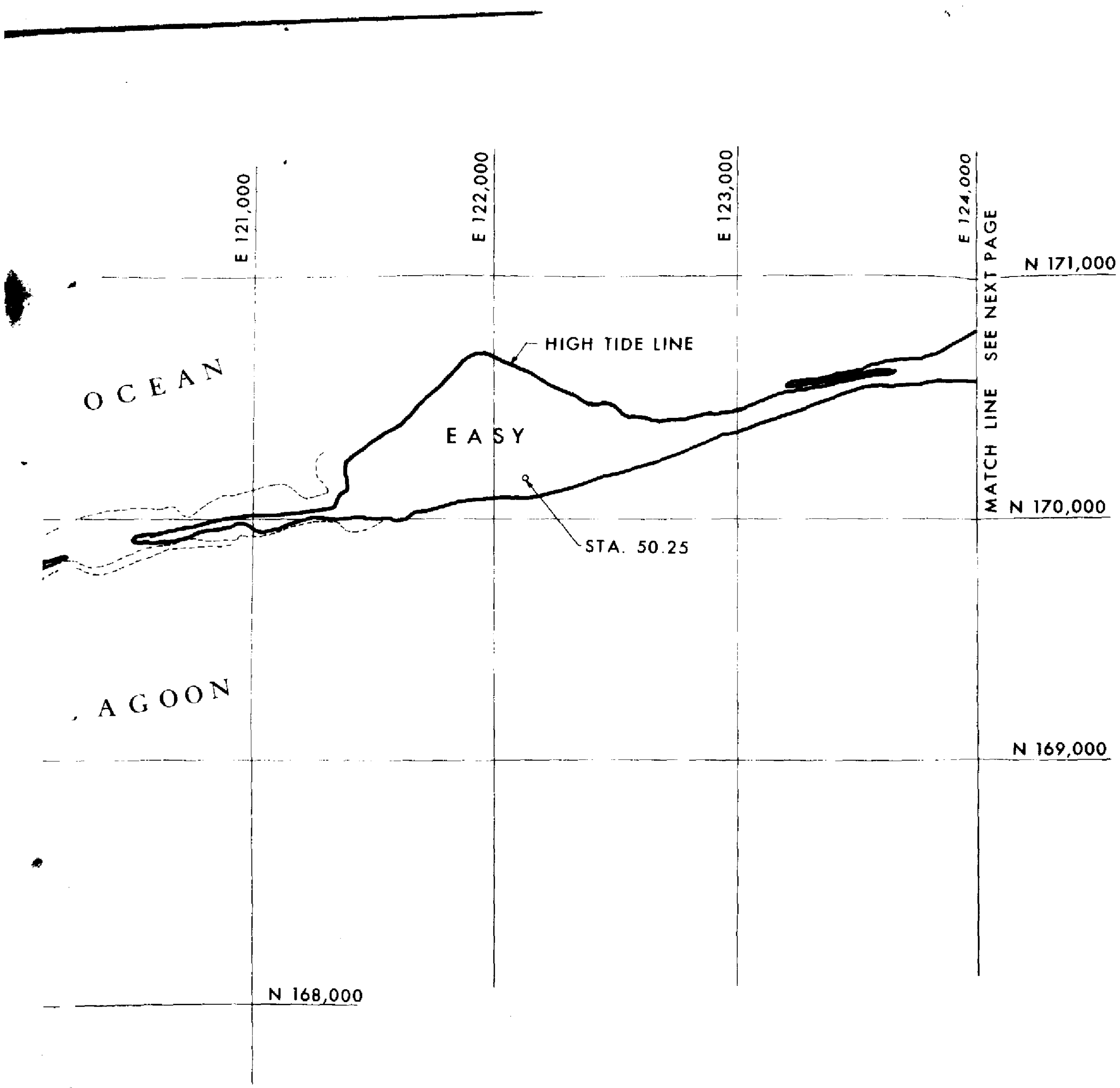


Figure No. 2-105. Scientific Plot Plan — Dog — Easy.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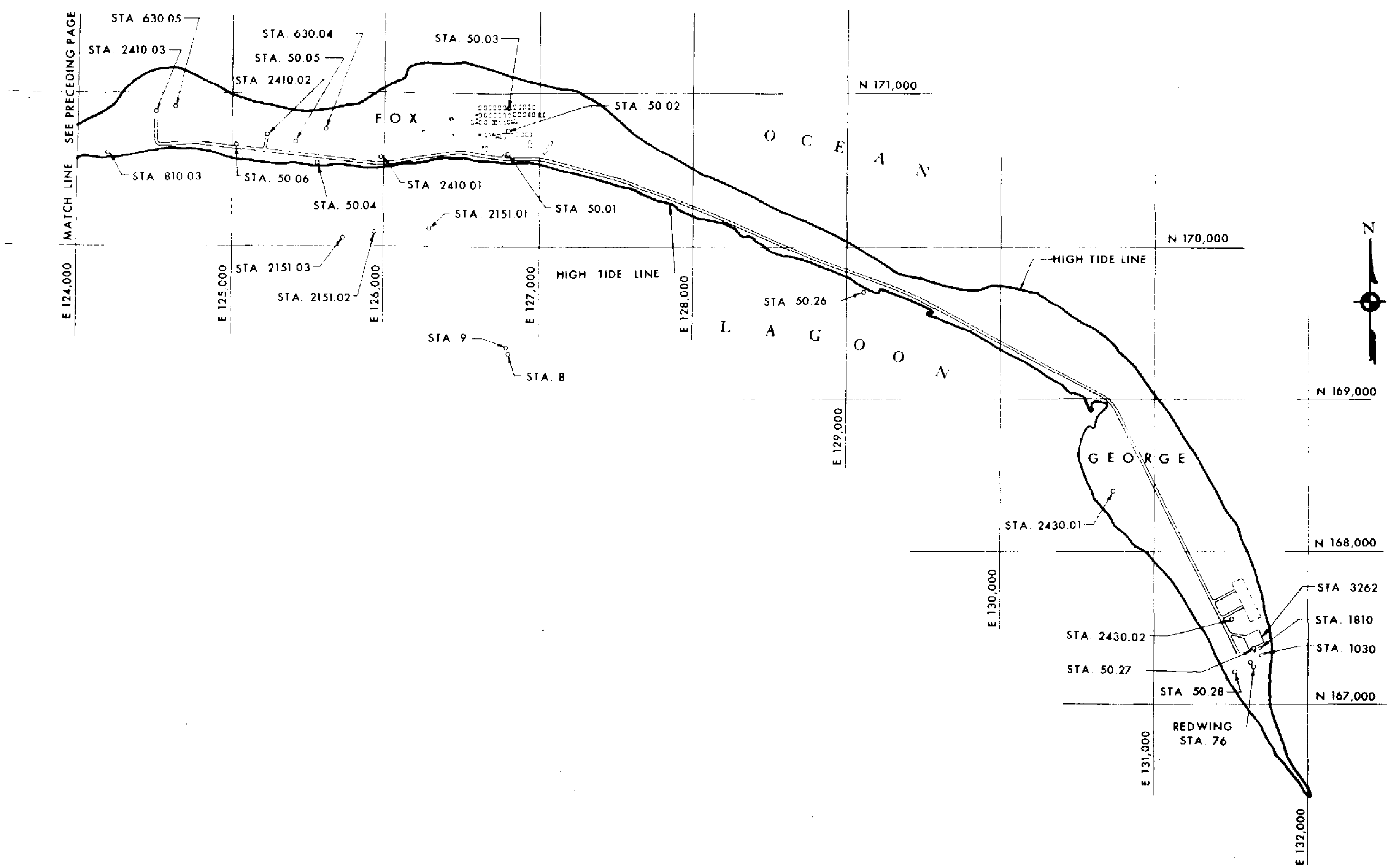


Figure No. 2-106. Scientific Plot Plan — Fox — George.

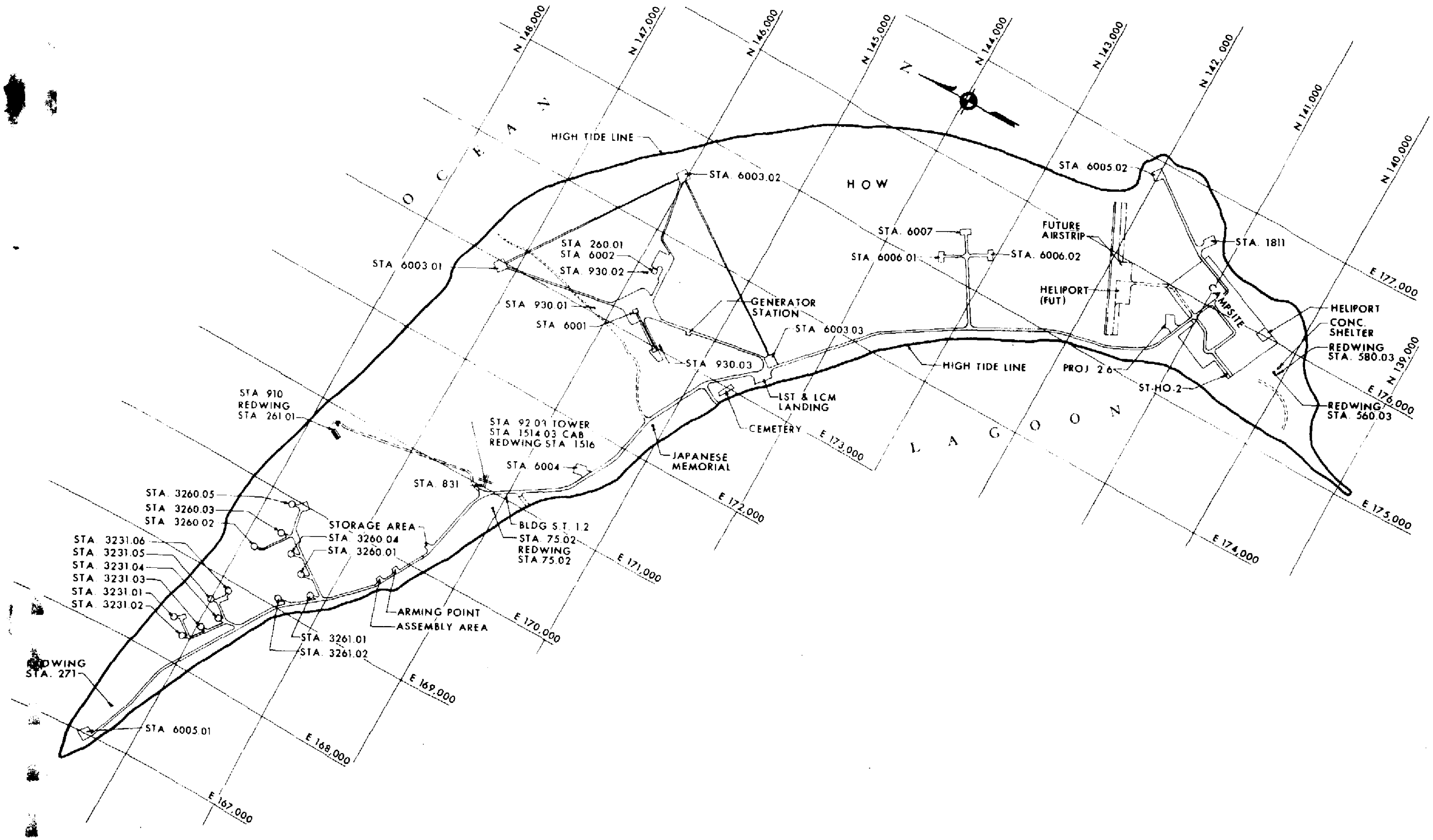


Figure No. 2-107. Scientific Plot Plan — How.

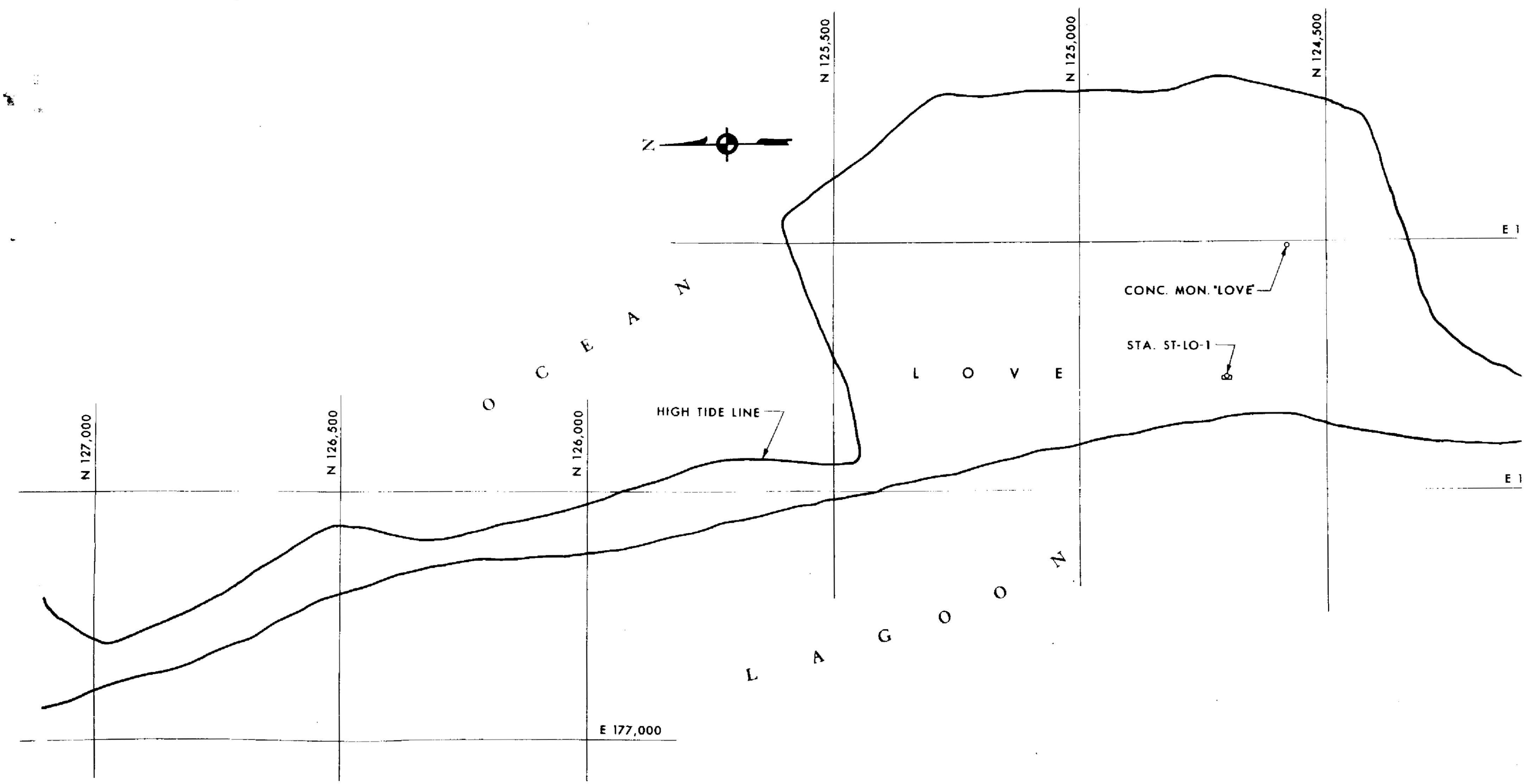
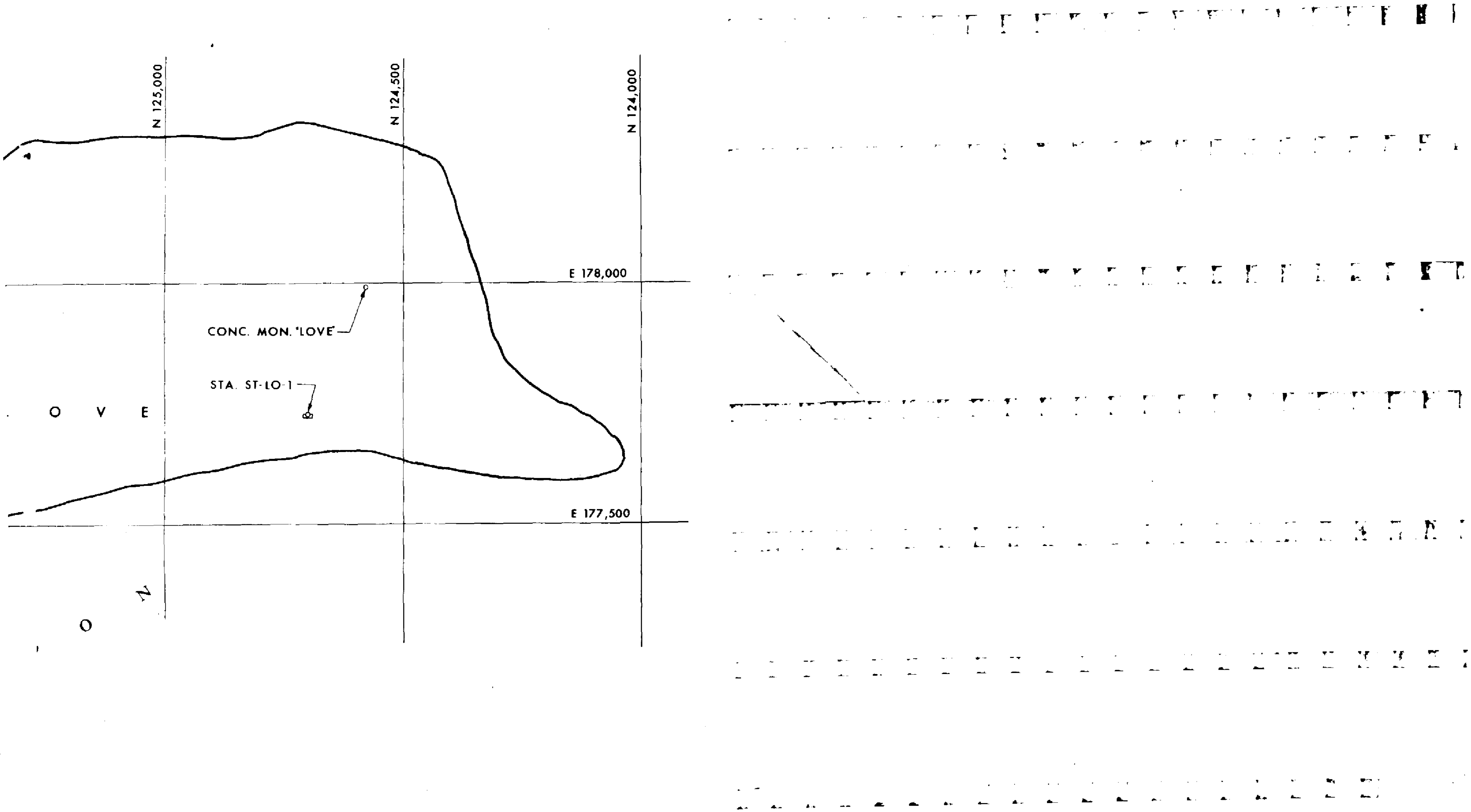


Figure No. 2-108. Scientific Plot Plan — Love.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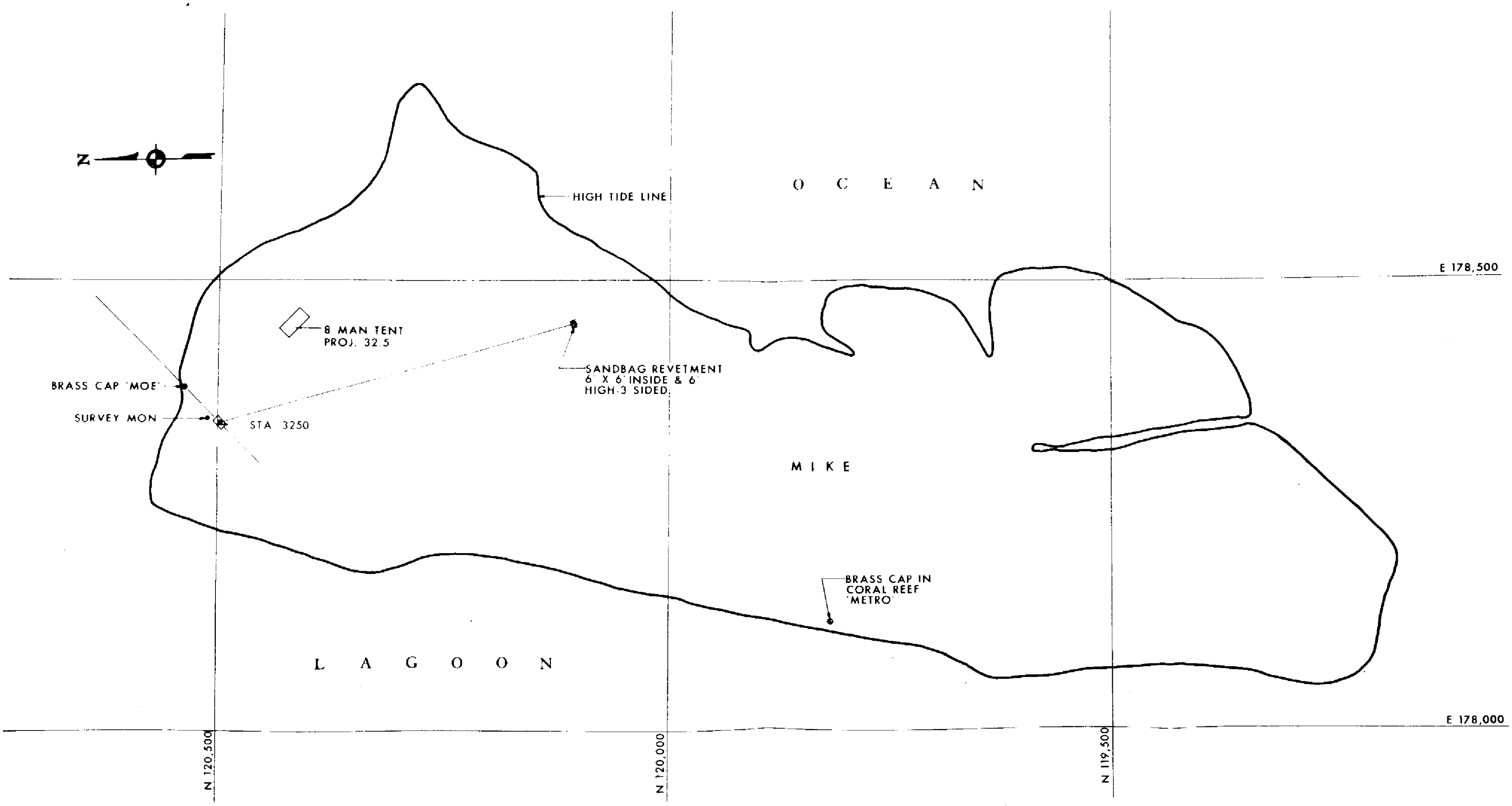


Figure No. 2-109. Scientific Plot Plan — Mike.

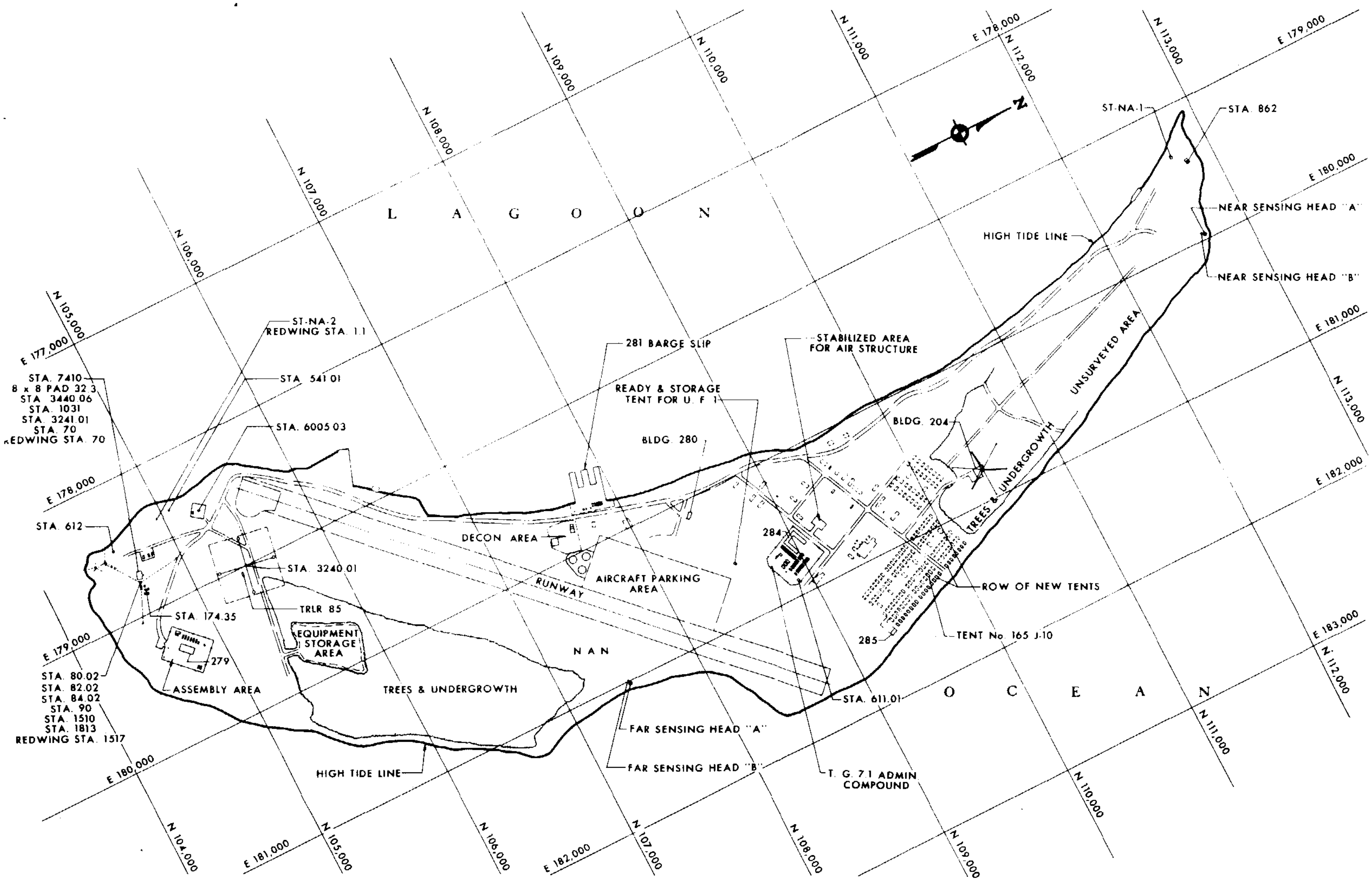


Figure No. 2-110. Scientific Plot Plan — Nan.

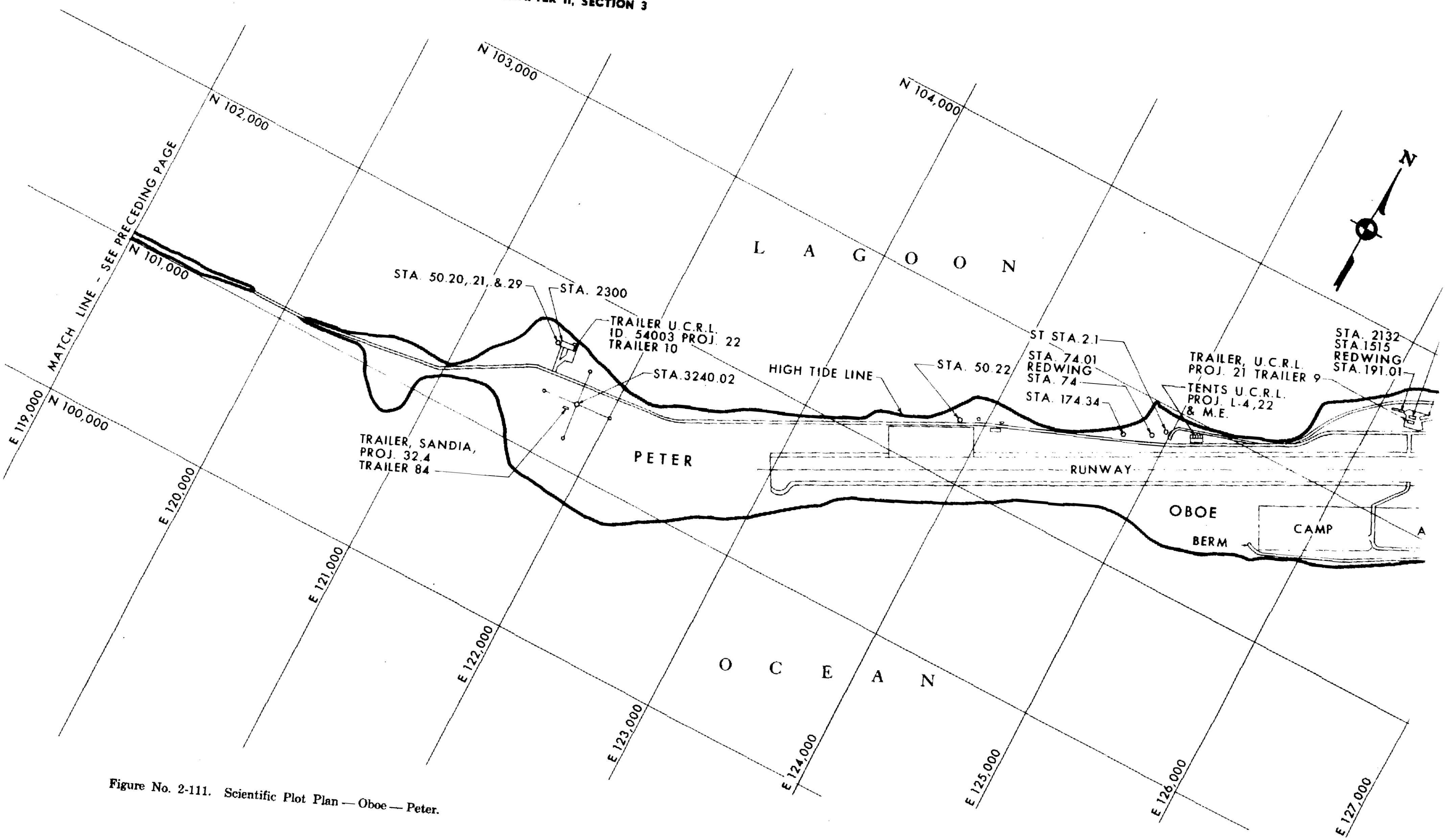
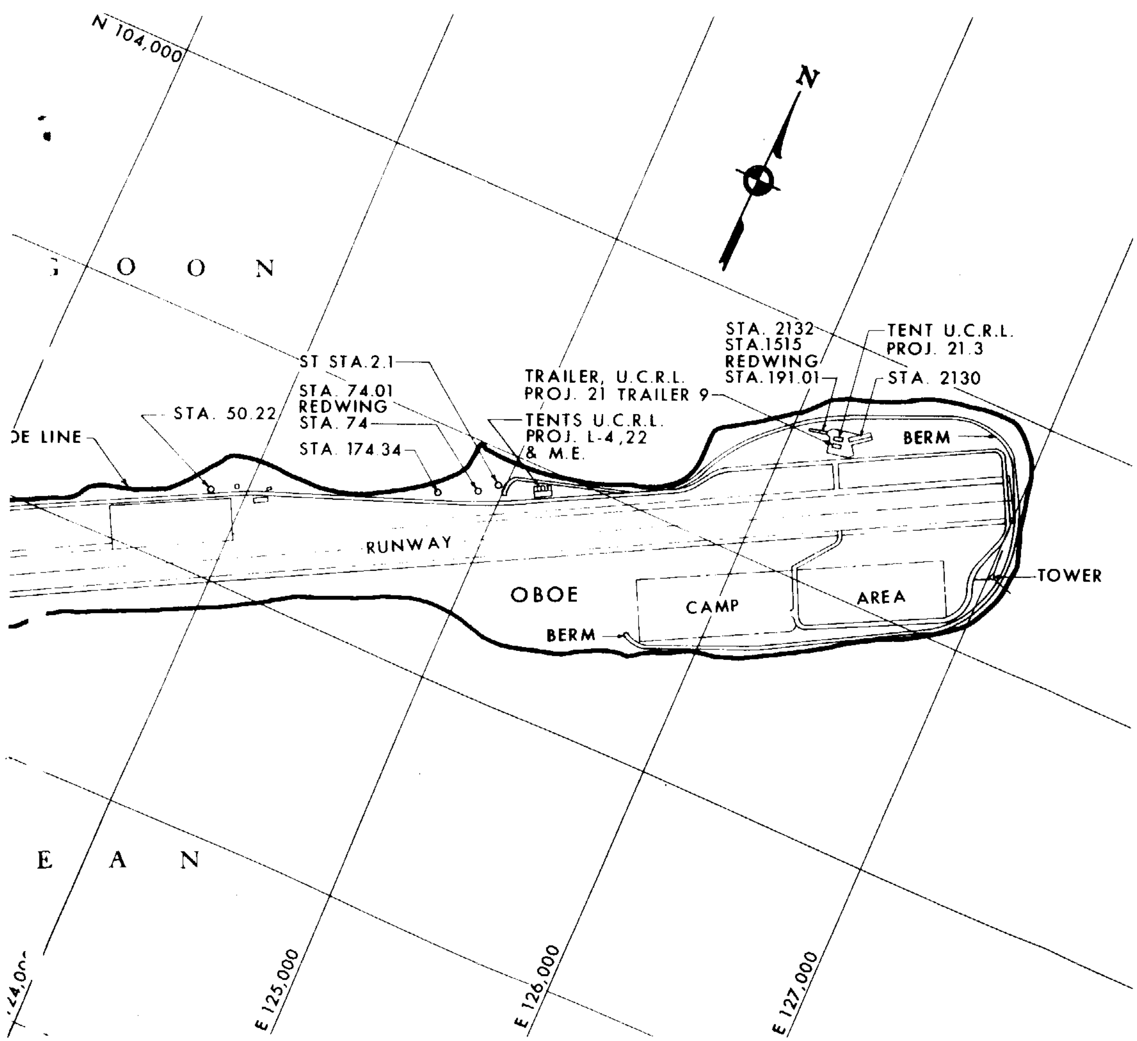


Figure No. 2-111. Scientific Plot Plan — Oboe — Peter.



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PROJ. L-4, 22
& M.E.
STA. 2132
STA. 1515
REDWING
STA. 191.01
TENT U.C.R.L.
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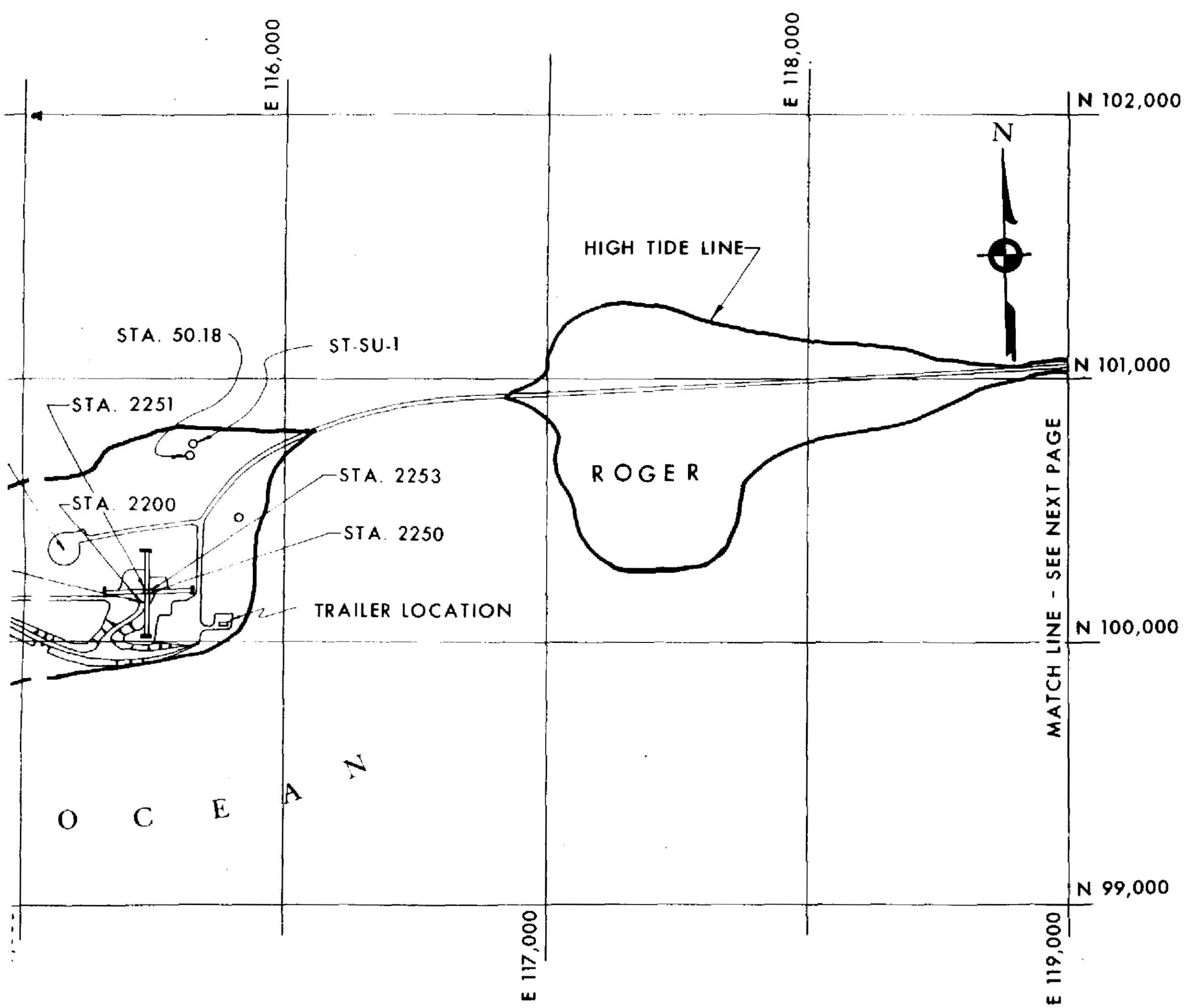
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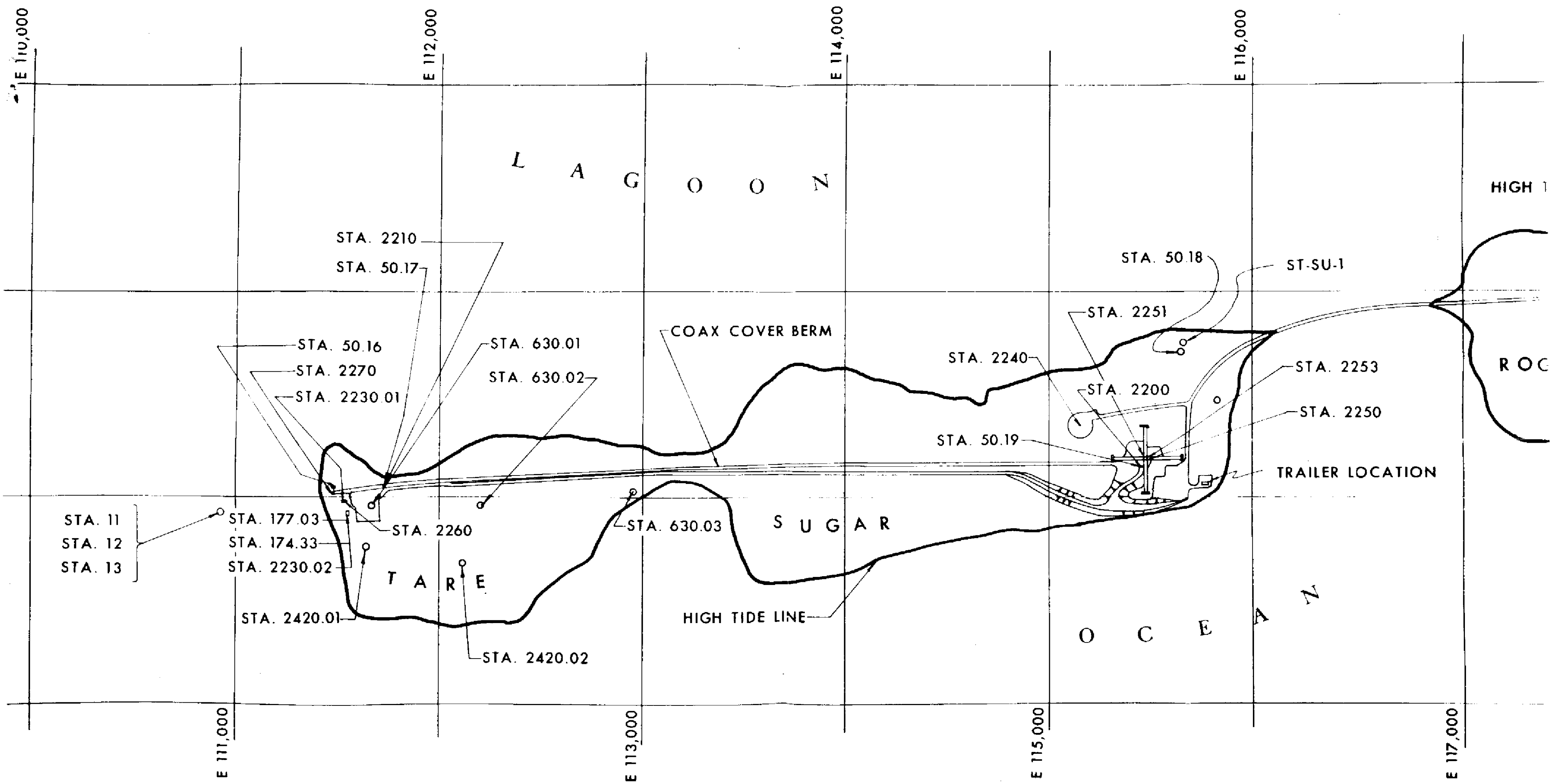


Figure No. 2-112. Scientific Pot Plan — Roger — Sugar — Tare.

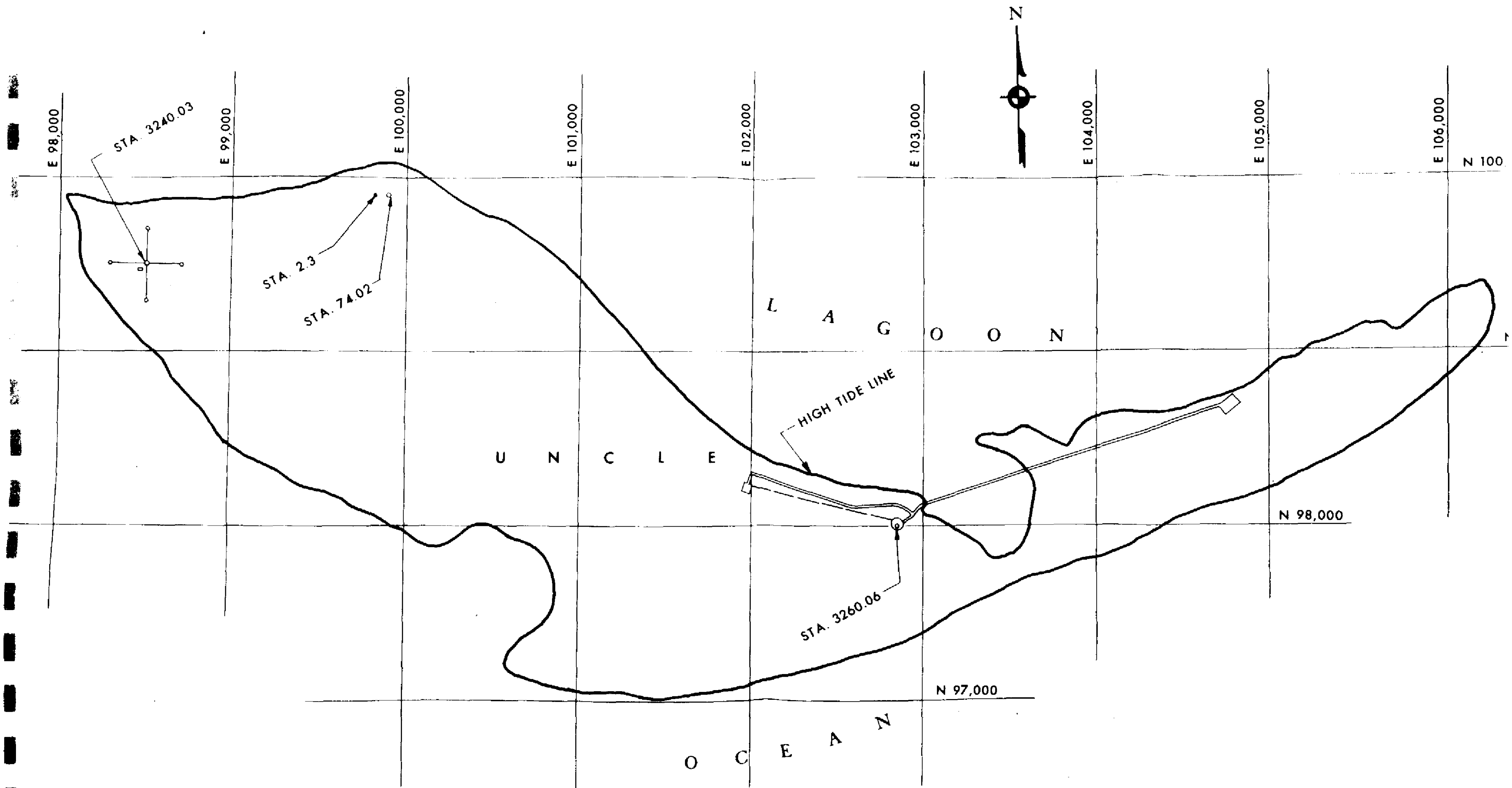
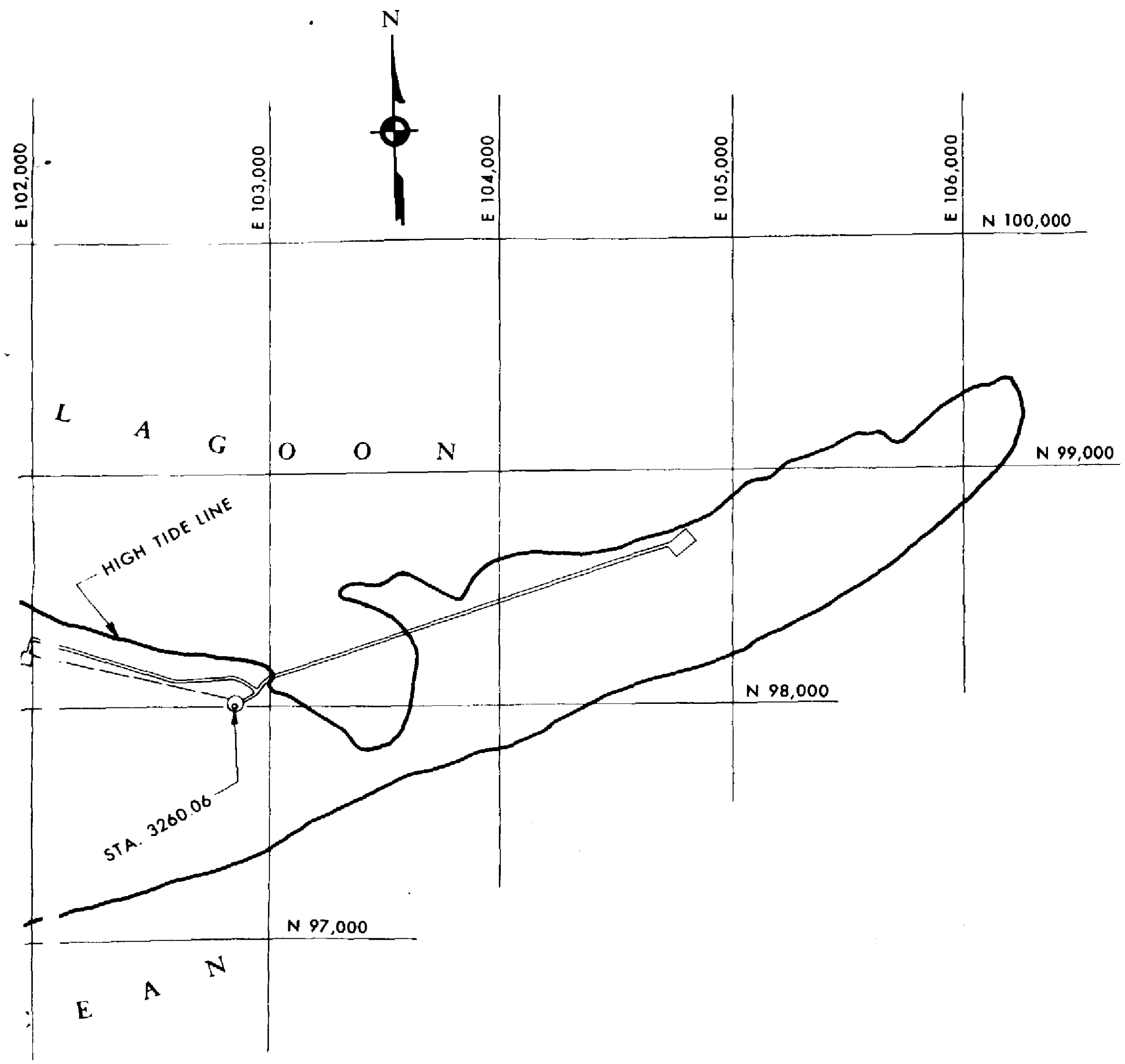


Figure No. 2-113. Scientific Plot Plan — Uncle.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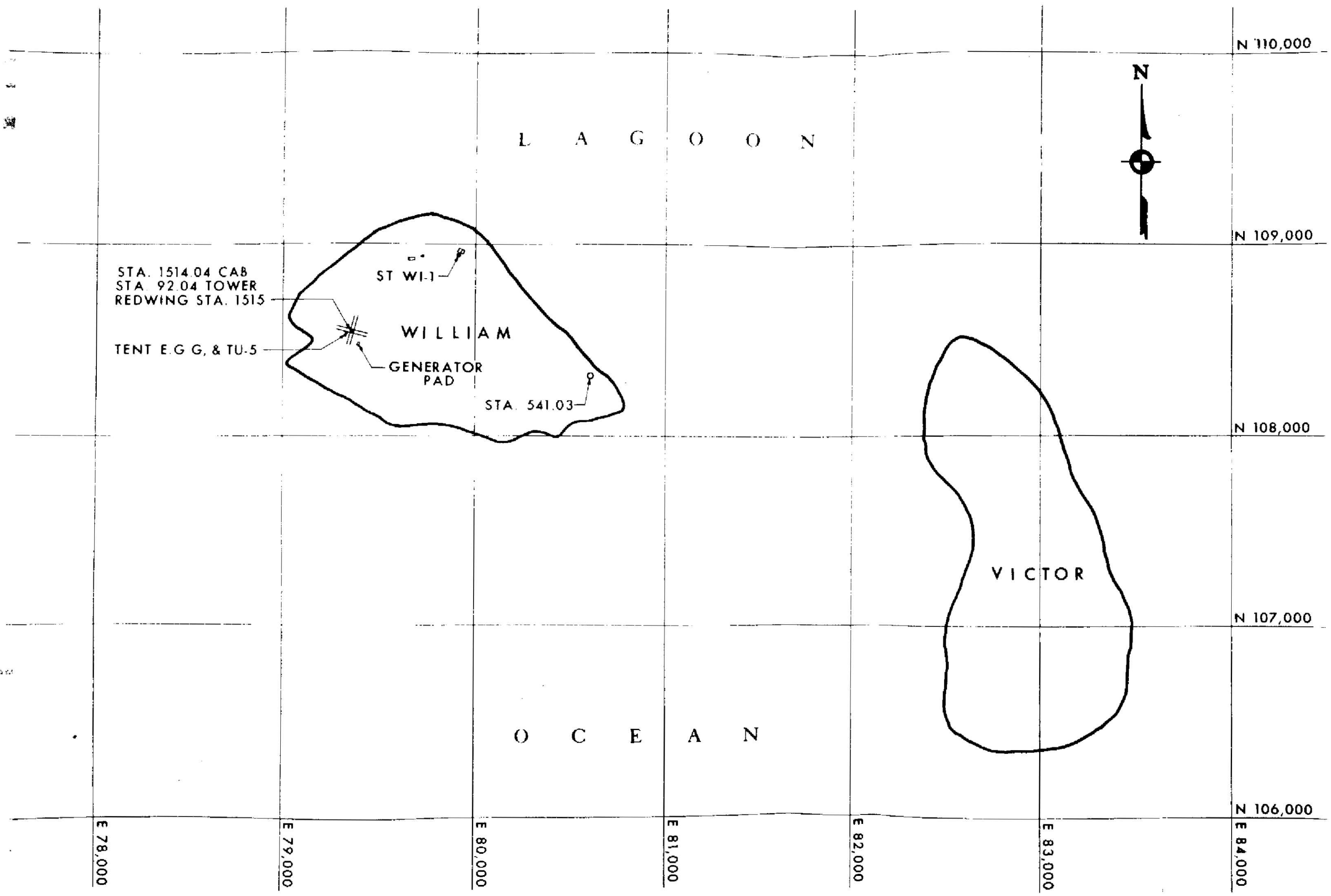


Figure No. 2-114. Scientific Plot Plan — Victor — William.

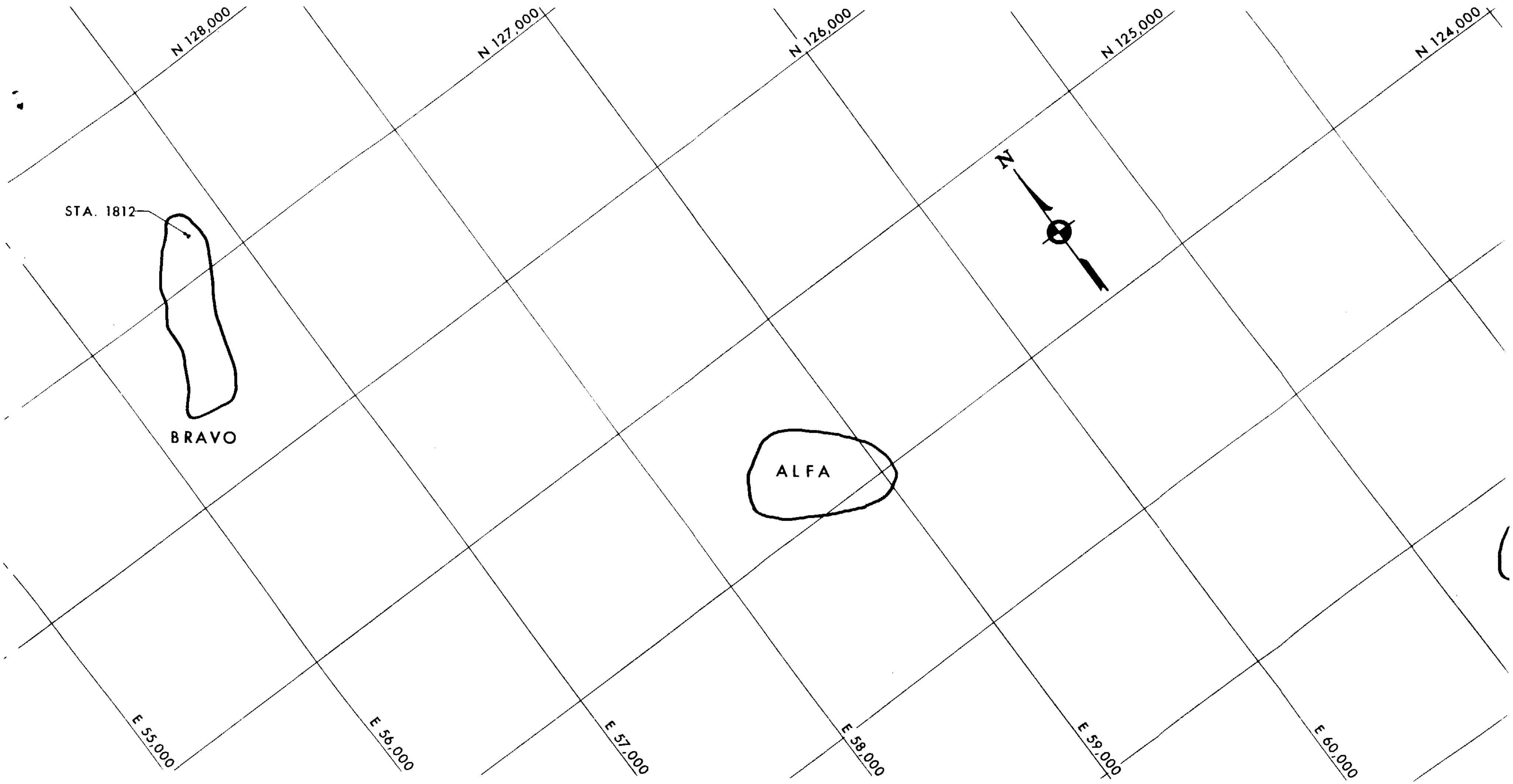
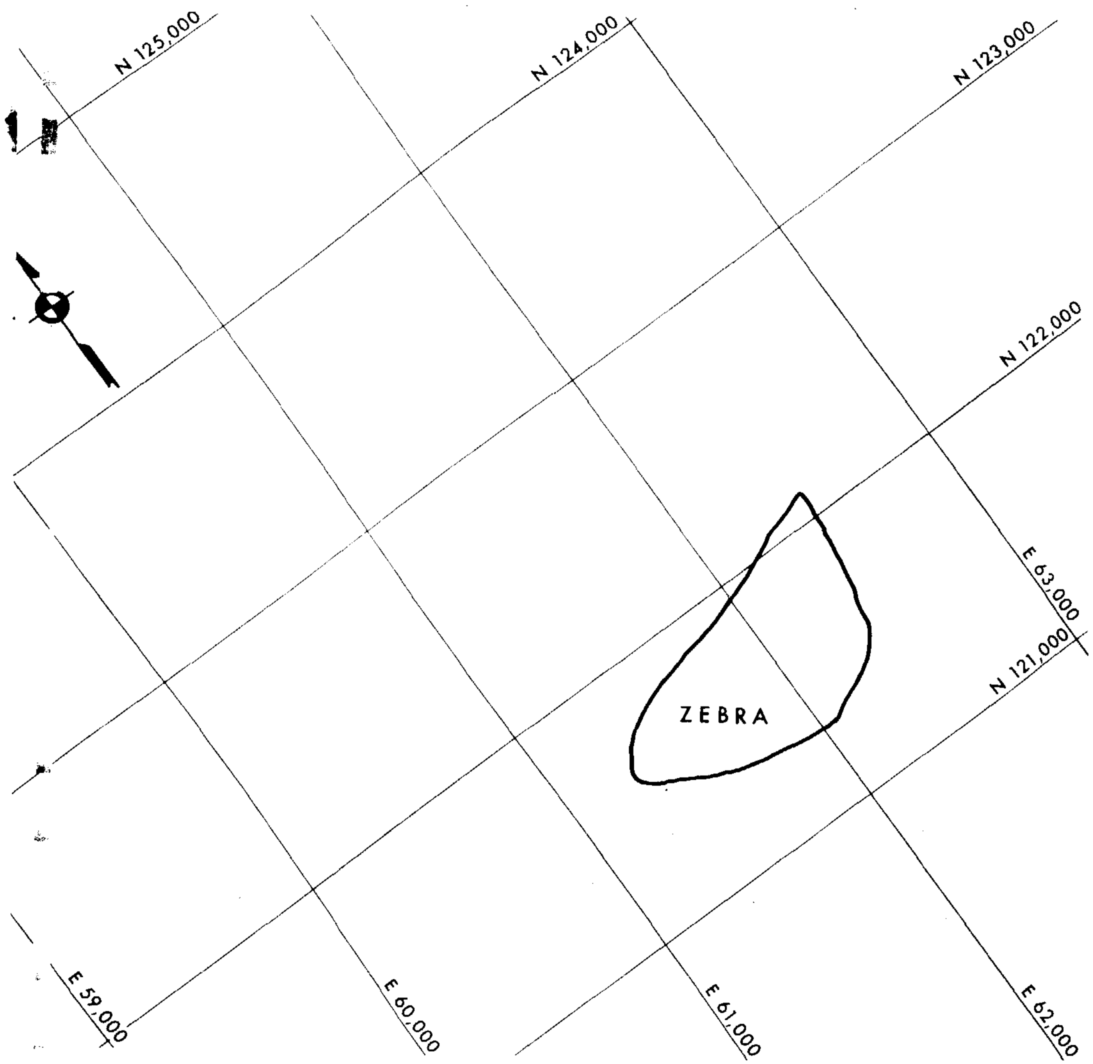


Figure No. 2-115. Scientific Plot Plan — Zebra — Alfa — Bravo.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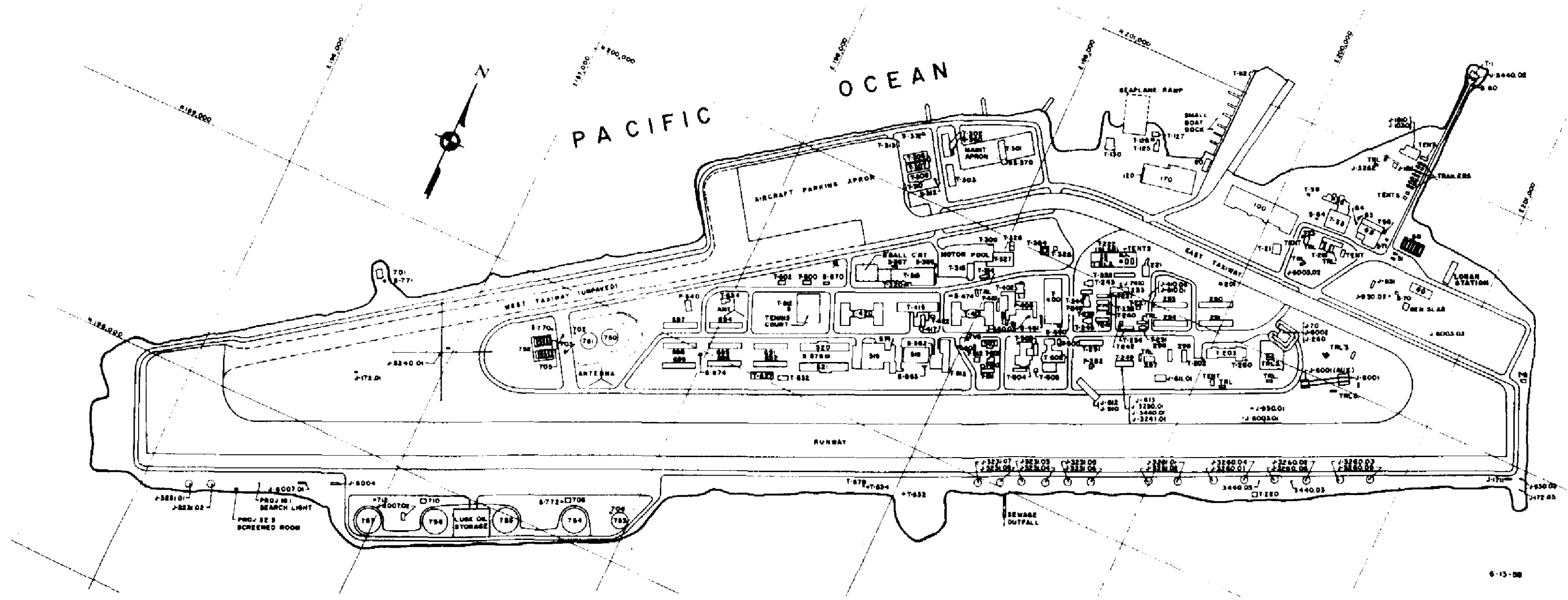


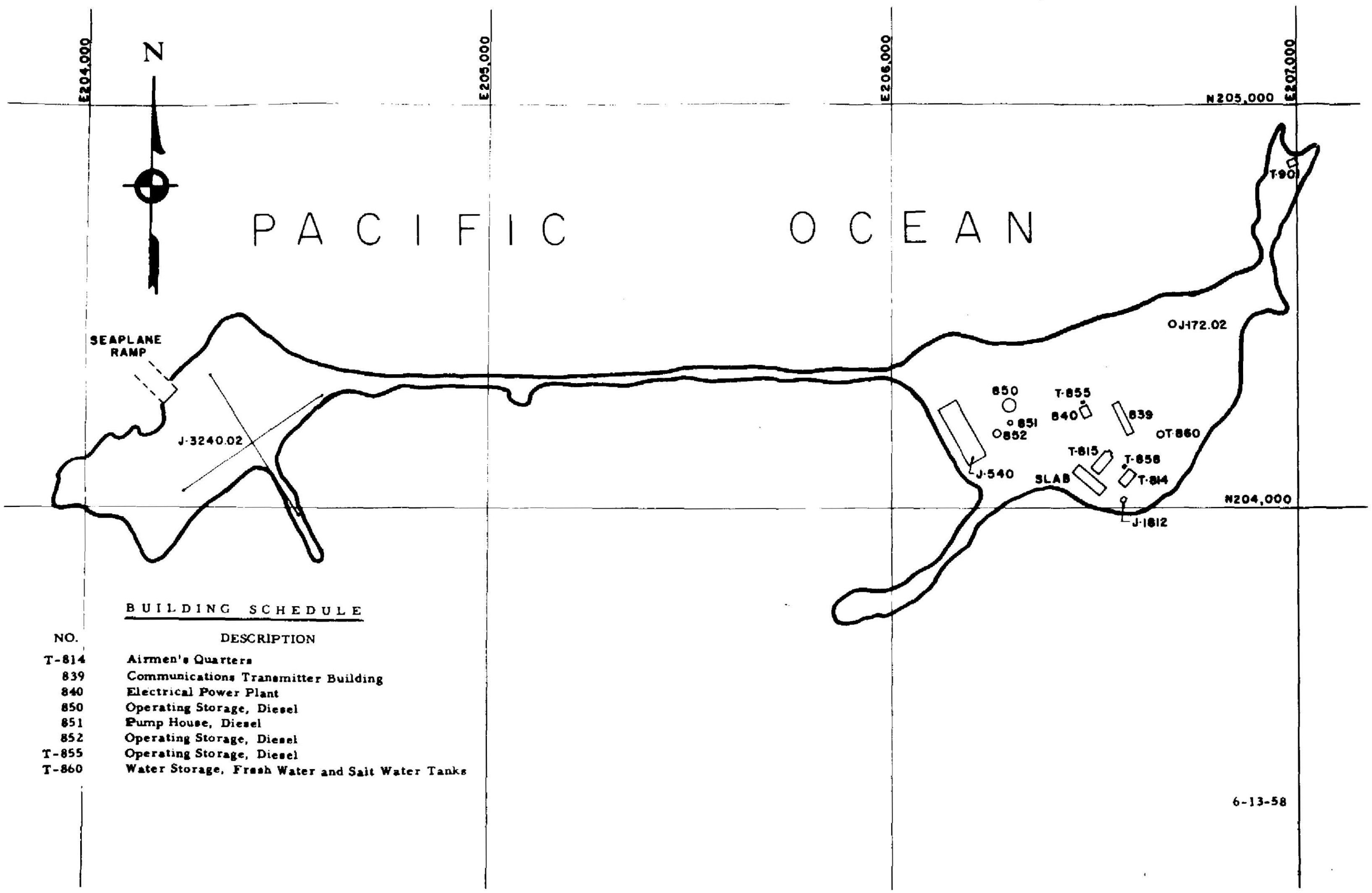
Figure No. 2-116. Scientific Plot Plan — Johnston Island.

B U I L

NO.	DESCRIPTION	NO.	DESCRIP
T-1	Visitor's Quarters	T-243	Quarters
T-3	Rawinsonde	T-244	School Building
TV-5	Electrical Transformer Vault	T-245	Quarters
T-33	Warehouse	T-246	Quarters
T-35	Evaporator Repair Shop	T-249	Base Headquarter Communications
T-36	Salt Water Pump House	T-251	Administration a
T-38	Fresh Water Pump House	P-252	Airfield Lighting
T-40	Mechanical Repair Shop	T-260	Fresh Water Sto
T-45	Power Plant and Meco Plant	S-270	Electrical Trans
50	Operating Storage, Mogas	290	Quarters
V-51	Fill Stand, Automotive	291	Quarters
53	Operating Storage, Diesel	293	Quarters
54	Operating Storage, Diesel	294	Quarters
S-60	Fresh Water Storage Tank	295	Quarters
S-64	Fresh Water Storage Tank	296	Quarters
S-70	Electrical Transformer Station	297	Quarters
100	Warehouse	T-300	Paint Storage
110	Crash Boat Flight Barracks	T-301	Nose Hanger
T-112	Tide Gage House	T-302	Parts Storage
120	Cold Storage Warehouse	T-303	Supply Warehous
T-125	Salt Water Pump House	T-306	Air Freight Term
T-126	Boat Repair Shop	T-307	Passenger Term
127	Boat Repair Shop	T-308	Operations, Tra
T-130	Beach House	T-310	Shed, Flight Line
170	Electrical Transformer Station	T-312	Electrical Emer,
200	Vacant	T-313	Shed, Flight Line
201	Storage, Ammunition	T-314	Quarters
T-202	Storage Shed	315	Power Plant
T-203	Officers' Club	T-319	Gymnasium
P-204	Insecticide Storage	T-324	Water Tower
P-205	Communications Storage	T-325	Refueling Vehicle
T-220	Recreation Shed	326	Concrete Block S
P-221	Rubber Storage	T-327	Motor Pool Shop
T-222	Concrete Slab	T-328	Auto Shop, Base
T-227	Sanitary Latrine	S-360	Fresh Water Sto
T-231	Family Housing, Officer	S-362	Fresh Water Sto
T-232	Chapel (Burned Down)	T-364	Water Storage T. Pumphouse
233	Visitors' Quarters	S-366	Fresh Water Sto
T-236	Telephone Exchange	S-367	Fresh Water Sto
T-237	Visitors' Quarters	S-370	Electrical Trans
T-238	Visiting Officers' Quarters	S-372	Electrical Trans
T-239	Visiting Officers' Quarters	T-400	Supply Warehous
T-240	Sanitary Latrine	T-402	Club, Service
T-241	School, Dependent		
T-242	Radio, MARS Building		

BUILDING SCHEDULE

NO.	DESCRIPTION
T-1	Visitor's Quarters
T-3	Rawinsonde
TV-5	Electrical Transformer Vault
T-33	Warehouse
T-35	Evaporator Repair Shop
T-36	Salt Water Pump House
T-38	Fresh Water Pump House
T-40	Mechanical Repair Shop
T-45	Power Plant and Meco Plant
50	Operating Storage, Mogas
V-51	Fill Stand, Automotive
53	Operating Storage, Diesel
54	Operating Storage, Diesel
S-60	Fresh Water Storage Tank
S-64	Fresh Water Storage Tank
S-70	Electrical Transformer Station
100	Warehouse
110	Crash Boat Flight Barracks
T-112	Tide Gage House
120	Cold Storage Warehouse
T-125	Salt Water Pump House
T-126	Boat Repair Shop
127	Boat Repair Shop
T-130	Beach House
170	Electrical Transformer Station
200	Vacant
201	Storage, Ammunition
T-202	Storage Shed
T-203	Officers' Club
P-204	Insecticide Storage
P-205	Communications Storage
T-220	Recreation Shed
P-221	Rubber Storage
T-222	Concrete Slab
T-227	Sanitary Latrine
T-231	Family Housing, Officer
T-232	Chapel (Burned Down)
233	Visitors' Quarters
T-236	Telephone Exchange
T-237	Visitors' Quarters
T-238	Visiting Officers' Quarters
T-239	Visiting Officers' Quarters
T-240	Sanitary Latrine
T-241	School, Dependent
T-242	Radio, MARS Building
T-243	Quarters
T-244	School Building
T-245	Quarters
T-246	Quarters
T-249	Base Headquarters and Communications
T-251	Administration and Post Office
P-252	Airfield Lighting Vault
T-260	Fresh Water Storage Tank
S-270	Electrical Transformer Station
290	Quarters
291	Quarters
293	Quarters
294	Quarters
295	Quarters
296	Quarters
297	Quarters
T-300	Paint Storage
T-301	Nose Hangar
T-302	Parts Storage
T-303	Supply Warehouse
T-306	Air Freight Terminal
T-307	Passenger Terminal
T-308	Operations, Traffic, Weather
T-310	Shed, Flight Line
T-312	Electrical Emergency Power
T-313	Shed, Flight Line
T-314	Quarters
315	Power Plant
T-319	Gymnasium
T-324	Water Tower
T-325	Refueling Vehicle Shop
326	Concrete Block Shed
T-327	Motor Pool Shop
T-328	Auto Shop, Base
S-360	Fresh Water Storage Tank
S-362	Fresh Water Storage Tank
T-364	Water Storage Tanks and Pumphouse
S-366	Fresh Water Storage Tank
S-367	Fresh Water Storage Tank
S-370	Electrical Transformer
S-372	Electrical Transformer
T-400	Supply Warehouse
T-402	Club, Service
P-405	Hospital
T-410	Quarters, Airmen
T-412	Airmen's Barracks
T-415	Theater
T-417	Bakery
T-420	Airmen's Barracks
T-422	Boiler House
S-460	Fresh Water Storage Tank
S-461	Fresh Water Storage Tank
S-474	Electrical Transformer
T-500	Supply Warehouse
T-502	NCO Club
T-503	Barber and Beauty Shop
T-504	Supply and Issue, Service Stock
505	Control Tower
T-506	Quarters
P-507	Radio Transmitter
T 509	Guard House
T 510	Vacant
T-512	Vacant
T-513	Machine Shop
T-518	Office and Shops
519	Mess Hall
520	Quarters
521	Quarters
T-533	AACS
T-534	Electrical Emergency Power
T-560	Fresh Water Storage Tank
S-562	Fresh Water Storage Tank
S-563	Fresh Water Storage Tank
S-565	Fresh Water Storage Tank
S-566	Fresh Water Storage Tank
S-567	Fresh Water Storage Tank
S 566	Fresh Water Storage Tank
S-569	Fresh Water Storage Tank
S-574	Electrical Transformer
S-576	Electrical Transformer
T-578	Electrical Transformer Station (Auxiliary)
T-600	Quarters
T-602	Quarters
T-612	Fresh Water Pump House
T-627	Fire Station
T-634	Transmitter Building
T-640	Paint Storage
T-670	Electrical Transformer Station
S-672	Electrical Transformer
S-674	Electrical Transformer Station
691	Quarters
692	Quarters
694	Quarters
695	Quarters
696	Quarters
697	Quarters
698	Quarters
699	Quarters
701	Weather Station
702	Pump Station, AvGas
703	Fill Stands, Truck
705	Petroleum Pump House
706	Pump Station, AvGas
708	Pump Station, Diesel
710	Shop, Tool
712	Pump Station, AvGas
750	Tank, Bulk AvGas
751	Tank, Bulk AvGas
752	Tank, Bulk AvGas
753	Tank, Bulk AvGas
754	Tank, Bulk Diesel
755	Tank, Bulk Diesel
756	Tank, Bulk AvGas
757	Tank, Bulk AvGas
S-770	Electrical Transformer Station
S-772	Electrical Transformer Station



BUILDING SCHEDULE

NO.	DESCRIPTION
T-814	Airmen's Quarters
839	Communications Transmitter Building
840	Electrical Power Plant
850	Operating Storage, Diesel
851	Pump House, Diesel
852	Operating Storage, Diesel
T-855	Operating Storage, Diesel
T-860	Water Storage, Fresh Water and Salt Water Tanks

Figure No. 2-117. Scientific Plot Plan — Sand Island.

SECTION 4
EXPENDABLE CONSTRUCTION

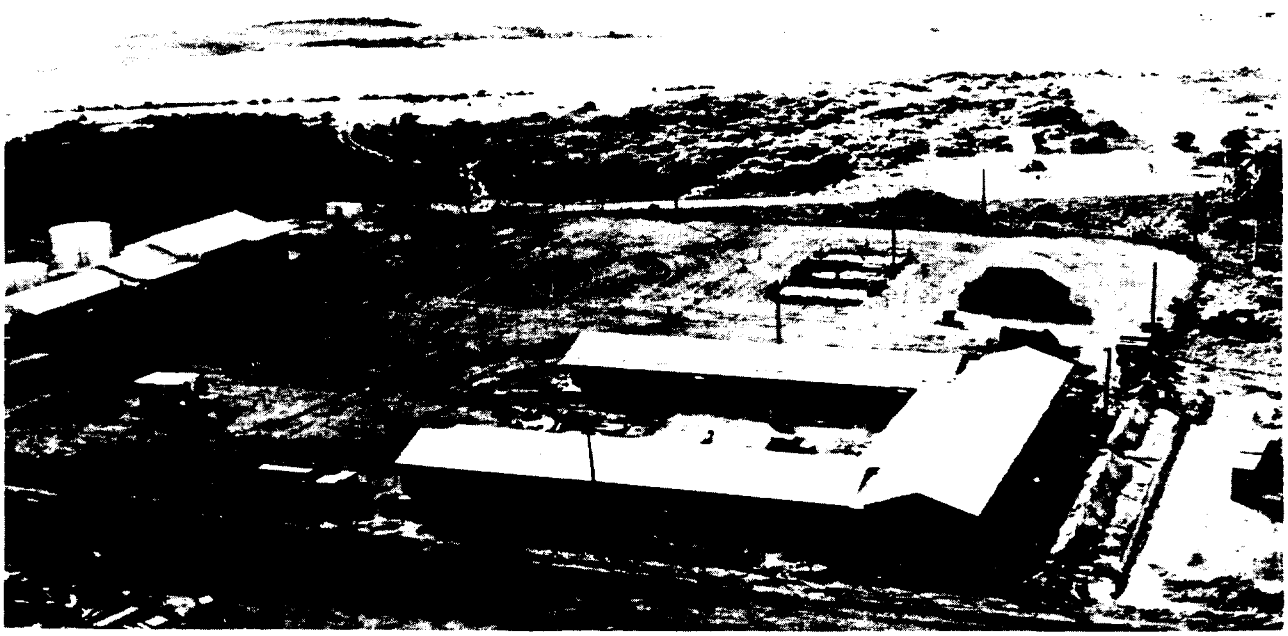
NAN CAMP.

The Nan camp was activated the first week of June 1957 and served as the base camp for Bikini Atoll. Work was immediately started on rehabilitation and maintenance of buildings and the checking out of all water and sewer lines. By the middle of July, the original population of 148 had doubled, and work was directed to the pre-cutting and prefabricating of buildings for the How and Oboe temporary camps. The aggregate program on Oboe was also in progress by that time, with drilling and blasting on a continuous basis to provide a stockpile of required materials.

Following the activation of the Nan camp, many material improvements were made, including additions or modifications to the Infirmary, Building 19; Camp Store, Building 18; Laundry and Distillation Plant, Building 25; and the fuel unloading and servicing facilities. New roads and parking areas were established to serve the new areas. Small boat piers were built near the LST pier and in the Navy Recreation Area. The recreation and swimming areas were improved, and a shark net was installed. Two volleyball, two handball, two tennis, and one basketball court were built for the recreation program; all were equipped with night lighting. Though originally designed to accommodate only 1000 men, the Nan camp had a population of over 1300 during the peak period.

The major facilities constructed at this site for Operation HARDTACK were the TG 7.1 Administration Building, the UCRL Assembly Area, Building 204, Communications, and a three-fingered Barge Slip and Assembly Area. The TG 7.1 Administration Building, No. 284, was a U-shaped building, 118x138x8-foot-high. The structure frame consisted of standard 24-foot timber trusses supported on wood stud walls with plywood siding and corrugated aluminum roofing. The building contained 28 rooms, including a reproduction room, a teletype room, a dehumidified area, and offices.

The UCRL Assembly Building, No. 279, was a 48x102-foot metal building and lean-to shelter used for weapons assembly and was designed to withstand the maximum anticipated



(Neg. No. W-V-202-11)

Figure No. 2-118. TG 7.1 Administrative Compound — Nan.

(Neg. No. W-876-12)

Figure No. 2-119. Assembly Building — Nan — 70% Complete.

overpressure at Bikini Atoll. The main portion of the building, Room 101, consisted of 28-foot-high, 31-foot-wide steel rigid frames spaced 20 feet on centers with girt and purlin framing supporting V-beam-type protected metal roofing and siding. A 15-ton electrically-operated bridge crane with a 5-ton auxiliary hoist was located in Room 101 and operated the length of the building. An automatic absorption-type dehumidifier and a compressor-condenser unit was installed outside the building with a ceiling-hung, self-contained evaporator unit installed in Room 103 to take care of the close humidity and temperature control.

Building 204, Communications, was constructed to house inter-atoll and intra-atoll radio communication equipment. The building was an L-shaped concrete structure with one leg 27x80x 15 feet high. The other leg was 41x53x11 feet high. The long portion of the structure was used for transmitter and receiver equipment. The shorter portion of the building was divided into seven rooms off a central corridor plan. A Cyphony Room contained floor trenches. Other rooms were used for maintenance, storage, rad-safety, Dark Room, etc. A 9x12-foot Transformer Room and a 9x18-foot Fan Room were included in the structure. To provide a highly reliable power supply to the monitor and receiving racks, dual regulators and transfer switches were utilized.

A three-fingered Barge Slip and Assembly Area were provided at Site Nan for the outfitting of User-furnished equipment onto the shot barges. The design was predicated on a need for two quiet water barge slips for loading weapon devices aboard with mobile cranes. The slips were 40 feet, 5 inches clear by 127 feet long; the two end fingers were 45 feet, 7 inches wide; and the center finger was 54 feet, 7 inches wide to allow mobile crane access to serve each slip. Each slip was enclosed from the lagoon in front by a steel gate, which was vertically removable by use of a mobile crane. A catwalk on top of each gate provided access between the slip fingers on the lagoon end.

TEMPORARY CAMPS.

Design criteria for the other temporary camps were standardized, and all camps, except the one at George, had similar facilities, varying only in the number of living quarters and latrines required to accommodate the anticipated populations. Buildings were erected in accordance with new Jobsite typical drawings for temporary buildings which required wood frame and plywood siding and metal roofs. Tents were framed, covered with tentage and flies, and mounted on concrete slabs. Power and water distillation plants varied in production capacities to meet local demands. Buildings at each site, except George, provided for a Mess Hall and Butcher Shop, Construction Office, Camp Store and Post Office, Refreshment Center, Fire House and First Aid Station, Timekeeping Office, Warehouse, Carpenter Shop, Plumbing and Electrical Shop, Vehicle Repair Shop, Water

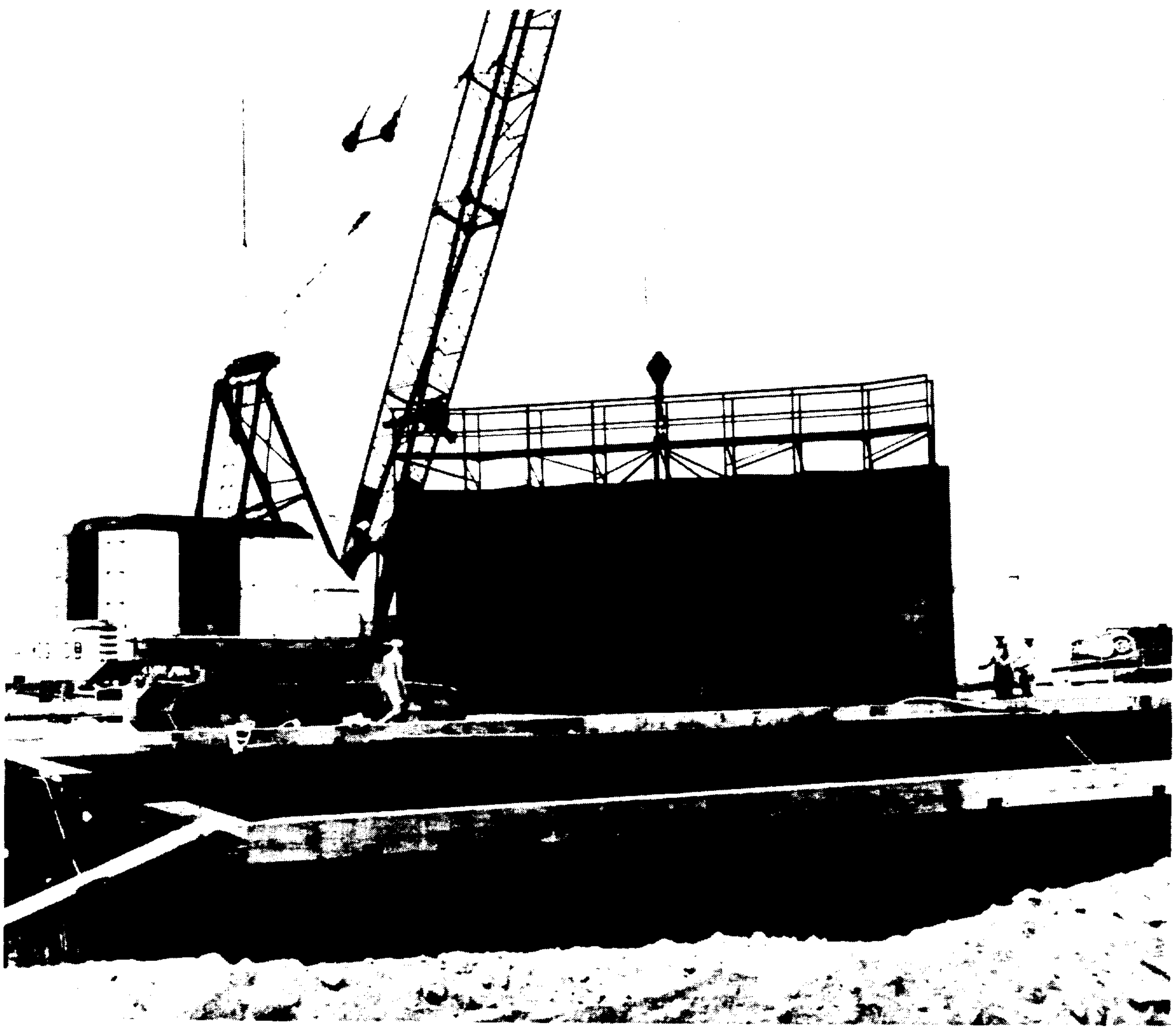
Distillation and Power House, Latrines, Reefer Shelter, Vegetable Storage Shed, and Laundry Shed. On Yvonne the Power Plant was housed in a concrete, earth-covered bunker. Work parties from Elmer initiated the work on Janet, Yvonne, and Ursula camps, with the latter camp cancelled after 13 floor slabs were poured. Initial work on the How and Oboe camps stemmed from the Nan camp.

Oboe camp was designed as a 500-man camp, but construction was authorized for only a 300-man camp. Work was started on 10 July 1957, and the camp was occupied on 18 November 1957. This camp remained in an operative status throughout the entire schedule of events at Bikini Atoll, with final roll-up completed subsequent to the JUNIPER event on 22 July 1958.

The How camp was designed and constructed as a 300-man camp, with camp preparations starting on 6 June 1957 and occupation taking place on 4 November 1957. This camp was rolled up on 26 April 1958, following the transfer of the ABMA program.

Janet camp was designed and constructed as a 300-man camp, with camp construction starting as of 9 July 1957. The camp was opened on 2 October 1957 and rolled up on 9 May 1958 in preparation for the KOA event.

Yvonne camp was constructed as a 200-man camp. The work started on 1 July 1957, and the camp was opened on 16 December 1957 and rolled up on 5 May 1958 in preparation for the CACTUS event.



(Neg. No. W-V-237-1)

Figure No. 2-120. Placing Gate in Barge Slip — Nan.

(Neg. No. W-882-11)

Figure No. 2-121. Site Janet Camp.

George camp was started on 17 February 1958 as a 30-man beachhead serviced from a marine craft, was occupied on 8 March 1958, and was closed on 18 April 1958.

Johnston Island, the revised location for the ABMA program, was selected when work was halted on Site How on 10 April 1958. It was initially occupied by H&N forces on 17 April 1958 and existing facilities were rehabilitated and modified to accommodate an anticipated peak population of 1200.

OFF-ATOLL PROJECTS.

As funds were provided, work was started on the structure to be furnished the natives being repatriated to Rongelap Atoll. The work was planned to be accomplished in two phases. Whenever possible, the precasting of concrete and the prefabrication of structures was done at Site Elmer. Living quarters, a Dispensary, a Council House, and water cisterns were the main facilities provided. On 20 June 1957 the construction crew returned to Elmer; everything was in readiness for the repatriation of the Rongelapese.

Planning for Operation HARDTACK included the rehabilitation of the Weather and Rad-safety Stations used in Operation REDWING plus the construction of new Weather Stations at Nauru, Truk, Utirik, and Ponape. Preliminary surveys were made at each site, which provided "punch-lists" for the construction planning. Construction at most sites was planned to be done in two phases, with most of the work being accomplished during the first phase. Second phase work included minor clean-up and the activation of the stations.

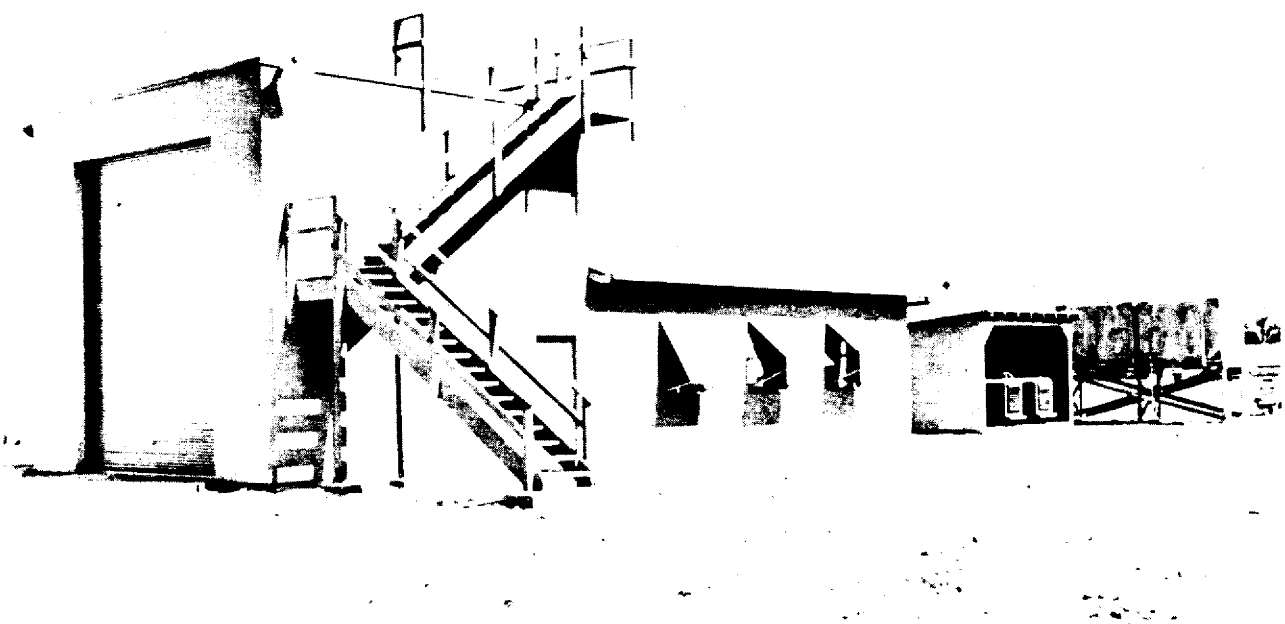
Work parties were planned to consist of an Assistant Superintendent and from 12 to 30 skilled men, depending upon the amount of work to be accomplished. Construction parties were augmented by Surveyors, an Inspector, marine operations personnel, Camp Utility Workers, and a First Aid Man. Native labor was used at some sites. Equipment sent with each party was standardized, usually consisting of a bulldozer, an end-loader, a crawler-crane, forklifts, an air compressor, a welding machine, a concrete mixer, dump, fuel, and pick-up trucks, and, in some instances, a concrete-finishing machine. Both equipment and building materials were loaded onto flat-bed trailers for quick off-loading from LSD- and LST-type vessels. LCU craft were used for off-loading from LSD vessels. The materials sent to each site varied with the amount of work to be done, with building prefabrication being done at Elmer or Nan, whenever practicable.

Building materials for the new Utirik Weather Station included 28,660 square feet of roofing and siding, 2200 square feet of plywood, 26,800 lineal feet of lumber, three 90-foot antenna poles, and heavy lumber for the construction of a new water tower. Thirty construction workers and collateral personnel made up the work party. Work was started on 16 October 1957 and was completed on 4 November 1957; the station was activated by another work party and turned over to the Air Force on 22 March 1958.

A work party of 12 men departed Elmer by LST for Ponape on 25 October 1957 to construct a new Weather Station which consisted of a single building utilizing local power. Twenty-nine cubic yards of concrete were poured for the building's slab; the building itself was constructed of plywood and was given three coats of paint, inside and out. Trust Territory officials furnished a truck, sand, and gravel for the concrete slab and native laborers from the Trust

(Neg. No. W-850-10)

Figure No. 2-122. Reefer Bank and Water Storage Tanks — Utirik.



(Neg. No. W-V-113-11)

Figure No. 2-123. Weather Station — Truk.

(Neg. No. W-223-10)

Figure No. 2-124. Weather Station — Kapingamarangi.

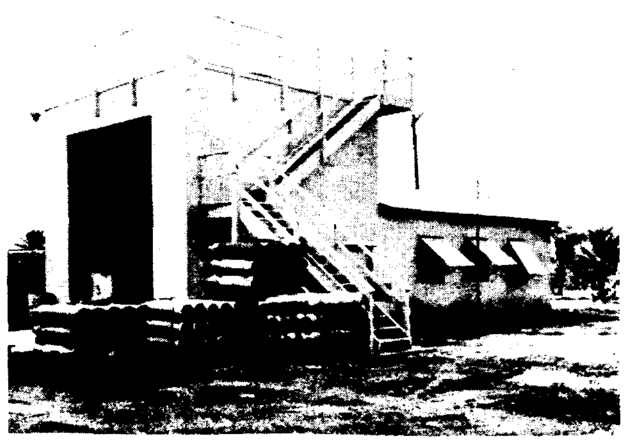
Territory labor pool, wherever needed. The work party left for Truk on 9 November 1957, after the Ponape requirements were met.

Arrival at Truk was on 11 November 1957, when the LST was beached and off-loading started. Ten natives were hired as common laborers. Work proceeded rapidly until 14 November when a typhoon forced the LST to remain at sea all day with the work party on board. Trust Territory personnel at this site were most cooperative. The Weather Observation Building and Generator Shed were completed on 26 November 1957. The work at Truk and Ponape required more than 5000 pounds of cement, 6500 pounds of electrical materials, and 15,000 pounds of plumbing materials.

Rehabilitation of the Ujelang Rad-safety Station was accomplished from 10 to 27 November 1957. A new Water Tower, Power and Distillation Building, and Pump House were erected, and all the tents were re-covered with new canvas. The station was activated on 23 March 1958.

The Wotho Rad-safety Station entailed construction of everything required for a tent camp, including four new floor slabs. The natives had stripped everything from the camp except the concrete following the REDWING operation. A new Power and Distillation Building was required. Work was accomplished from 30 November through 14 December 1957. Upon completion of the work, two natives were hired to safeguard the camp until its activation on 20 March 1958.

The Ronelap Rad-safety Station was designed to be an 8-man camp, but, because of added requirements, housing facilities were increased to accommodate 30 men. The station was located four miles west of the LST beaching area and small boat pier, requiring all supplies to be trucked over a very narrow rough, winding road. One building was erected to provide housing for eight men, the mess facilities and operations room, and a latrine. Eight-man tents were erected to provide housing for the



(Neg. No. W-V-245-2)

Figure No. 2-125. Weather Station — Ponape.

additional population. A Water Tower, Power and Distillation Building, and Pump Shed were the only other items of construction. Work started on 28 December 1957 and was completed on 9 January 1958. The camp was activated on 16 March 1958.

The work party, equipment, and materials for the rehabilitation of the Kapingamarangi and Kusaie Weather Stations departed Elmer on 29 November 1957. The Kapingamarangi Station was completed on 10 December 1957, and the work party moved on to Kusaie. Upon completion of the work at Kusaie, the work party returned to Elmer, arriving there on 24 December 1957. The Kapingamarangi Weather Station was activated during the week ending 16 March 1958, preceded by the activation of the Kusaie Station during the week ending 23 February 1958.

Eighteen construction workers and supporting service personnel with building materials departed Elmer on 28 January 1958 to accomplish the rehabilitation of the Weather Station at Tarawa. Materials included 2000 pounds of cement, 5600 pounds of plumbing materials, 10,250 pounds of electrical supplies, and five reels of electrical cable. Some native labor was used, with the hiring being done through the office of the British Residency. Harmonious relationships were maintained with the British residents and the natives. The job was completed on 10 February 1958, and the work party returned to Eniwetok. Activation of the Tarawa Weather Station took place on 18-19 March 1958.

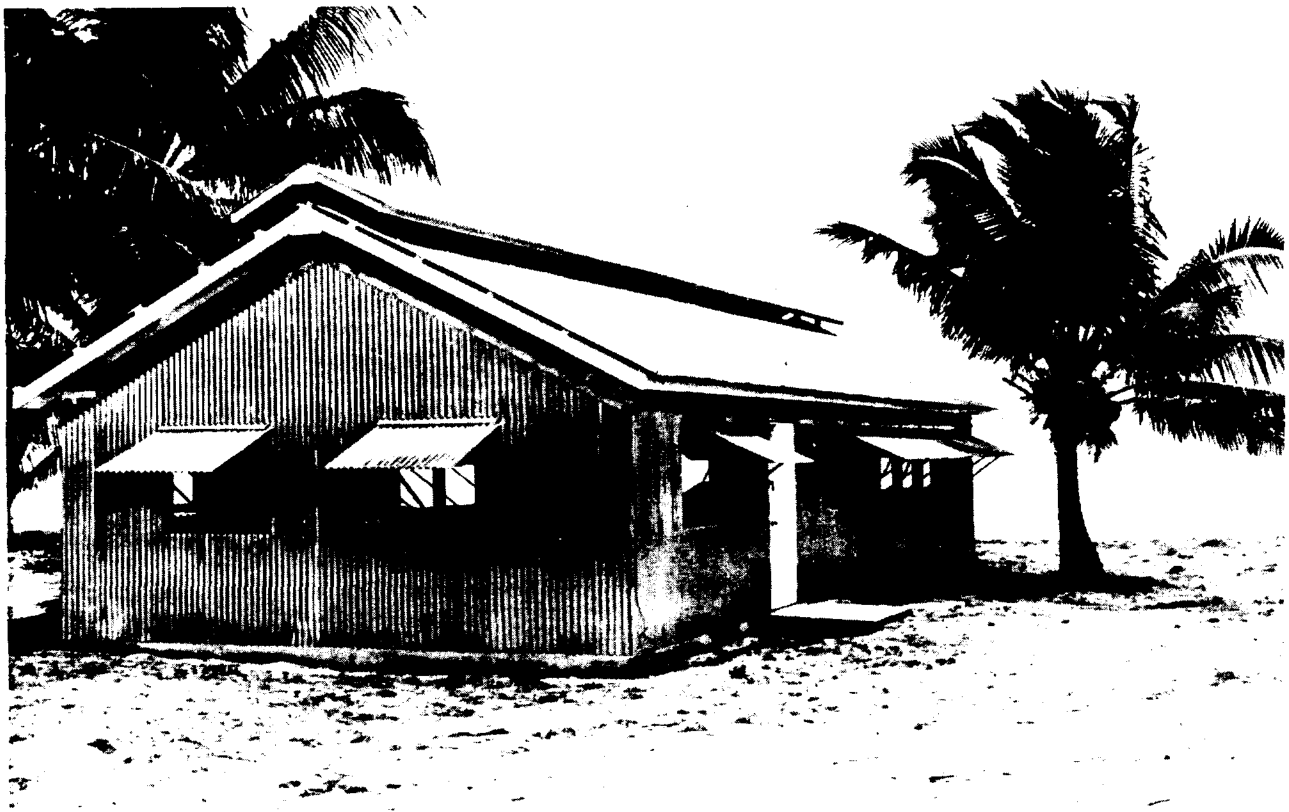
Following an agreement between the AEC and the Australian Government, land was leased from the British Phosphate Commission and plans were formalized for the construction of a Weather Station at Nauru, an island lying 770 nautical miles southeast of Eniwetok. Thirty-six construction personnel, augmented by collateral workers, arrived at Nauru on 4 March 1958. Sea conditions were adverse and on one occasion the ship, with the construction crew aboard, was forced to put to sea for the entire day. When equipment and materials were finally ashore, work was started simultaneously on a temporary camp, the permanent camp, and the rehabilitation of the Nauru Airstrip. The airstrip had not been used for two years.

The following facilities made up the permanent camp: two barracks, a Day Room, Mess Hall, Reefer Shed, Power and Distillation Building, Pump House, Operations Building, septic tanks, two antenna poles, and a concrete pad for the Rawinsonde instrument. Rehabilitation of the airfield entailed filling, grading, watering, and compacting. The airfield was 4228 feet long and 150 feet wide, with a 300 foot turn-around at both ends.

Some additional equipment was rented from the British Phosphate Commission, which also furnished operators and laborers and provided 197 cubic yards of ready-mix concrete. Through-

(Neg. No. W-851-6)

Figure No. 2-126. Typical Power and Distillation Plant — Off-Atoll.



(Neg. No. W-V-224-3)

Figure No. 2-127. Typical Building — Off-Atoll.

out the construction period, pleasant relations were maintained with the Nauru Administration and the natives. The station was turned over to the Air Force on 2 April 1958.

Equipment installed in all Weather and Rad-safety Stations included power generators, distillation units, acid pumps, salt and fresh water pumps, water and fuel tanks, reefers, stoves and griddles, ice-makers, refrigerators and freezers, electric water coolers, hot water heaters, sinks, and hot lockers.

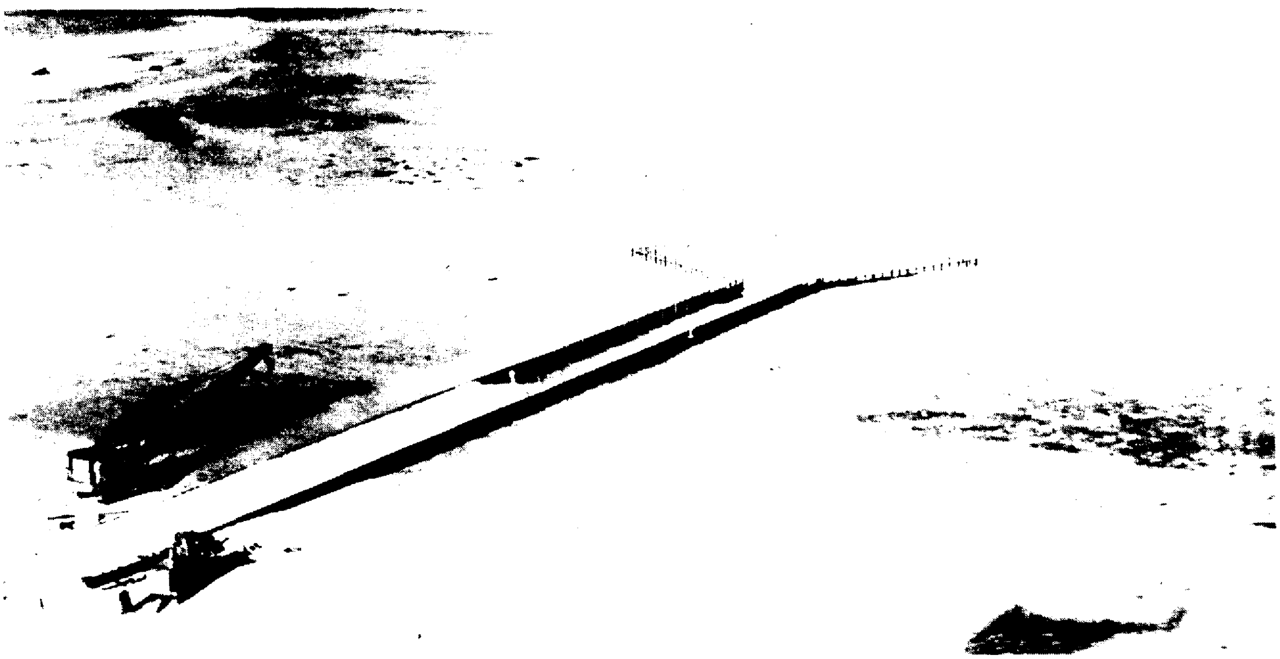
SUBMARINE CABLE SYSTEMS.

Submarine cable systems on both Bikini and Eniwetok Atolls were tested during the interim period immediately following Operation REDWING. In November 1957 Work Orders were received directing the replacement of certain portions of the existing systems and the laying of some new lines of 16-pair and 26-pair cables. Cables were placed between Station 77.02 on Janet and Station 25 off Alice bypassing the Gene Complex because of the scheduled KOA event. Prior to each barge event, a 16-pair and a 26-pair cable were tied in between the barge and the nearest timing or control station. One cable was laid on the oceanside reef at Elmer to circumvent digging a trench for the cable laying.

A new method of laying submarine cable was devised during this Operation, using an LCU carrying four reels of cable on racks as the prime vehicle. After spending a pair of reels, the loose ends were passed to a splicing crew in an accompanying LCM; the LCU then continued laying cable and was met by a second LCM also carrying a splicing crew. Thus, laying and splicing were carried on simultaneously. By 15 June 1958 more than 187,000 feet of 16-pair and 554,000 feet of 26-pair submarine cable had been laid at Bikini Atoll. During the same period, more than 125,000 feet of 16-pair and 268,000 feet of 26-pair submarine cable had been placed at Eniwetok Atoll.

ROADS, CAUSEWAYS AND MAN-MADE ISLANDS.

On Bikini Atoll the existing causeways on Tare Complex and between Fox and George were rebuilt with no complicating factors. Roads on causeways were made 20 feet with a protective berm on each side. Causeways on Eniwetok Atoll connecting Gene and Helen, and Helen and Irene were built with little trouble. The old causeway between Helen and Irene was destroyed in Operation REDWING and could not be rebuilt because of the deep crater. Consequently, a new causeway was built in a north-

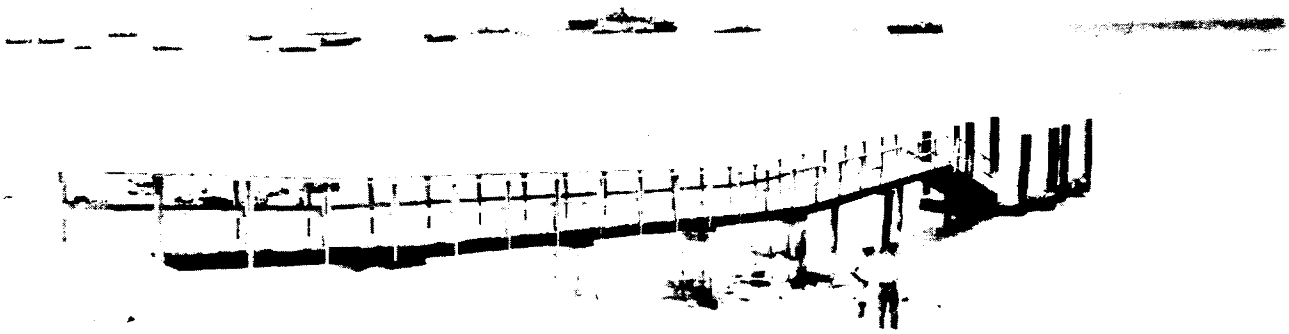


(Neg. No. W-856-5)

Figure No. 2-128. Causeway and Man-made Island — Helen — Eniwetok Atoll — 30% Complete.

(Neg. No. W-V-122-3)

Figure No. 2-129. Causeway Constructed Between Roger and Sugar — Bikini Atoll.



(Neg. No. W-V-271-12)

Figure No. 2-130. Small Boat Pier — Nan.

erly direction from the southwest end of Irene to the east end of Helen. Concrete riprap from demolished stations on Janet was used to hold the fill in place.

To facilitate the construction of Station 1210.01, a 100x100-foot man-made island was built on the north side of Helen and was connected to the island by a 24-foot-wide by 250-foot-long causeway. Both the man-made island and the causeway were enclosed by 3-inch rough planking which was bolted to rail pilings. Fills for the island and causeway consisted of compacted pit-run coral. Typhoon "Ophelia" washed out a small part of the fill, but the damage was quickly repaired.

MISCELLANEOUS CONSTRUCTION.

Helicopter pads on Eniwetok Atoll were located on Alice, Irene, Mary, Wilma, Bruce, David, Glenn, Henry, and Leroy. All were covered with pierced steel planking, 100x100 feet, in cleared areas having a radius of 150 feet, and all were equipped with windsocks. Pads were also located on Charlie, George, How, and William on Bikini Atoll and were stabilized areas at least 100 feet square and were also equipped with windsocks.

Existing airfields on Nan, Peter-Oboe, Elmer, Janet, Tilda, and Yvonne were all rehabilitated, with the Yvonne strip being extended 200 feet on the ocean end of the field. Nan, Elmer, and Yvonne airstrips were compacted and sealed with asphalt emulsion, while the other airstrips were compacted and finished using coral aggregate as follows: sub-grade compacted to 40% CBR and base course to 60% CBR.

Personnel and Small Craft Piers were built at Gene, Janet, Ursula, Yvonne, Nan, Utirik, Rongelap, and Wotho. Those at Eniwetok and Bikini Atolls were constructed with wood or steel piling and those at the Weather and Radsafety Stations were constructed by laying decking over two or more Navy cubes. Lengths and locations of the latter piers were determined in the field.

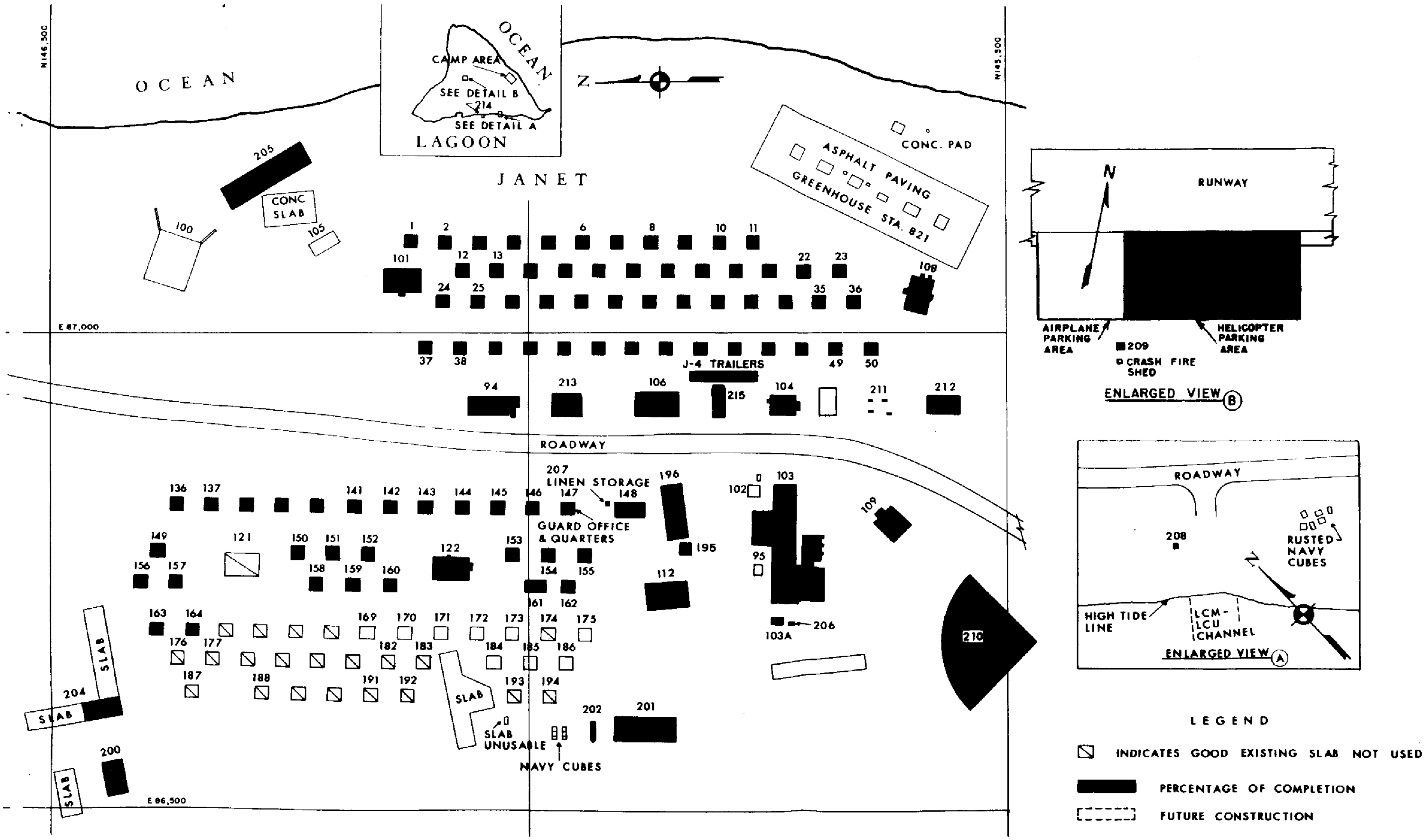
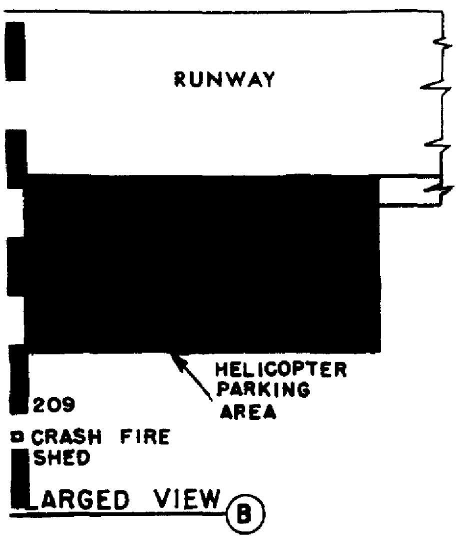
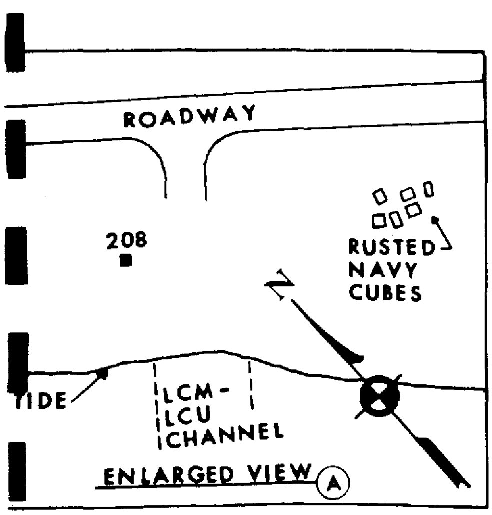


Figure No. 2-131. Janet Campsite — Eniwetok Atoll.

BUILDING

BLDG. No.	
1-50	4-MA
94	REFR
95	ICE
100	
101	LATR
102	GARB
103	MESS
103A	BOILE
104	FIRE
105	WATE
106	CONS
108	LATRI
109	MOVIE
112	WARE
121	
122	LATR
136-146	4-MAN
147	GUAR
148	CAMP
149-160	4-MAN
161	GYMN
162-164	4-MAN
165-194	4-MAN
195	PORT
196	DAY
200	EXIST
201	HEAV & PLU
202	GREAS
203	
204	CARPE
205	POWER
206	LAUNI
207	LINEN
208	MARIN
209	AIR OI
210	SOFTB
211	HORSE
212	VOLLE
213	P. X.,
214	PERS
215	TG 7.





BUILDING SCHEDULE

BLDG. No.	DESCRIPTION
1-50	4-MAN TENT
94	REFRESHMENT BLDG.
95	ICE FLAKE MACHINE
100	
101	LATRINE & SHOWER - 125-MAN
102	GARBAGE STORAGE
103	MESS HALL
103A	BOILER HOUSE
104	FIRE STATION & FIRST AID
105	WATER TOWER
106	CONSTRUCTION OFFICE
108	LATRINE & SHOWER - 100-MAN
109	MOVIE THEATER
112	WAREHOUSE
121	
122	LATRINE & SHOWER - 100-MAN
136-146	4-MAN TENT
147	GUARD OFFICE & QUARTERS
148	CAMP OFFICE & STORAGE
149-160	4-MAN TENT
161	GYMNASIUM
162-164	4-MAN TENT
165-194	4-MAN TENT SLABS
195	PORTABLE TIME OFFICE
196	DAY ROOM & LIBRARY
200	EXISTING SLAB
201	HEAVY EQUIP., ELECTRICAL, & PLUMBING SHOP
202	GREASE RACK
203	
204	CARPENTER'S SHOP & SAWMILL
205	POWER AND DISTILLATION PLANT
206	LAUNDRY
207	LINEN STORAGE
208	MARINE DISPATCHER'S OFFICE
209	AIR DISPATCHER'S TENT
210	SOFTBALL FIELD
211	HORSESHOE PITS
212	VOLLEYBALL COURTS
213	P.X., P.O. & BARBER SHOP
214	PERSONNEL PIER
215	TG 7.1 OFFICE TENT

LEGEND

DICATES GOOD EXISTING SLAB NOT USED

PERCENTAGE OF COMPLETION

FUTURE CONSTRUCTION

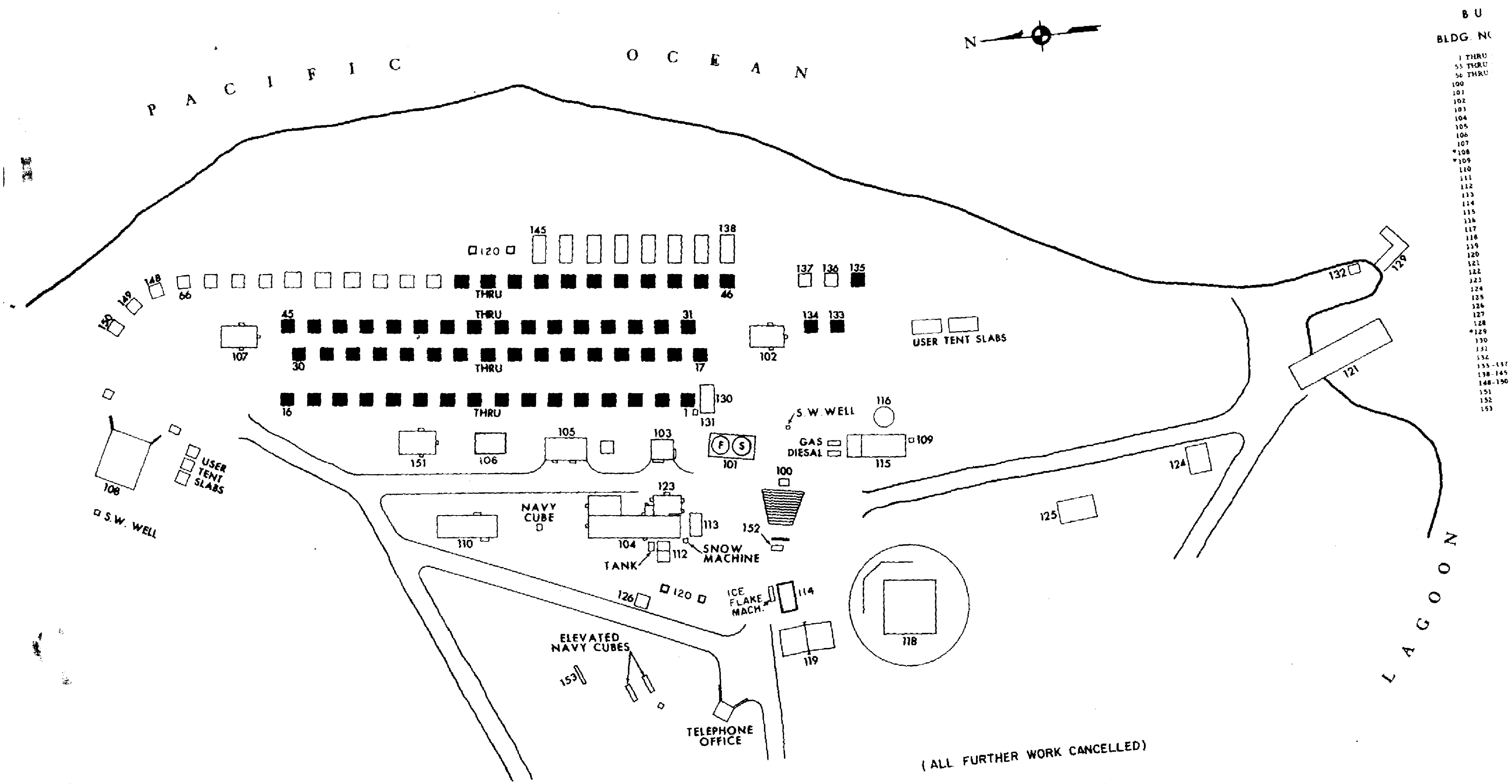
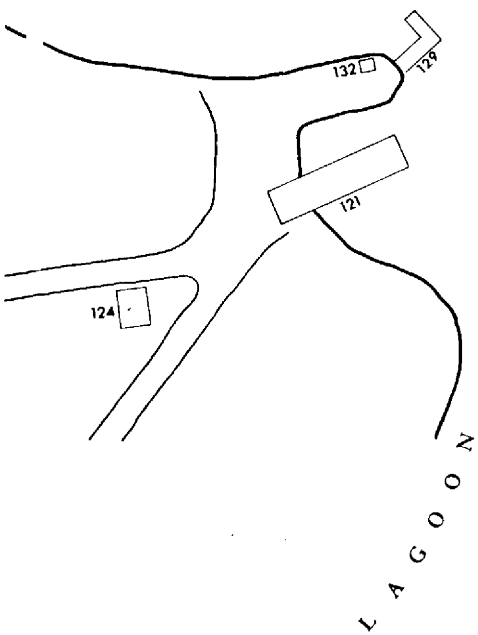


Figure No. 2-132. Ursula Campsite — Eniwetok Atoll.



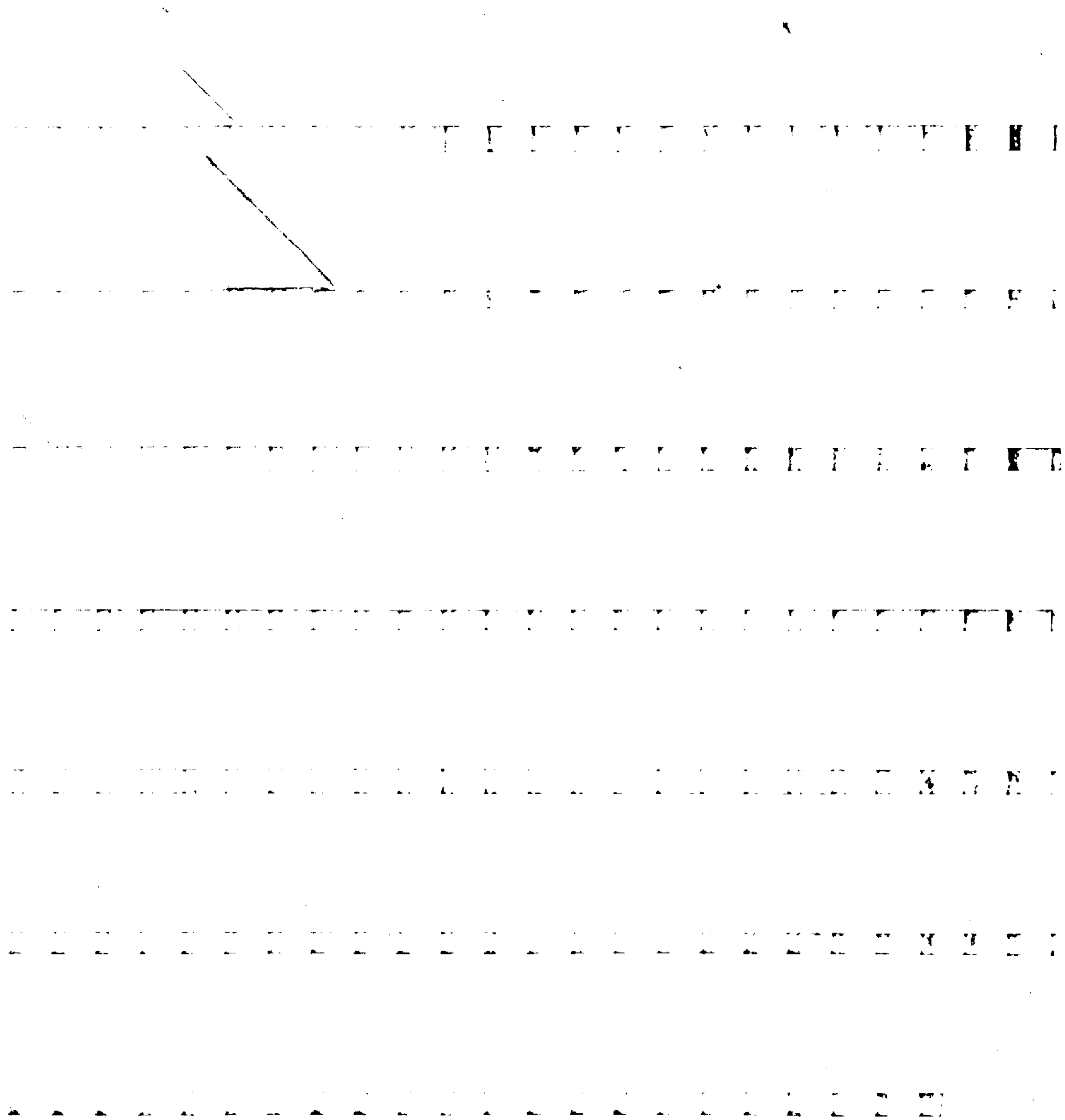
BUILDING SCHEDULE

BLDG. NO	DESCRIPTION
1 THRU 52	4 MAN TENTS
53 THRU 55	4 MAN TENTS
56 THRU 66	4 MAN TENTS
100	MOVIE THEATER
101	(2) 4200 GAL. TANKS & TOWER
102	SHOWER & LATRINES (100 MAN)
103	FIRE & FIRST AID
104	MESS HALL
105	ADMIN. OFFICE & READING ROOM
106	P.O. & P.X.
107	SHOWER & LATRINES (100 MAN)
*108	POWER BUILDING
*109	ACID TANK
110	HEAVY EQUIP. PLUMBING & ELEC. SHOPS
111	GARBAGE SHED
112	BOILER HOUSE & LAUNDRY
113	DRY STORES
114	RECREATION SHELTER
115	DISTILLATION PLANT
116	21,000 GALLON TANK
117	
118	SOFTBALL FIELD
119	VOLLYBALL COURT
120	HORSESHOE PITS
121	CONCRETE LANDING RAMP (LCT)
122	
123	REEFER SHELTER
124	WAREHOUSE
125	CARPENTER SHOP
126	TIME & ACCOUNTING OFFICE
127	
128	
*129	PERSONNEL PIER
130	CAMP OFFICE & WAREHOUSE
131	CLEAN LINEN STORAGE
132	MARINE DISPATCH SHED
133-137	4 MAN TENTS
138-145	8 MAN TENTS
148-150	4 MAN TENTS
151	125 MAN LATRINE
152	FIELD LATRINE
153	GREASE RACK

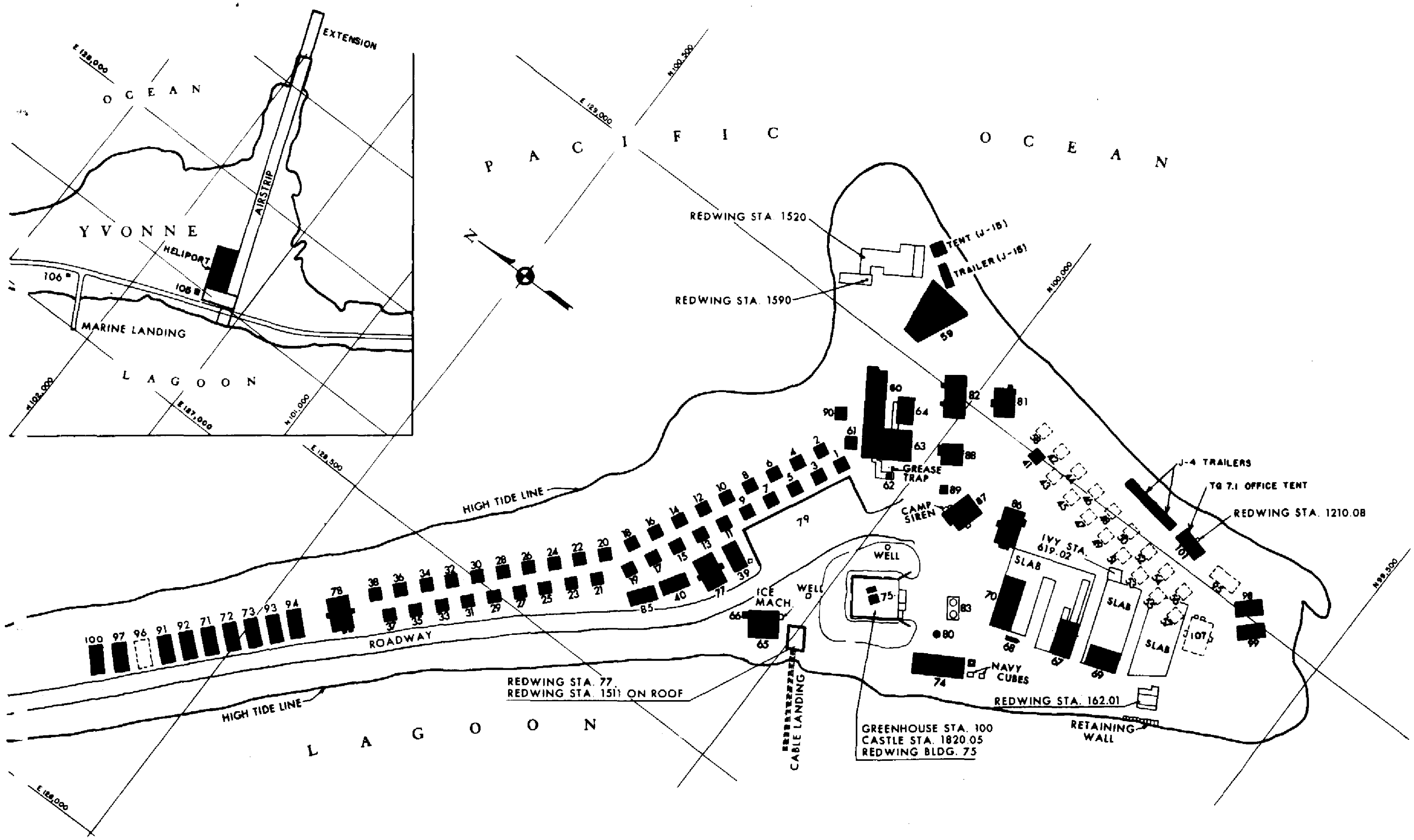
*EXISTING STRUCTURES TO BE REUSED

LEGEND

PERCENT COMPLETED



ED)



BUILDING SCHEDULE

BLDG. No.	DESCRIPTION
1 THRU 38	4-MAN TENTS
39	8-MAN TENT
40	6-MAN TENT
41	GUARD QUARTERS
42 - 58	4-MAN TENTS
59	MOVIE
60	MESSHALL
61	BOILER HOUSE
62	GARBAGE SHED
63	BUTCHER SHOP
64	3 REEFERS & SHELTER
65	REFRESHMENT BLDG.
66	REEFER
67	HVY. EQUIP. SHOP
68	GREASE RACK
69	CARP. SHOP
70	PLUMB'G & ELECT. SHOP
71 - 73	8-MAN TENTS
74	DISTILLATION PLANT
75	POWER HOUSE
76	
77-78	2 LATRINES (100 MAN)
79	MOTOR POOL - PARK
80	21,000 GAL. G'ND ST'G TANK
81	PX, PO, & BARBER SHOP
82	CONST. OFFICE
83	WATER TOWER
84	
85	DAY ROOM & GYM
86	WAREHOUSE ST'G
87	FIREHOUSE & FIRST AID
88	CAMP OFFICE & STORES
89	TIMEKEEPING
90	LAUNDRY
91 - 94	8-MAN TENTS
95 - 100	8-MAN TENTS
105	AIR DISPATCHER TENT
106	MARINE DISPATCHER TENT
98	DAY ROOM
99	GYMNASIUM
101	TG 7.1 OFFICE TENT

LEGEND

(solid bar)	PERCENTAGE OF COMPLET
(dashed outline)	NEW OR EXISTING SLAB NO TO BE USED

Figure No. 2-133. Yvonne Campsite — Eniwetok Atoll.

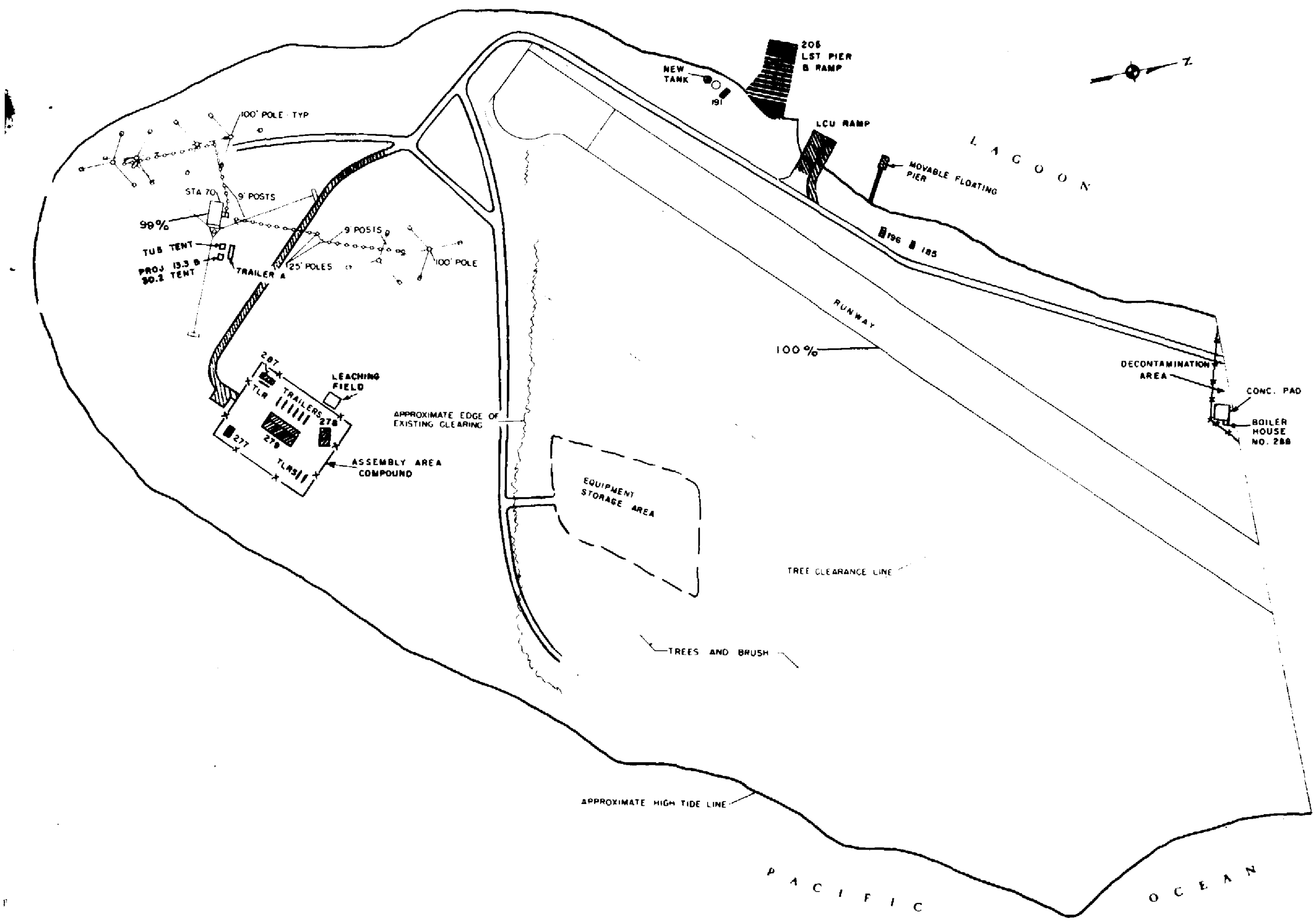


Figure No. 2-134. Site Nan — Bikini Atoll — Sheet 1 of 2.

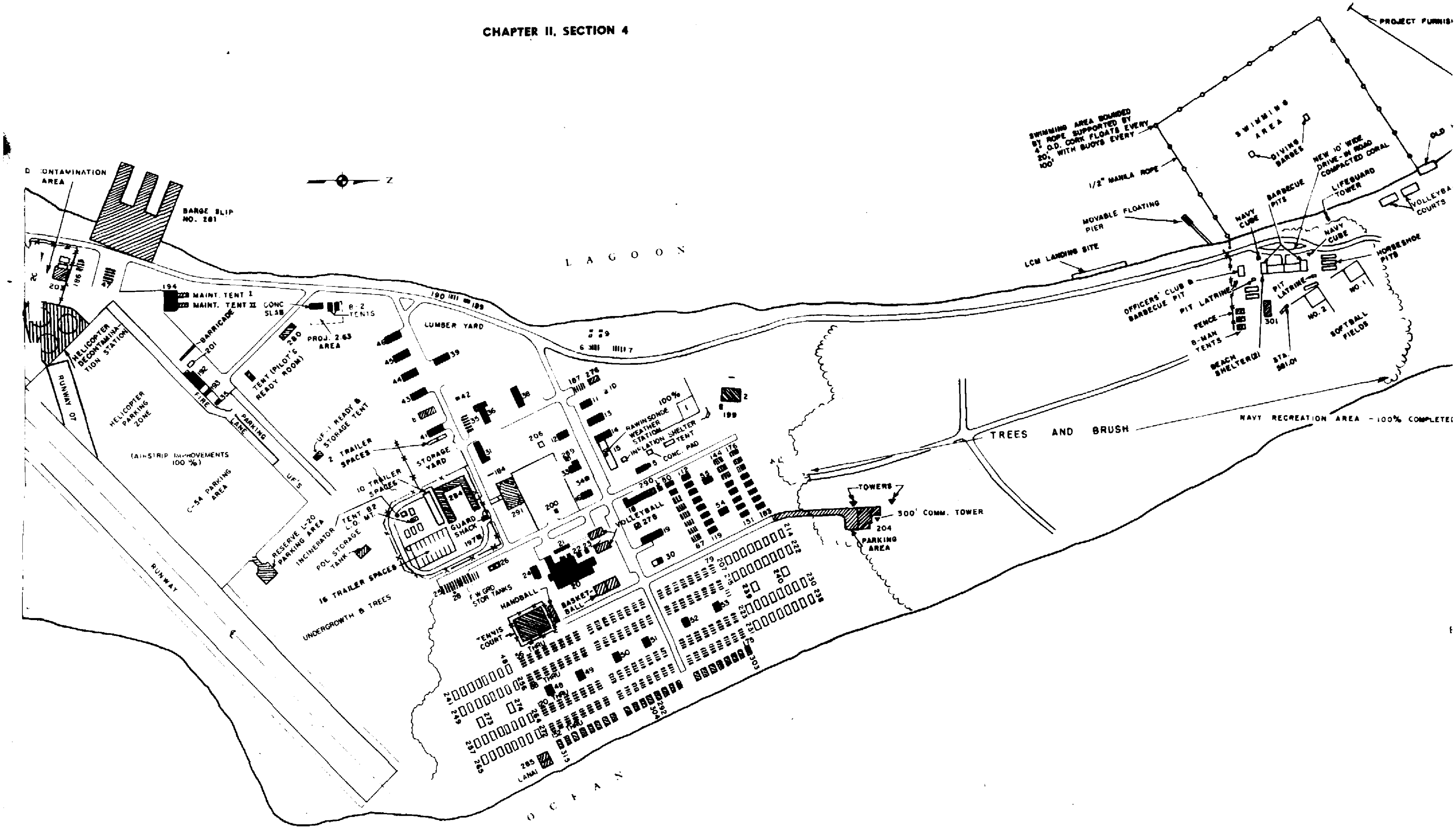
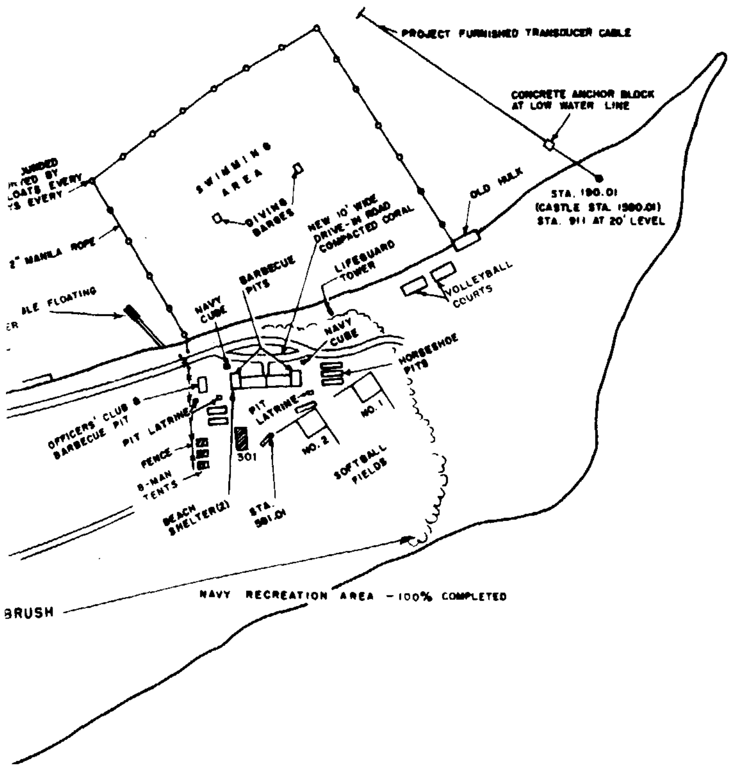


Figure No. 2-134-A. Site Nan — Bikini Atoll — Sheet 2 of 2.



BLDG. NO.	DESCRIPTION
206	FIELD MATERIAL TEST LAB
301	NAVY PORT FACILITIES
277	S/S STORAGE
278	HIGH EXPLOSIVE STORAGE BUNKER
279	ASSEMBLY BLDG. - UCRL
281	BARGE SLIP
280	WAREHOUSE
284	TG 7.1 OFFICE BLDG.
287	LAB. BLDG.
286	JTF-7 CLUB
288	BOILER HOUSE
275	BARBER SHOP
276	GUARD QUARTERS
207-274	8-MAN TENTS
239-240	LATRINES
273-274	LATRINES
290	CHAPLAIN'S TENT
292-315	8-MAN TENTS
291	SANDIA STORAGE FACILITIES (AIR STRUCTURE)
289	LINEN STORAGE

BLDG NO	DESCRIPTION
1	BASEBALL FIELD
2	MOVIE
3	VOLLEYBALL COURT
4	
5	CHAPEL
6	RECREATION
7	REFRESHMENT BLDG
8	STORES BLDG
9	HORSESHOE PITS (2)
10	LATRINE
11	GUARD OFFICE
12	TEST LAB & SURVEY
13	CONSTRUCTION OFFICE
14	ADMINISTRATION BLDG
15	AEC BLDG & WEATHER STATION
16	TIME & FISCAL OFFICE
17	
18	PX, PO, BARBER SHOP & PX STORAGE
19	INFIRMARY
20	MESSHALL
21	REEFERS
22	BOILER HOUSE
23	GARBAGE SHED
24	MESSHALL STORAGE
25	LAUNDRY & DISTILLATION PLANT
26	WATER TOWER
27	
28	WELL
29	
30	DAY ROOM & LIBRARY
31	HEAVY EQUIPMENT SHOP
32	
33	CAMP OFFICE
34	DISPATCHER'S OFFICE
35	AIR DISPATCHER
36	PLUMBING & SHEET METAL SHOP
37	
38	ELECTRIC & REFRIG SHOP
39	CARPENTER SHOP & SAWMILL
40	
41	AEC WAREHOUSE
42	LATRINE
43	DRY STORES
44	BULK STORAGE
45	BIN STORAGE
46	CEMENT STORAGE
47	POWER HOUSE NA-500 (EXISTING)
48-55	LATRINES (25-MAN TYP)
56-183	TENTS (8-MAN TYP)
184	GREASE RACK
185	MARINE DISPATCHER SHED
186	PADSAFE BLDG
187	FIRE STATION
188	
189	PAINT STORAGE
190	PAINT SHOP
191	MARINE POL FACILITIES
192	AIR OPERATIONS BLDG
193	FIRE & CRASH BLDG
194	HANGAR
195	
196	MARINE REPAIR SHOP
197	LATRINE
198	PORTABLE PIER STORAGE BLDG.
199	FIELD LATRINE
200	MOTOR POOL DISPATCHER TENT
201	TENT
202	8-MAN TENT
203	96-MAN DECONTAMINATION BLDG.
204	COMMUNICATIONS FACILITIES
205	LST PIER

NEW CONSTRUCTION

FUTURE CONSTRUCTION

REHABILITATED

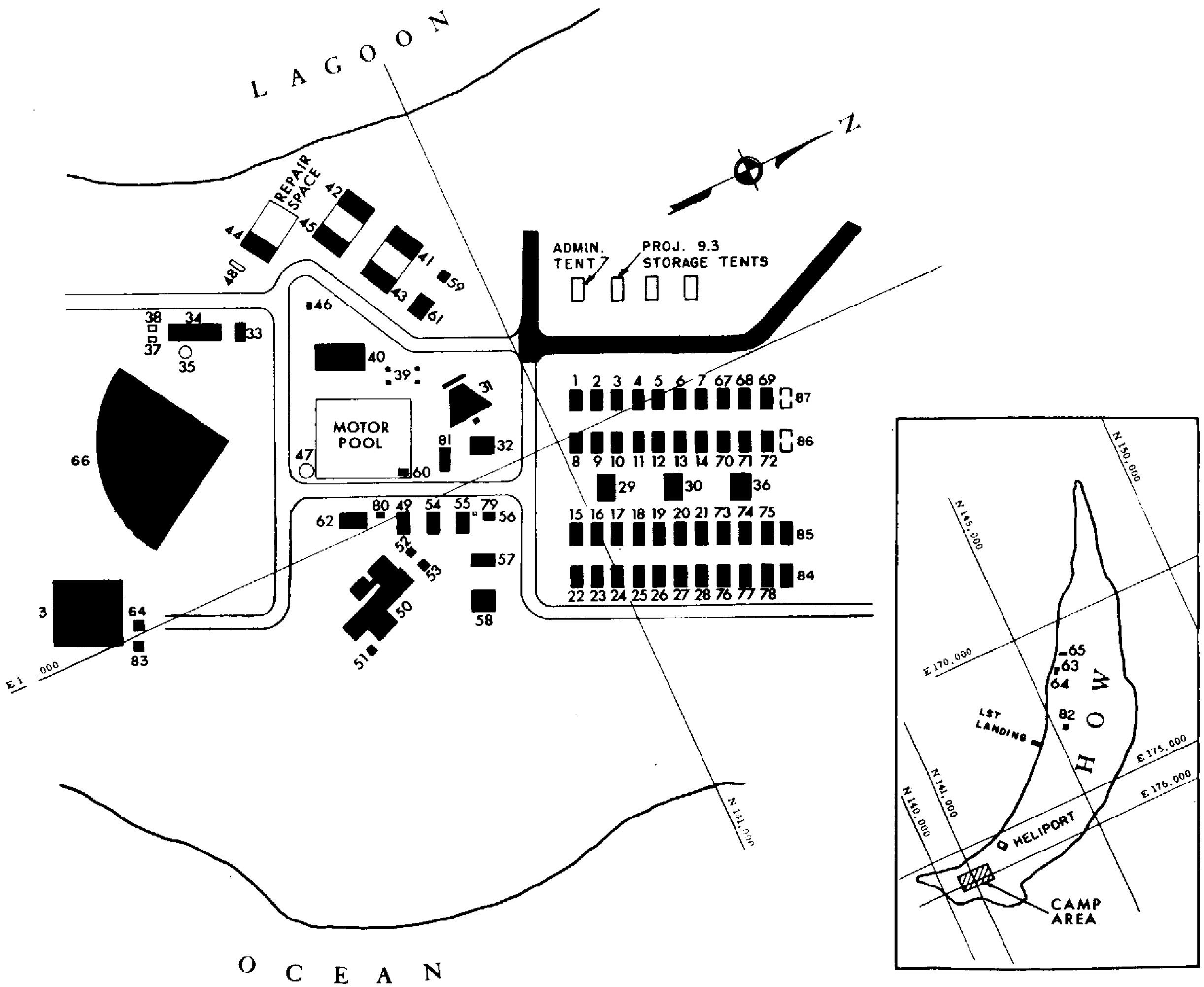


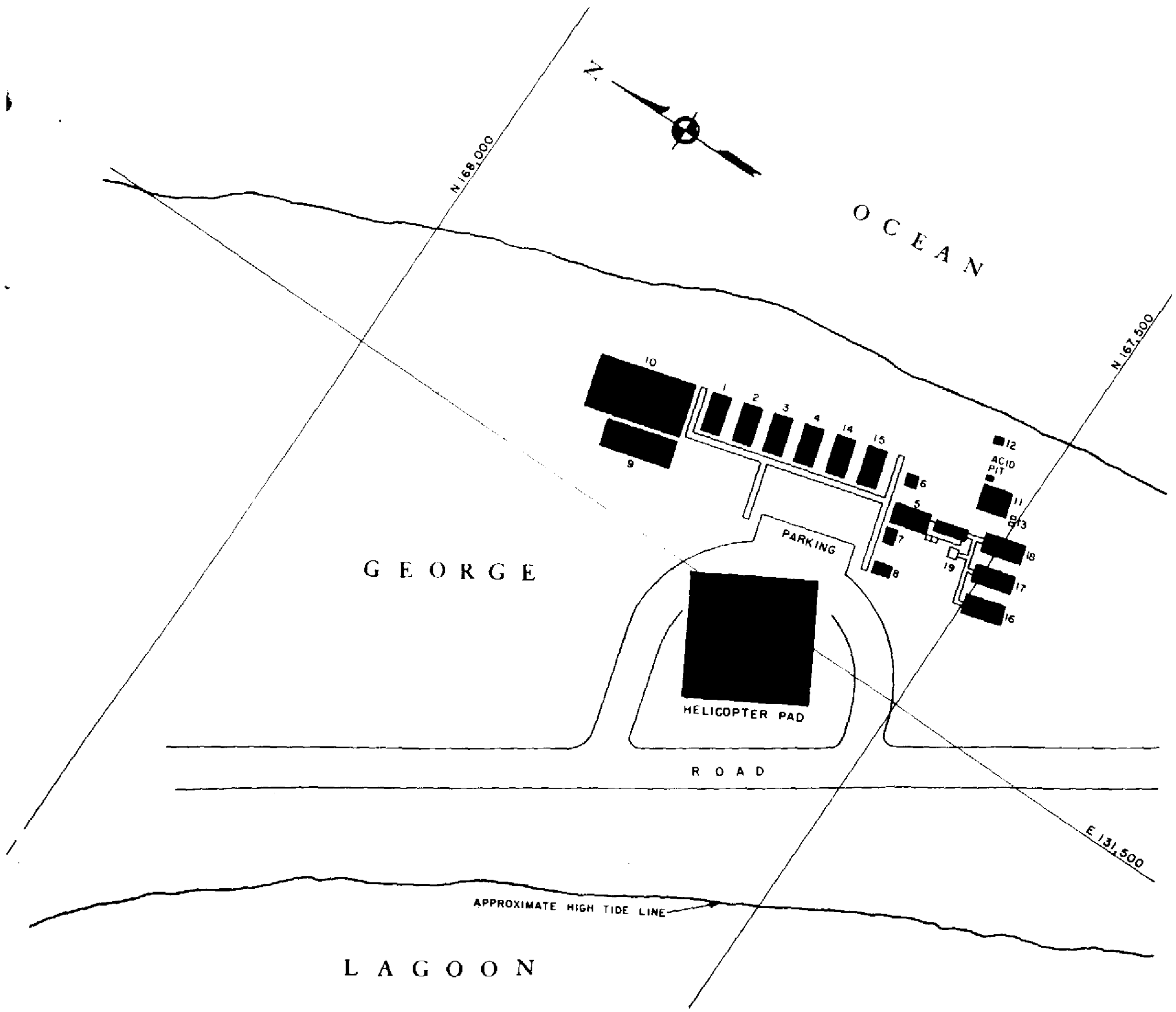
Figure No. 2-135. How Campsite — Bikini Atoll.

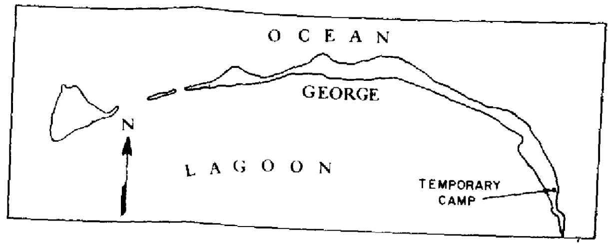
BUILDING SCHEDULE

DESCRIPTION	NO.
8 - MAN TENTS	1 - 28
125 - MAN LATRINES	29 - 30
MOVIE - TYPE 2	31
P.X., P.O. & BARBER SHOP	32
WATER TOWER	33
POWER & DISTILLATION PLANT	34
21,000 GALLON GROUND STORAGE TANK	35
125 - MAN LATRINE	36
ACID PIT	37
FUEL OIL TANKS	38
HORSESHOE PITS	39
VOLLEYBALL COURTS	40
ELECTRICAL & REFRIGERATION SHOP	41
CARPENTER SHOP	42
PLUMBING & SHEET METAL SHOP	43
VEHICLE REPAIR & HEAVY EQUIPMENT SHOP	44
GENERAL BULK STORAGE	45
FIELD LATRINE	46
GASOLINE TANK	47
GREASE RACK	48
DAY ROOM & LIBRARY	49
350 - MAN MESS HALL	50
GARBAGE SHED	51
LAUNDRY	52
BOILER HOUSE	53
RECREATION BLDG.	54
CAMP OFFICE	55
TIME SHACK	56
GYM	57
REFRESHMENT BLDG.	58
GUARD OFFICE & QUARTERS	59
MOTOR POOL DISPATCHER SHED	60
FIRST AID & FIRE STATION	61
ADMINISTRATION BLDG.	62
HELICOPTER PAD	63
AIR DISPATCHER SHED	64
MARINE DISPATCHER SHED	65
SOFTBALL FIELD	66
8 - MAN TENTS	67 - 78
CLEAN LINEN STORAGE	79
FIELD LATRINE	80
TG 7.1 OFFICE TENT	81
STORAGE BLDG.-PROJ. 9.3	82
MP ORDERLY TENT	83
8-MAN TENTS	84,85
8-MAN TENTS (FUTURE)	86,87

PERCENTAGE OF COMPLETION

FUTURE CONSTRUCTION





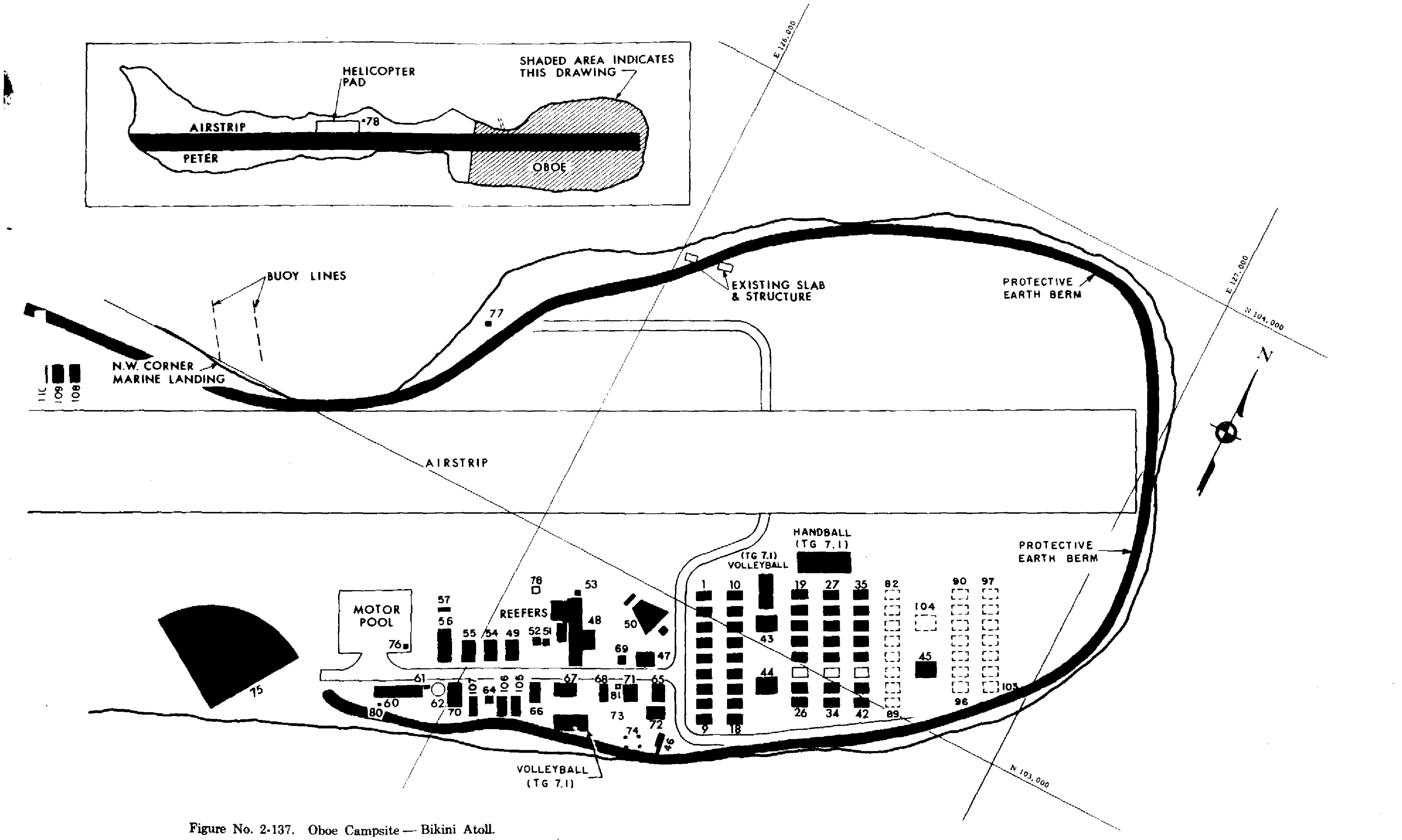
BUILDING SCHEDULE

DESCRIPTION	NO.
QUARTERS	1
QUARTERS	2
QUARTERS	3
QUARTERS	4
MESS HALL	5
LAUNDRY	6
SHOWERS	7
LATRINE	8
HORSESHOE PIT	9
VOLLEY BALL COURT	10
DISTILLATION PLANT	11
PUMP SHELTER	12
NAVY CUBES	13
QUARTERS	14
QUARTERS	15
QUARTERS	16
QUARTERS	17
OFFICE & STORAGE	18
TRANSPORTAINER	19

PERCENTAGE OF COMPLETION

FUTURE CONSTRUCTION

Figure 2-136. George Campsite — Bikini Atoll.



BUILDI

DESCRIPTION

8 - MAN TENTS
125 - MAN LATRINES
REFRESHMENT STAN
P.O., P.X., & BARBE
350 - MAN MESS HA
REFRIGERATION & E
MOVIE - CLASS 2
GARBAGE SHED
LAUNDRY
BOILER HOUSE
CARPENTER SHOP
PLUMBING & SHEET
VEHICLE & HEAVY E
GREASE RACK
GAS TANK
WATER TOWER
POWER & DISTILLAT
FUEL OIL STORAGE
21,000 GALLON GRO
ACID PIT
FIELD LATRINE
FIRE & FIRST AID ST
CAMP OFFICE
ADMINISTRATION B
RECREATION BLDG.
TIME OFFICE (ON SK
BULK STORAGE
DAY ROOM
GYM
VOLLEYBALL COUR
HORSE SHOE PITS
SOFTBALL FIELD
MOTOR POOL DISPA
MARINE DISPATCHE
AIR DISPATCHER SH

SALT WATER WELL
CLEAN LINEN STOR

UCRL OFFICE TEN
L-4 OFFICE & WA
L-6 STORAGE TEN

PER
FUT

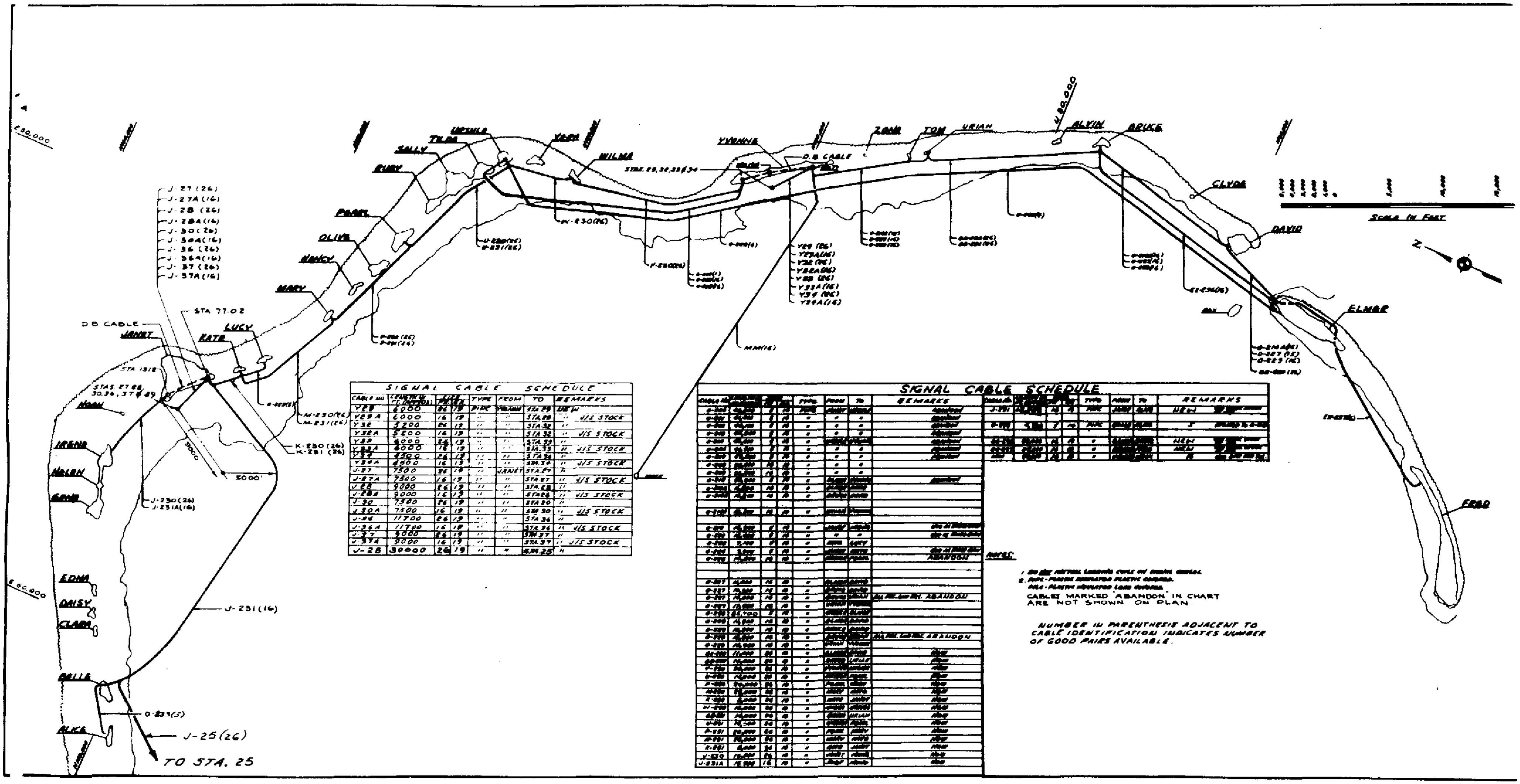
Figure No. 2-137. Oboe Campsite — Bikini Atoll.

BUILDING SCHEDULE

DESCRIPTION	NO.
8 - MAN TENTS	1 - 42
125 - MAN LATRINES	43 - 45
REFRESHMENT STAND	46
P.O., P.X., & BARBER SHOP	47
350 - MAN MESS HALL	48
REFRIGERATION & ELECTRIC SHOP	49
MOVIE - CLASS 2	50
GARBAGE SHED	51
LAUNDRY	52
BOILER HOUSE	53
CARPENTER SHOP	54
PLUMBING & SHEET METAL SHOP	55
VEHICLE & HEAVY EQUIPMENT REPAIR	56
GREASE RACK	57
GAS TANK	58
WATER TOWER	59
POWER & DISTILLATION PLANT	60
FUEL OIL STORAGE	61
21,000 GALLON GROUND STORAGE TANK	62
ACID PIT	63
FIELD LATRINE	64
FIRE & FIRST AID STATION	65
CAMP OFFICE	66
ADMINISTRATION BLDG.	67
RECREATION BLDG.	68
TIME OFFICE (ON SKIDS)	69
BULK STORAGE	70
DAY ROOM	71
GYM	72
VOLLEYBALL COURT	73
HORSE SHOE PITS	74
SOFTBALL FIELD	75
MOTOR POOL DISPATCHER SHED	76
MARINE DISPATCHER SHED	77
AIR DISPATCHER SHED	78
	79
SALT WATER WELL	80
CLEAN LINEN STORAGE	81
	82-103
	104
UCRL OFFICE TENTS	105-106
L-4 OFFICE & WAREHOUSE	107
L-6 STORAGE TENTS	108-110

PERCENTAGE OF COMPLETION

FUTURE CONSTRUCTION



SIGNAL CABLE SCHEDULE

CABLE NO.	LENGTH IN FT. (APPROX.)	SIZE PR.	SIZE GA.	TYPE	FROM	TO	REMARKS
Y29	6000	26	19	PIPE	YVONNE	STA. 29	NEW
Y29A	6000	16	19	"	"	STA. 29	" J/S STOCK
Y32	5200	26	19	"	"	STA. 32	"
Y32A	5200	16	19	"	"	STA. 32	" J/S STOCK
Y33	6000	26	19	"	"	STA. 33	"
Y33A	6000	16	19	"	"	STA. 33	" J/S STOCK
Y34	4500	26	19	"	"	STA. 34	"
Y34A	4500	16	19	"	"	STA. 34	" J/S STOCK
J-27	7500	26	19	"	JANET	STA. 27	"
J-27A	7500	16	19	"	"	STA. 27	" J/S STOCK
J-28	9000	26	19	"	"	STA. 28	"
J-28A	9000	16	19	"	"	STA. 28	" J/S STOCK
J-30	7500	26	19	"	"	STA. 30	"
J-30A	7500	16	19	"	"	STA. 30	" J/S STOCK
J-36	11700	26	19	"	"	STA. 36	"
J-36A	11700	16	19	"	"	STA. 36	" J/S STOCK
J-37	9000	26	19	"	"	STA. 37	"
J-37A	9000	16	19	"	"	STA. 37	" J/S STOCK
J-25	30000	26	19	"	"	STA. 25	"

SIGNAL CABLE SCHEDULE

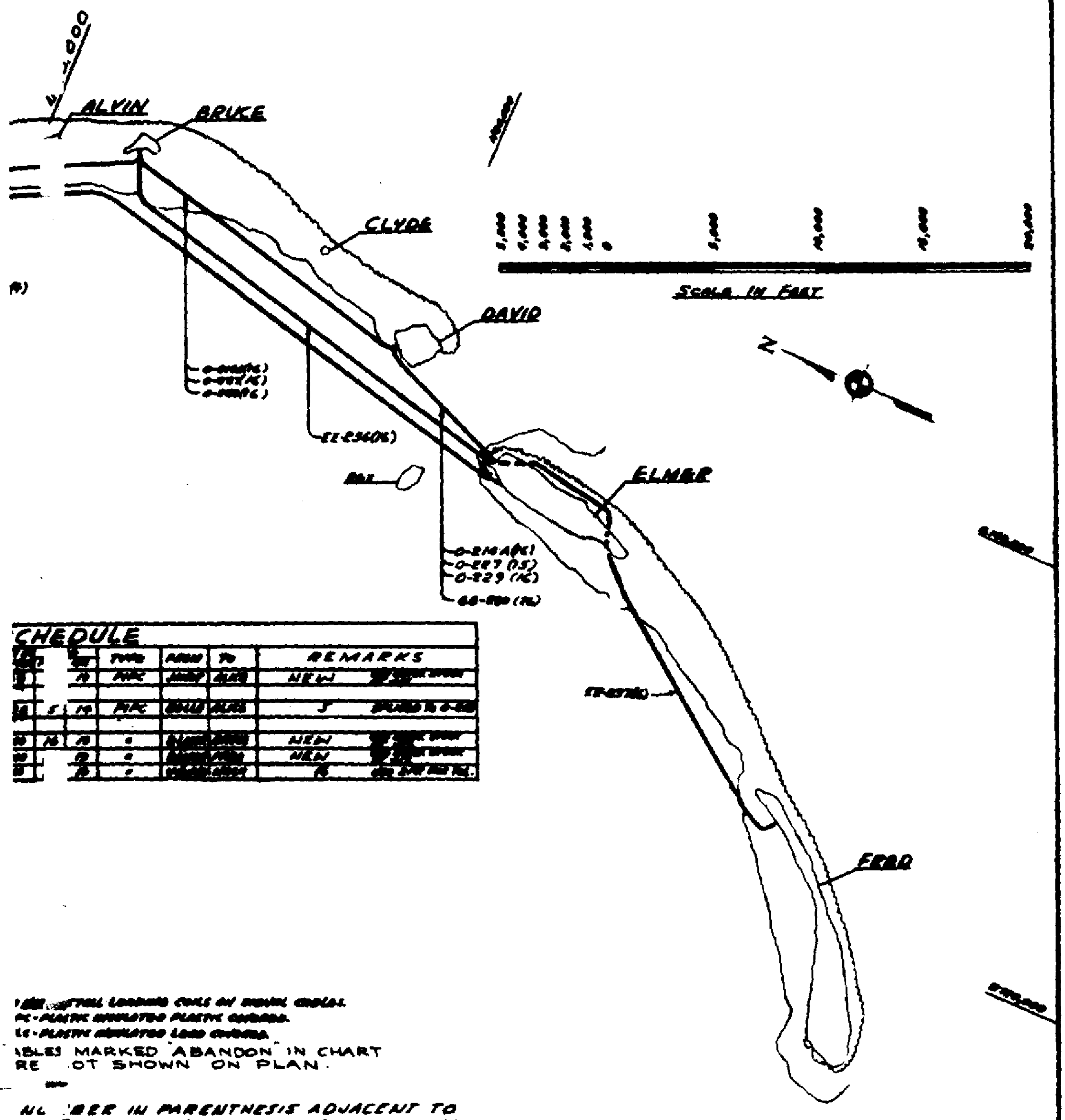
CABLE NO.	LENGTH	SIZE		TYPE	FROM	TO	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES:

CABLES MARKED "ABANDON" IN CHART ARE NOT SHOWN ON PLAN.

NUMBER IN PARENTHESIS ADJACENT TO CABLE IDENTIFICATION INDICATES NUMBER OF GOOD PAIRS AVAILABLE.

Chart No. 2-3. Submarine Signal Cable System — Eniwetok Atoll.



CHEDULE

			TYPE	FROM	TO	REMARKS	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	NEW	[illegible]
[illegible]	5	[illegible]	[illegible]	[illegible]	[illegible]	J	[illegible]
[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	NEW	[illegible]
[illegible]		[illegible]	"	[illegible]	[illegible]	NEW	[illegible]
[illegible]		[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] LOADING COILS ON [illegible] CABLES.
PC - PLASTIC INSULATED PLASTIC COVERED.
LC - PLASTIC INSULATED LEAD COVERED.
ABLES MARKED "ABANDON" IN CHART
RE OT SHOWN ON PLAN.

NU BER IN PARENTHESIS ADJACENT TO
CABLE IDENTIFICATION INDICATES NUMBER
OF GOOD PAIRS AVAILABLE.

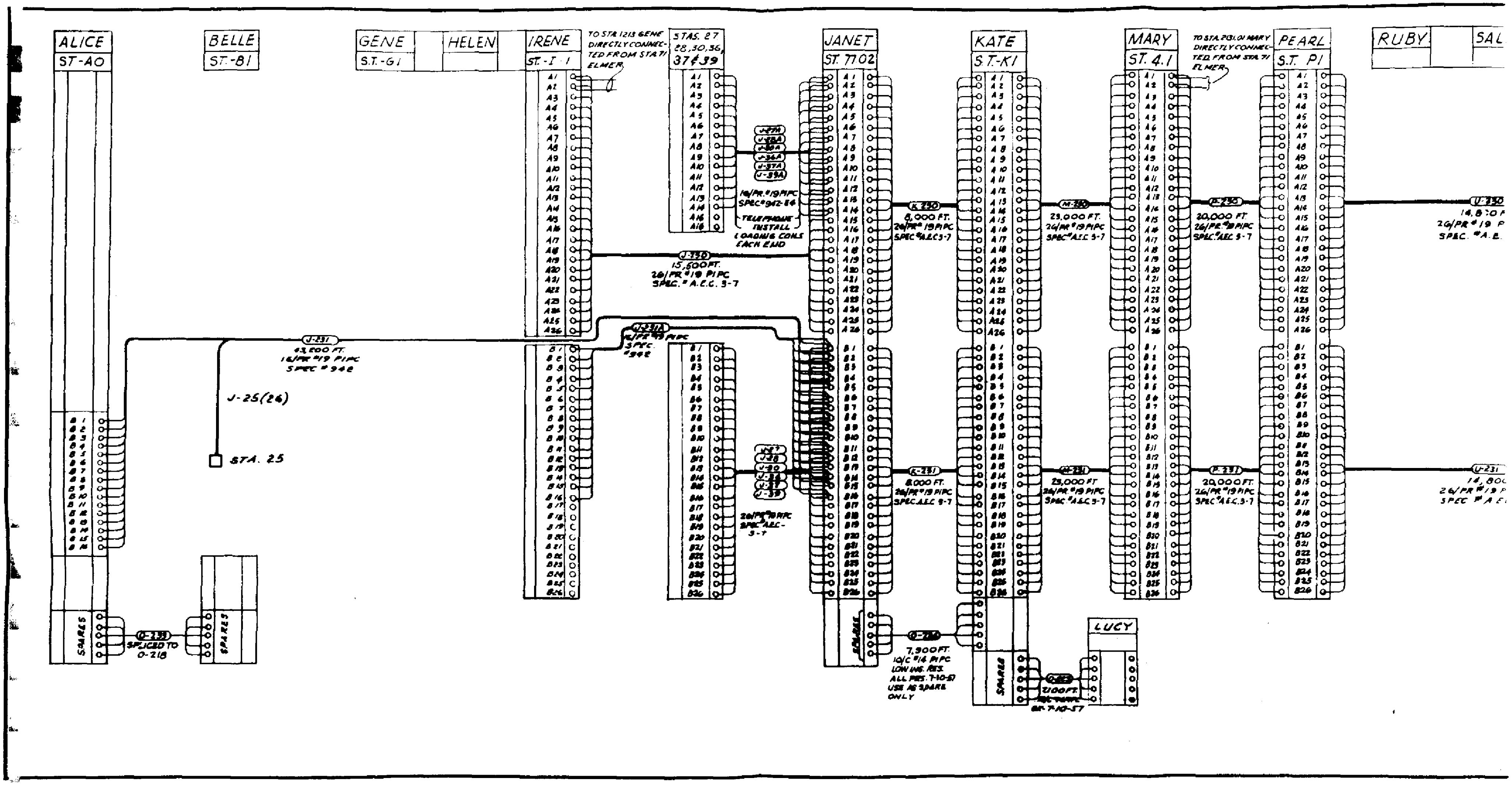
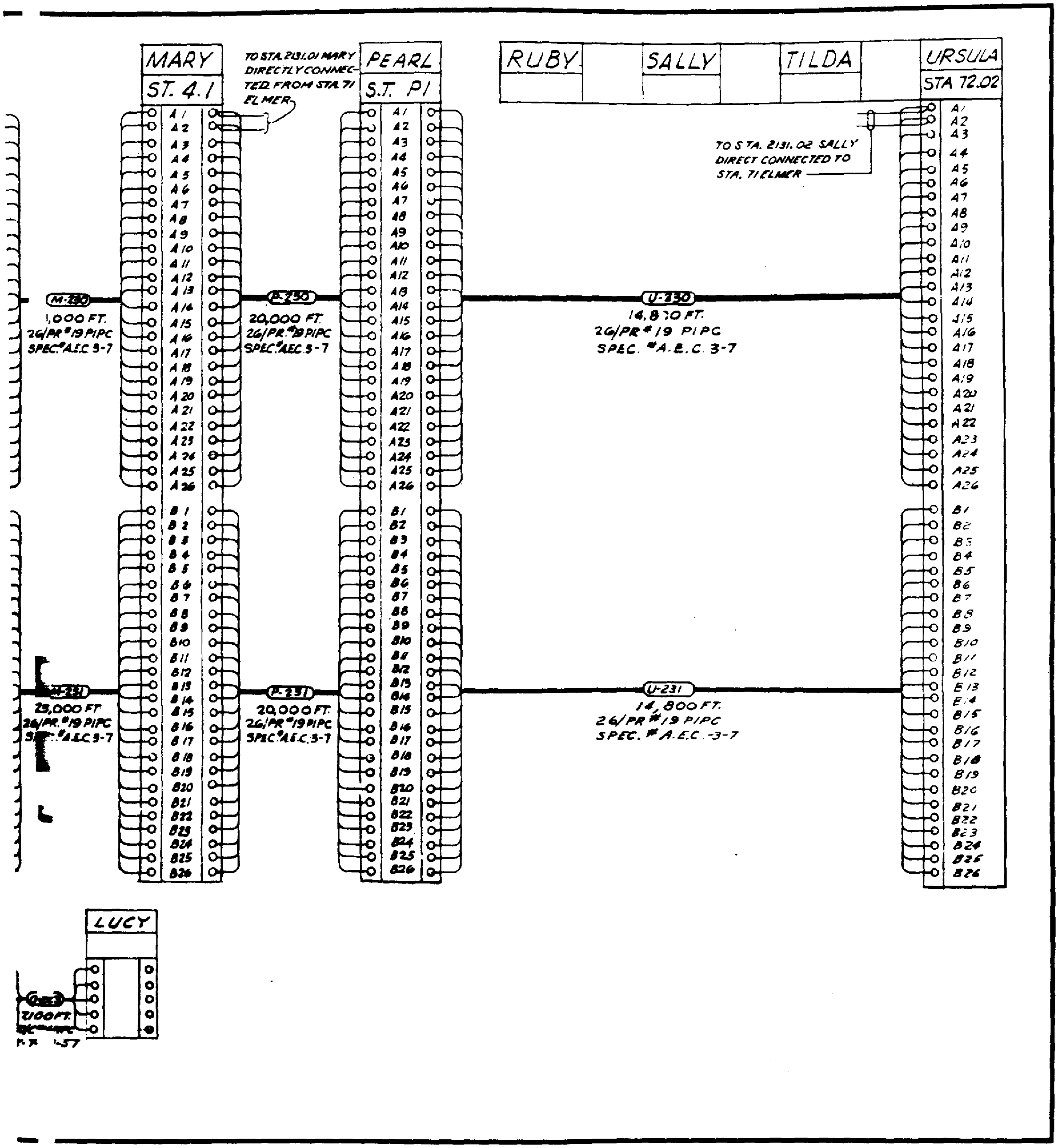


Chart 2-4. Submarine Signal Cable System Schematic Diagram
Eniwetok Atoll — Sheet 1 of 2.



MARY
ST. 4.1
TO STA. 2131.01 MARY DIRECTLY CONNECTED FROM STA. 71 ELMER
PEARL
S.T. P1
RUBY
SALLY
TILDA
URSULA
STA 72.02
TO STA. 2131.02 SALLY DIRECT CONNECTED TO STA. 71 ELMER
M-230
1,000 FT.
26/PR #19 PIPC
SPEC. # A.E.C. 3-7
P-230
20,000 FT.
26/PR. #19 PIPC
SPEC. # A.E.C. 3-7
U-230
26/PR #19 PIPC
SPEC. # A.E.C. 3-7
M-231
P-231
20,000 FT.
26/PR #19 PIPC
SPEC. # A.E.C. 3-7
U-231
14,800 FT.
26/PR #19 PIPC
SPEC. # A.E.C. 3-7
LUCY
2100 FT.

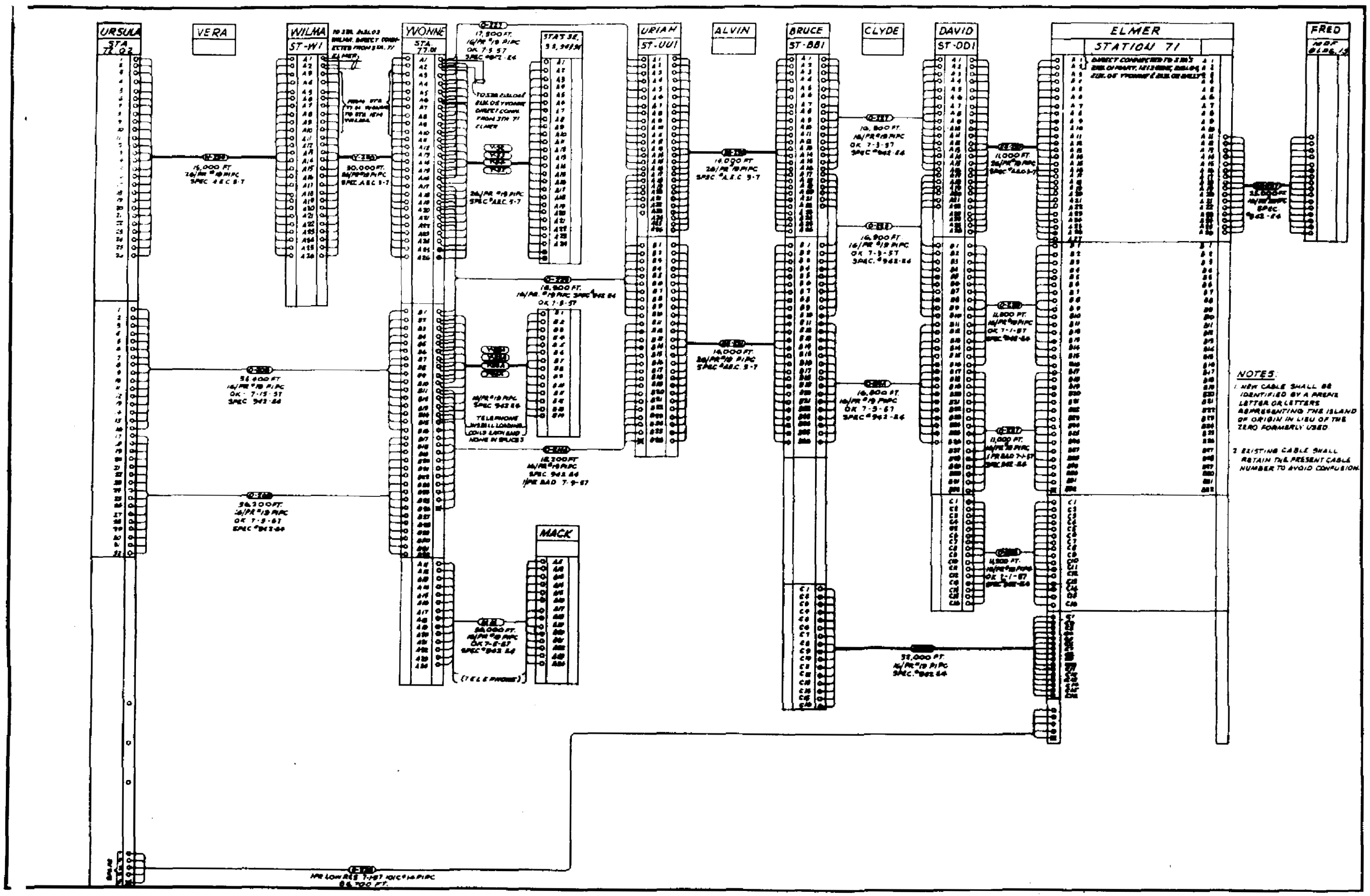
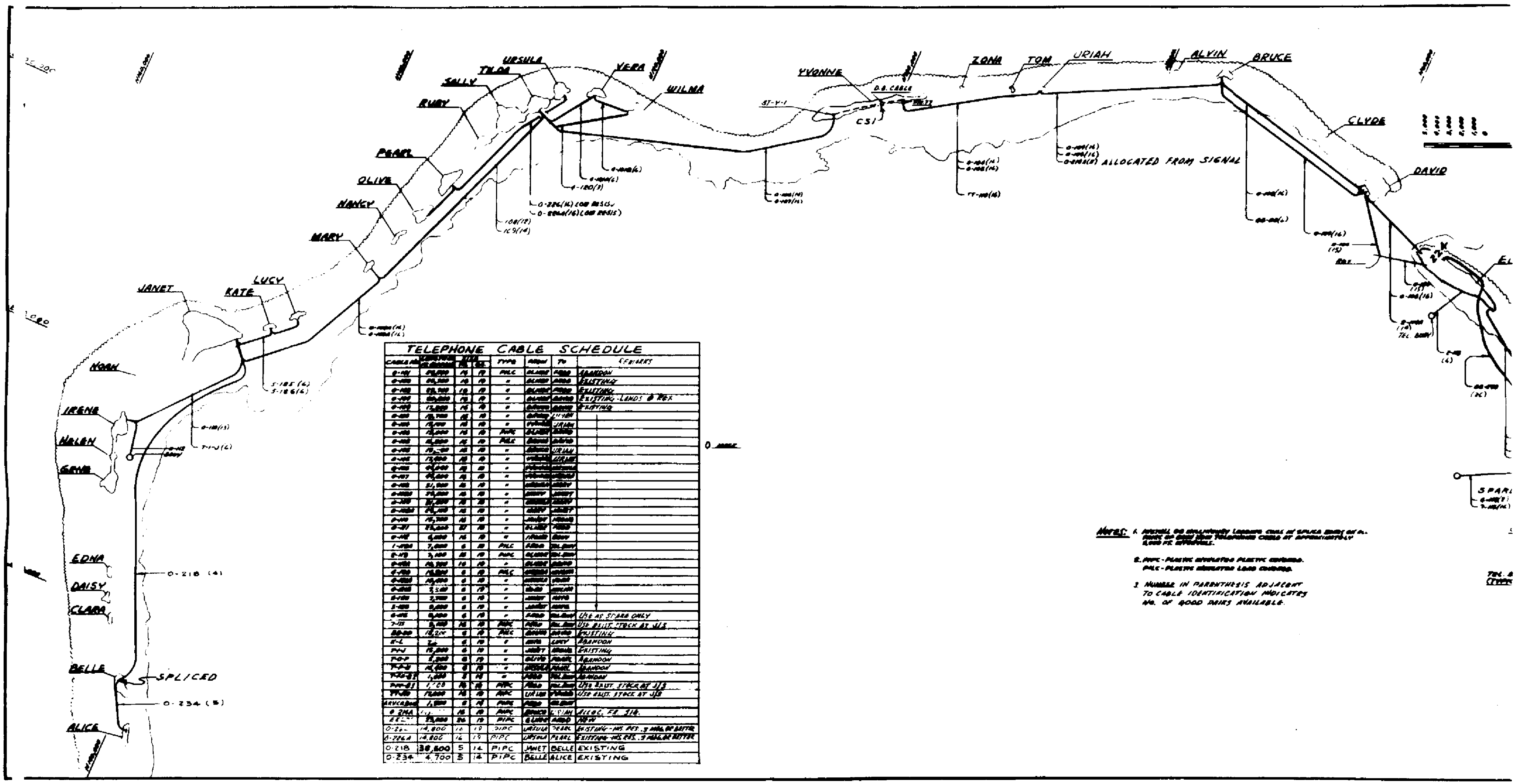


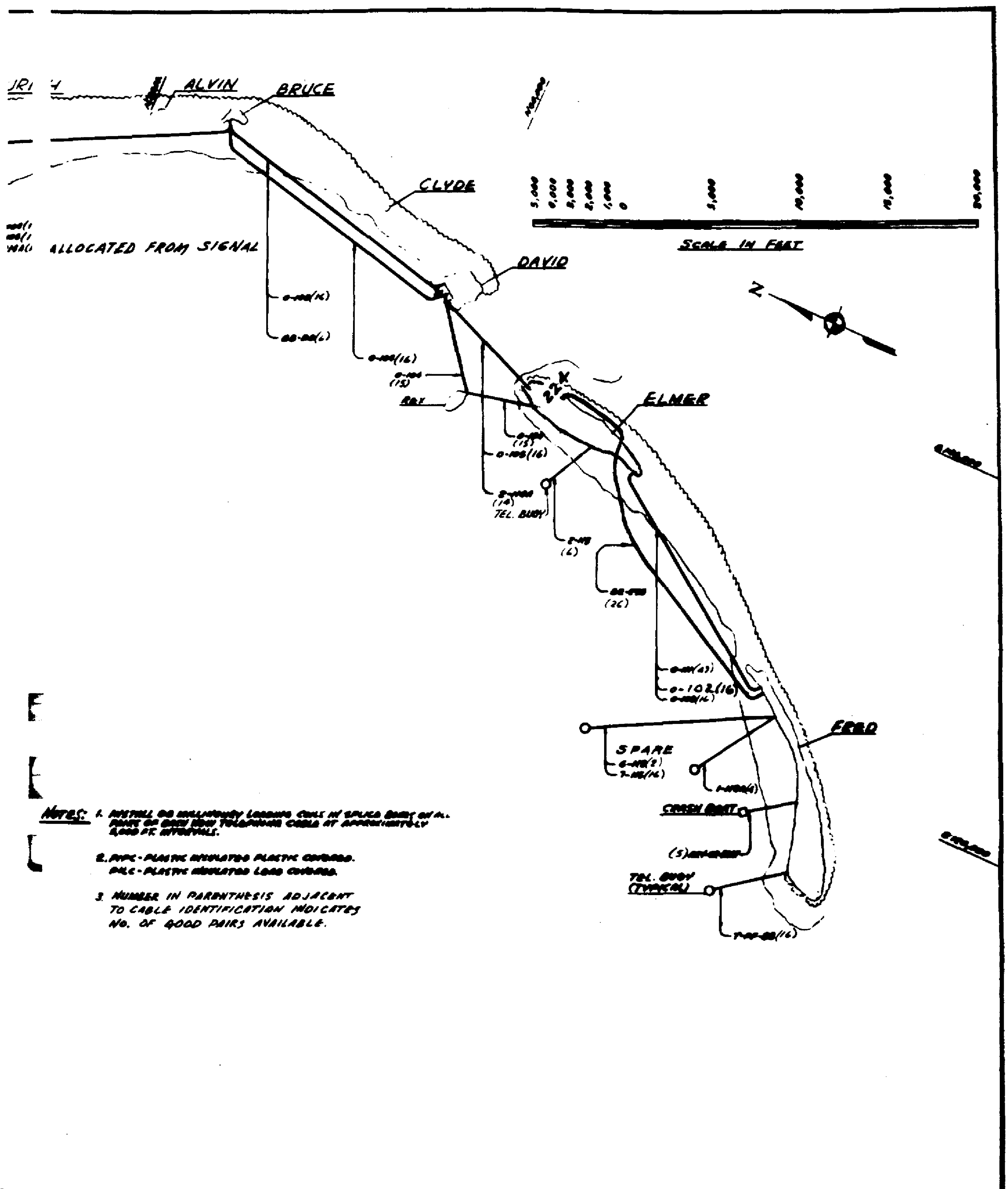
Chart No. 2-4-A. Submarine Signal Cable System Schematic Diagram
Eniwetok Atoll — Sheet 2 of 2.



TELEPHONE CABLE SCHEDULE

CABLE NO.	[illegible]	SIZE		TYPE	FROM	TO	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	PILC	[illegible]	[illegible]	ABANDON
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	EXISTING
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	EXISTING
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	EXISTING - LANDS [illegible] REX
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	EXISTING
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	URIAH	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	URIAH	
[illegible]	[illegible]	[illegible]	[illegible]	PIPC	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	PILC	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	URIAH	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	URIAH	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	6	[illegible]	PILC	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	PIPC	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	PILC	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	USE AS SPARE ONLY
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	USE EXIST. STOCK AT J/S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	EXISTING
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	LUCY	ABANDON
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	EXISTING
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	ABANDON
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	PEARL	ABANDON
[illegible]	[illegible]	[illegible]	[illegible]	"	[illegible]	[illegible]	ABANDON
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	USE EXIST. STOCK AT J/S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	URIAH	[illegible]	USE EXIST. STOCK AT J/S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ALLOC. FR. SIG.
[illegible]	[illegible]	[illegible]	[illegible]	PIPC	[illegible]	[illegible]	NEW
0-226	14,800	16	19	PIPC	URSULA	PEARL	EXISTING - [illegible]
0-226A	14,800	16	19	PIPC	URSULA	PEARL	EXISTING - [illegible]
0-218	38,600	5	14	PIPC	JANET	BELLE	EXISTING
0-234	4,700	5	14	PIPC	BELLE	ALICE	EXISTING

Chart No. 2-5. Submarine Telephone Cable System — Eniwetok Atoll.


ALVIN
BRUCE
CLYDE
DAVID
ELMER
FRED
ALLOCATED FROM SIGNAL
SCALE IN FEET
5,000
10,000
15,000
20,000
TEL. BUOY
SPARE
CRASH BOAT
TEL. BUOY (TYPICAL)
o-102(16)
NOTES:
3. NUMBER IN PARENTHESIS ADJACENT TO CABLE IDENTIFICATION INDICATES NO. OF GOOD PAIRS AVAILABLE.

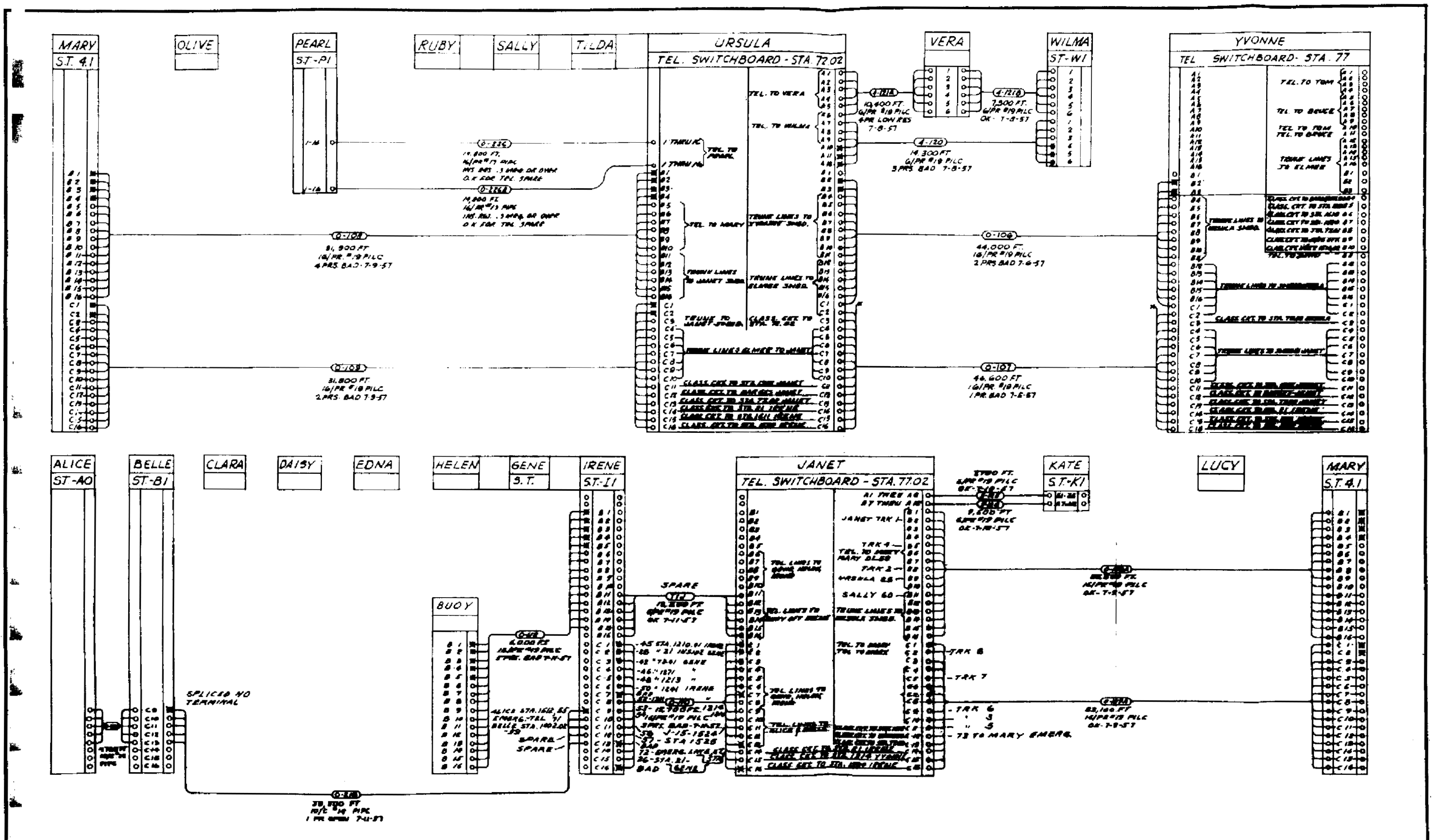


Chart No. 2-6. Submarine Telephone Cable System Schematic Diagram — Eniwetok Atoll — Sheet 1 of 2.

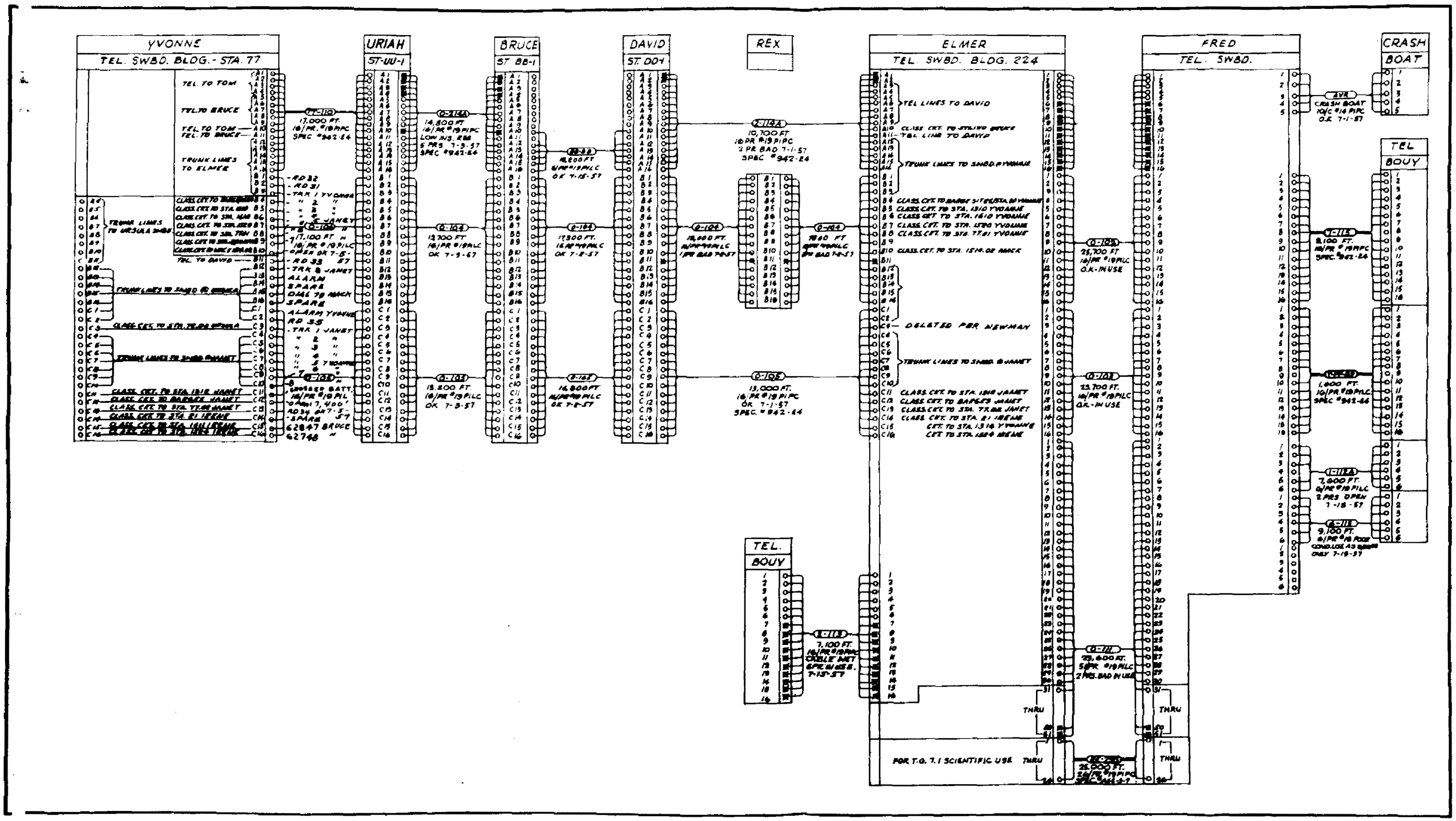
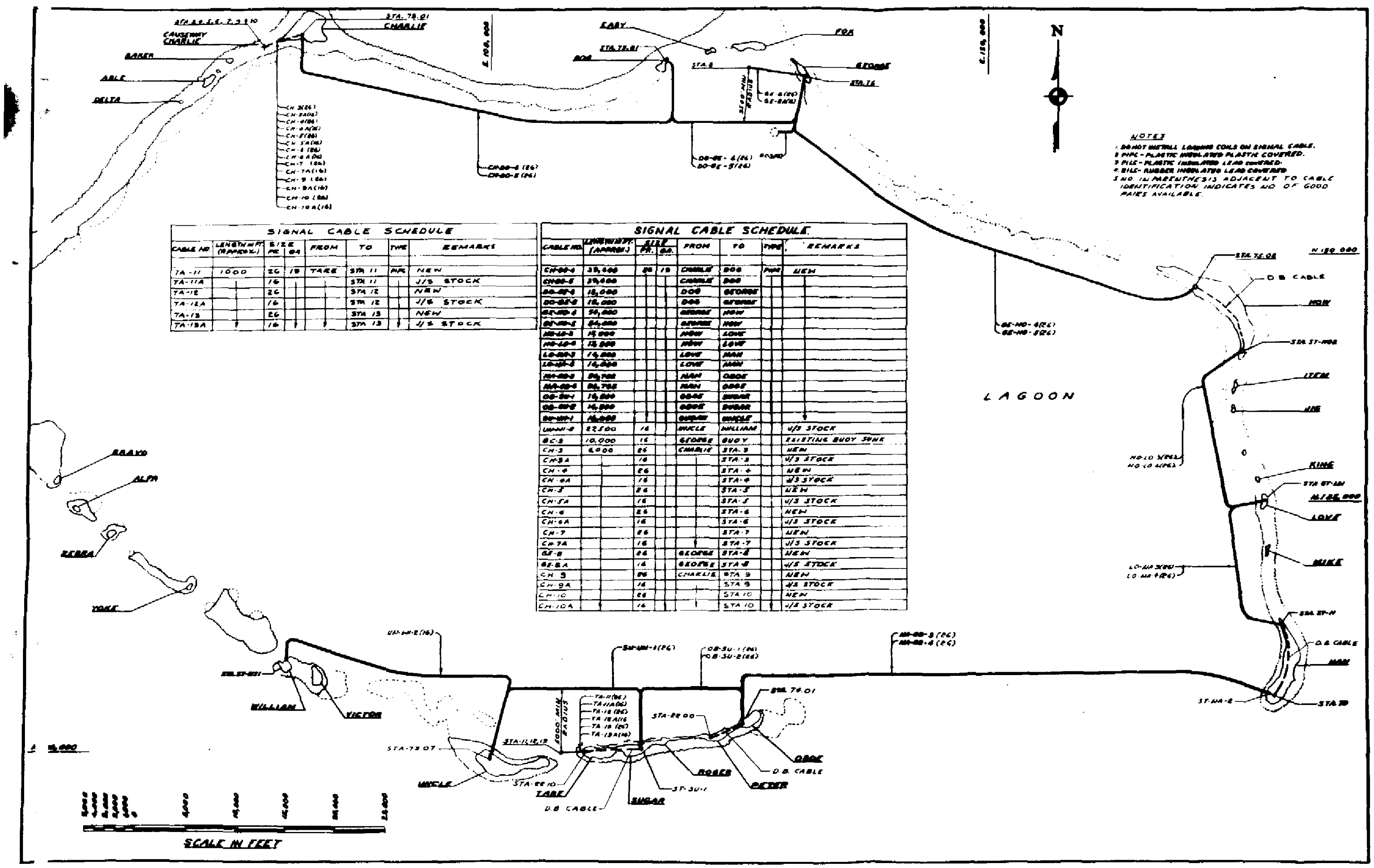


Chart No. 2-6-A. Submarine Telephone Cable System Schematic Diagram
Eniwetok Atoll — Sheet 2 of 2.



SIGNAL CABLE SCHEDULE							
CABLE NO.	LENGTH IN FT. (APPROX.)	SIZE PR.	SIZE GA.	FROM	TO	TYPE	REMARKS
TA-11	1000	26	19	TARE	STA 11	PIPC	NEW
TA-11A		16			STA 11		U/S STOCK
TA-12		26			STA 12		NEW
TA-12A		16			STA 12		U/S STOCK
TA-13		26			STA 13		NEW
TA-13A		16			STA 13		U/S STOCK

SIGNAL CABLE SCHEDULE							
CABLE NO.	LENGTH IN FT. (APPROX.)	SIZE PR.	SIZE GA.	FROM	TO	TYPE	REMARKS
CH-DO-4	39,400	26	19	CHARLIE	DOG	PIPC	NEW
CH-DO-5	39,400			CHARLIE	DOG		
DO-GE-4	18,000			DOG	GEORGE		
DO-GE-5	18,000			DOG	GEORGE		
GE-HO-4	54,000			GEORGE	HOW		
GE-HO-5	54,000			GEORGE	HOW		
HO-LO-3	15,000			HOW	LOVE		
HO-LO-4	15,000			HOW	LOVE		
LO-MA-3	14,000			LOVE	MAN		
LO-MA-4	14,000			LOVE	MAN		
MA-OB-3	36,700			MAN	OBOE		
MA-OB-4	36,700			MAN	OBOE		
OB-SU-1	14,000			OBOE	SUGAR		
OB-SU-2	14,000			OBOE	SUGAR		
SU-UN-1	14,000			SUGAR	UNCLE		
UN-WI-2	22,500	16		UNCLE	WILLIAM		U/S STOCK
BC-3	10,000	16		GEORGE	BUOY		EXISTING BUOY SUNK
CH-3	6000	26		CHARLIE	STA-3		NEW
CH-3A		16			STA-3		U/S STOCK
CH-4		26			STA-4		NEW
CH-4A		16			STA-4		U/S STOCK
CH-5		26			STA-5		NEW
CH-5A		16			STA-5		U/S STOCK
CH-6		26			STA-6		NEW
CH-6A		16			STA-6		U/S STOCK
CH-7		26			STA-7		NEW
CH-7A		16			STA-7		U/S STOCK
GE-8		26		GEORGE	STA-8		NEW
GE-8A		16		GEORGE	STA-8		U/S STOCK
CH-9		26		CHARLIE	STA 9		NEW
CH-9A		16			STA 9		U/S STOCK
CH-10		26			STA 10		NEW
CH-10A		16			STA 10		U/S STOCK

Chart No. 2-7. Submarine Signal Cable System — Bikini Atoll.

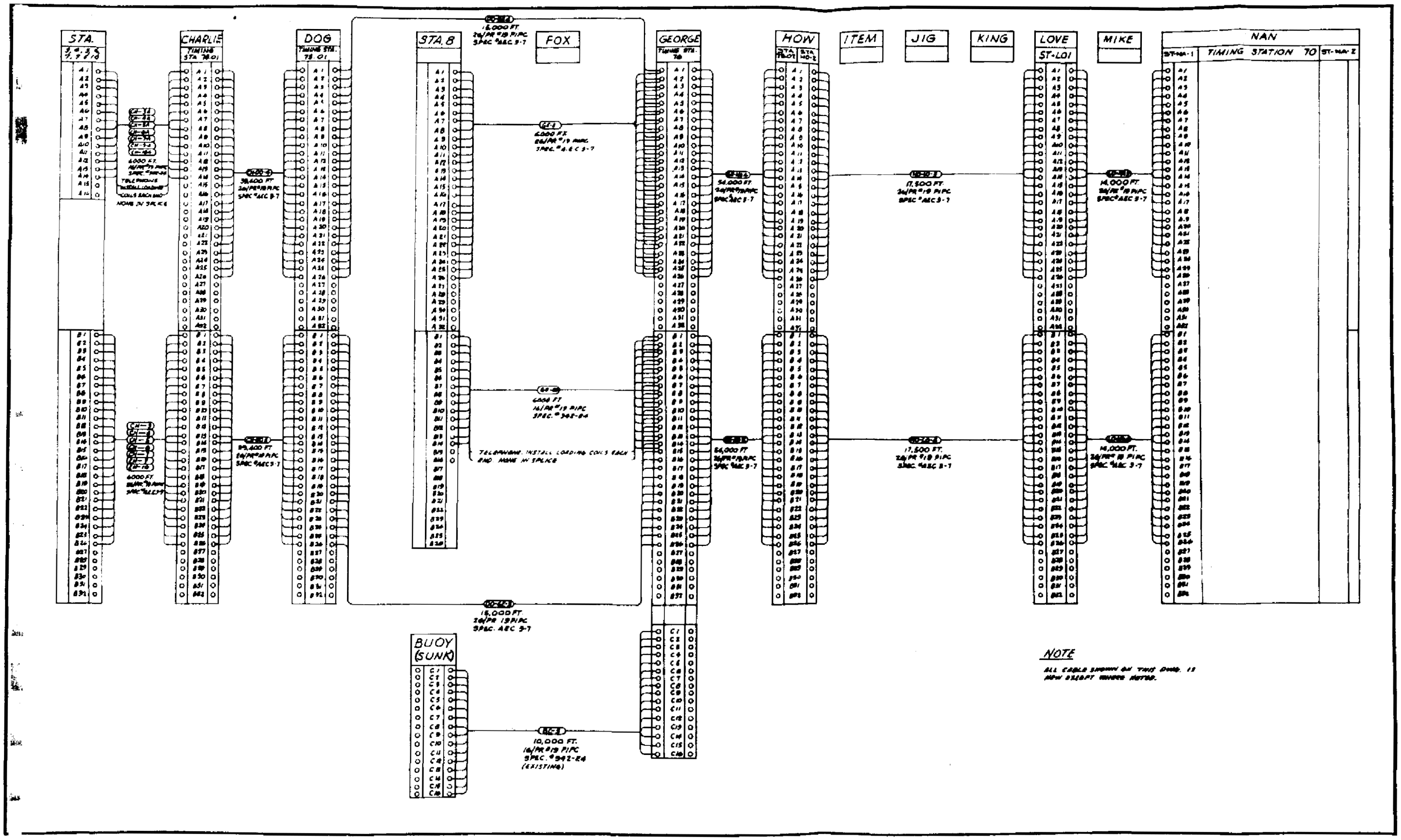


Chart No. 2-8. Submarine Signal Cable System Schematic Diagram
Bikini Atoll — Sheet 1 of 2.

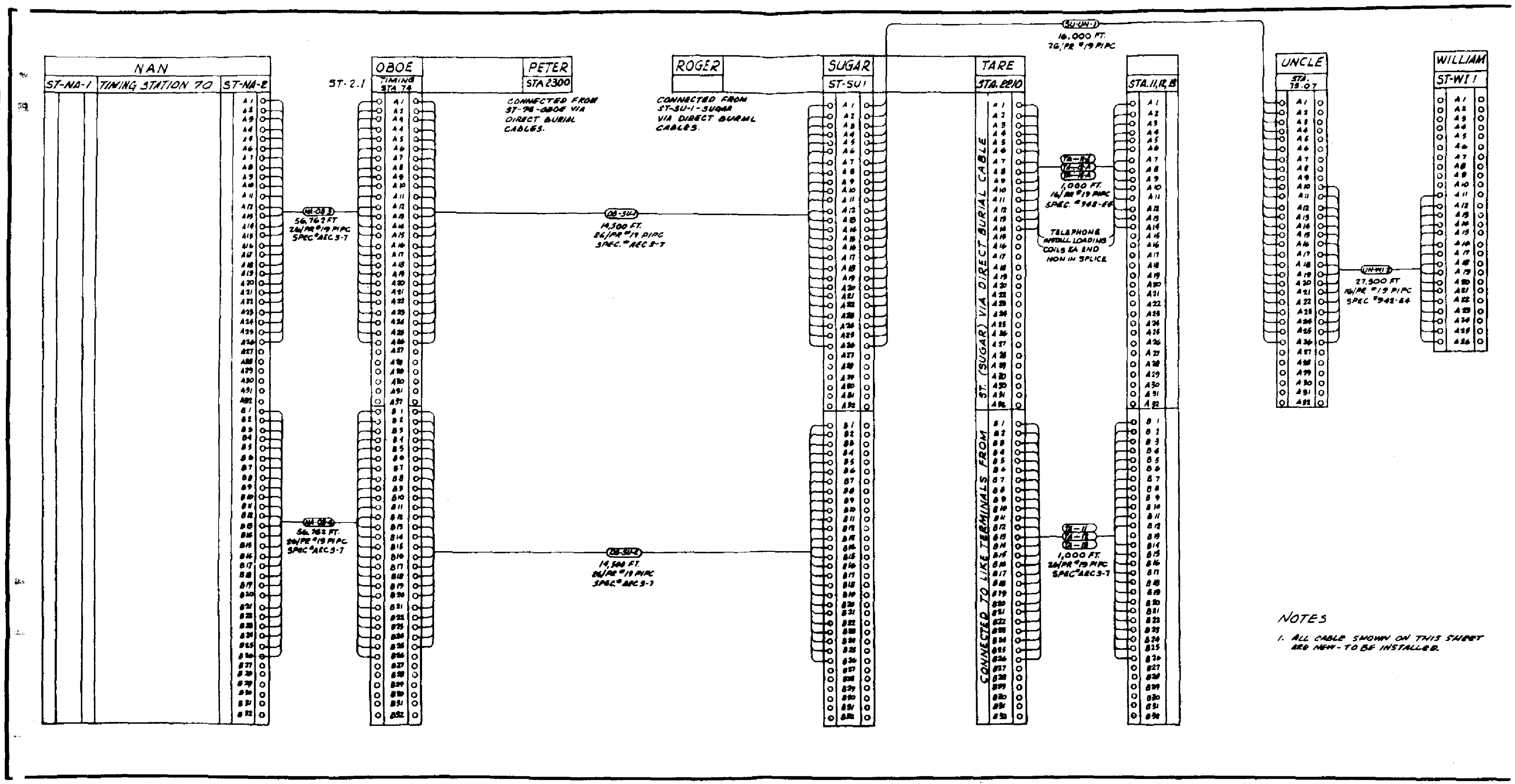
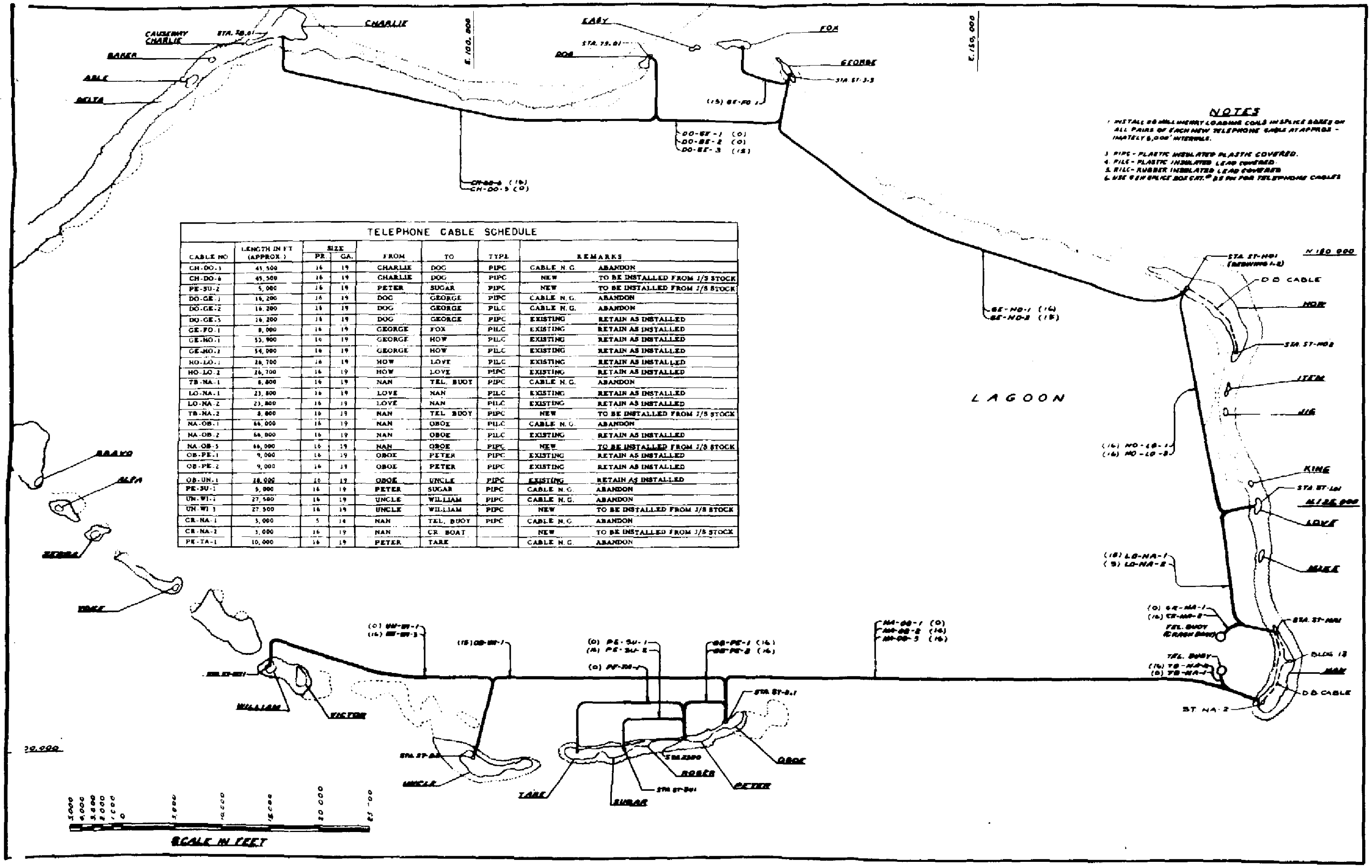


Chart No. 2-8-A. Submarine Signal Cable System Schematic Diagram
Bikini Atoll — Sheet 2 of 2.



TELEPHONE CABLE SCHEDULE								
CABLE NO	LENGTH IN FT (APPROX.)	SIZE PR.	SIZE GA.	FROM	TO	TYPE	REMARKS	
CH-DO-3	45,500	16	19	CHARLIE	DOG	PIPC	CABLE N.G.	ABANDON
CH-DO-6	45,500	16	19	CHARLIE	DOG	PIPC	NEW	TO BE INSTALLED FROM J/S STOCK
PE-SU-2	5,000	16	19	PETER	SUGAR	PIPC	NEW	TO BE INSTALLED FROM J/S STOCK
DO-GE-1	16,200	16	19	DOG	GEORGE	PIPC	CABLE N.G.	ABANDON
DO-GE-2	16,200	16	19	DOG	GEORGE	PILC	CABLE N.G.	ABANDON
DO-GE-3	16,200	16	19	DOG	GEORGE	PIPC	EXISTING	RETAIN AS INSTALLED
GE-FO-1	8,000	16	19	GEORGE	FOX	PILC	EXISTING	RETAIN AS INSTALLED
GE-HO-1	53,900	16	19	GEORGE	HOW	PILC	EXISTING	RETAIN AS INSTALLED
GE-HO-2	54,000	16	19	GEORGE	HOW	PILC	EXISTING	RETAIN AS INSTALLED
HO-LO-1	26,700	16	19	HOW	LOVE	PILC	EXISTING	RETAIN AS INSTALLED
HO-LO-2	26,700	16	19	HOW	LOVE	PIPC	EXISTING	RETAIN AS INSTALLED
TB-NA-1	8,800	16	19	NAN	TEL. BUOY	PIPC	CABLE N.G.	ABANDON
LO-NA-1	23,800	16	19	LOVE	NAN	PILC	EXISTING	RETAIN AS INSTALLED
LO-NA-2	23,800	16	19	LOVE	NAN	PILC	EXISTING	RETAIN AS INSTALLED
TB-NA-2	8,800	16	19	NAN	TEL. BUOY	PIPC	NEW	TO BE INSTALLED FROM J/S STOCK
NA-OB-1	66,000	16	19	NAN	OBOE	PILC	CABLE N.G.	ABANDON
NA-OB-2	66,000	16	19	NAN	OBOE	PILC	EXISTING	RETAIN AS INSTALLED
NA-OB-3	66,000	16	19	NAN	OBOE	PIPC	NEW	TO BE INSTALLED FROM J/S STOCK
OB-PE-1	9,000	16	19	OBOE	PETER	PIPC	EXISTING	RETAIN AS INSTALLED
OB-PE-2	9,000	16	19	OBOE	PETER	PIPC	EXISTING	RETAIN AS INSTALLED
OB-UN-1	18,000	10	19	OBOE	UNCLE	PIPC	EXISTING	RETAIN AS INSTALLED
PE-SU-1	5,000	16	19	PETER	SUGAR	PIPC	CABLE N.G.	ABANDON
UN-WI-1	27,500	16	19	UNCLE	WILLIAM	PIPC	CABLE N.G.	ABANDON
UN-WI-3	27,500	16	19	UNCLE	WILLIAM	PIPC	NEW	TO BE INSTALLED FROM J/S STOCK
CR-NA-1	3,000	5	14	NAN	TEL. BUOY	PIPC	CABLE N.G.	ABANDON
CR-NA-2	3,000	16	19	NAN	CR. BOAT		NEW	TO BE INSTALLED FROM J/S STOCK
PE-TA-1	10,000	16	19	PETER	TARE		CABLE N.G.	ABANDON

Chart No. 2-9. Submarine Telephone Cable System — Bikini Atoll.

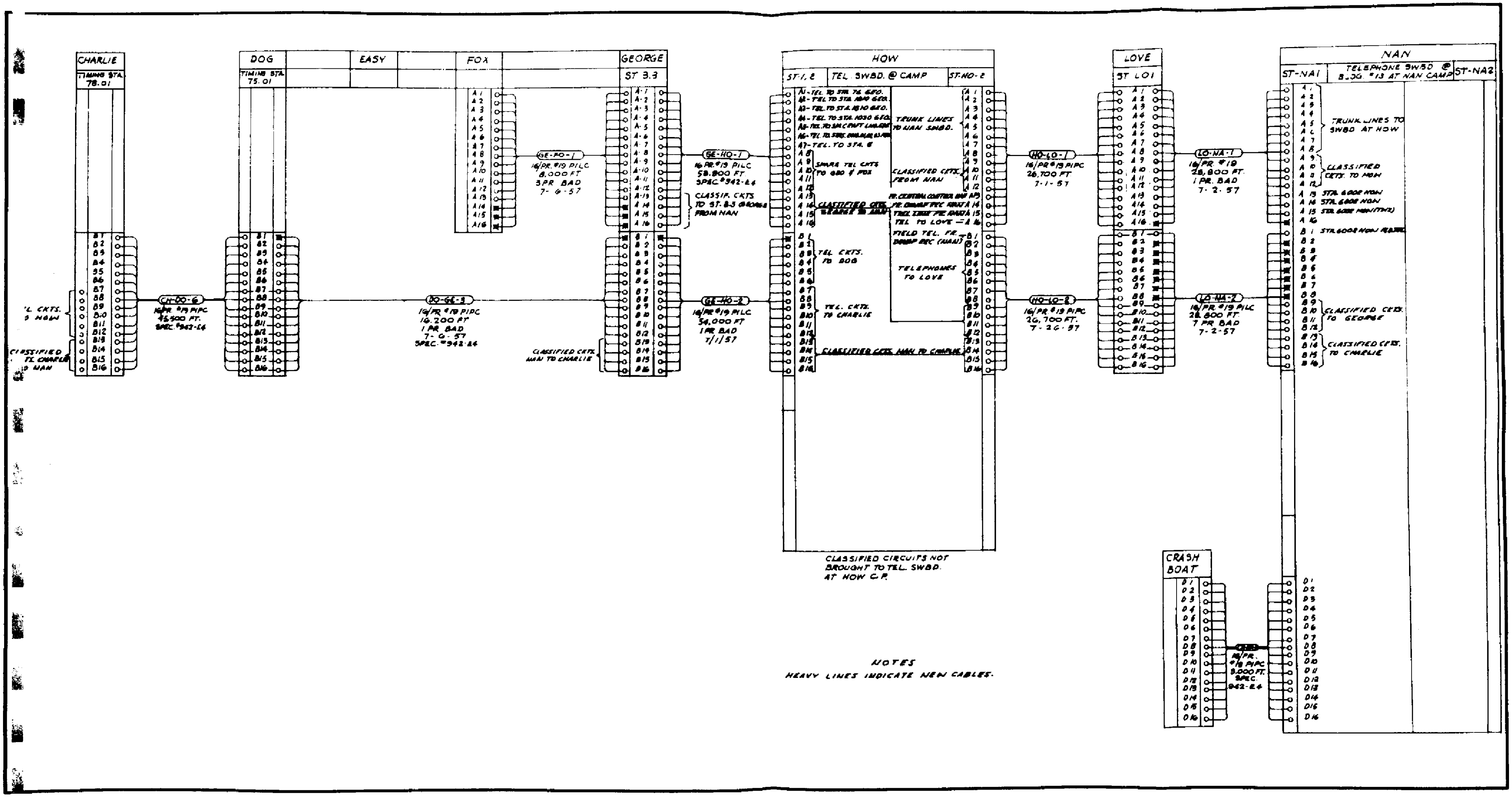


Chart No. 2-10. Submarine Telephone Cable System Schematic Diagram
Bikini Atoll — Sheet 1 of 2.

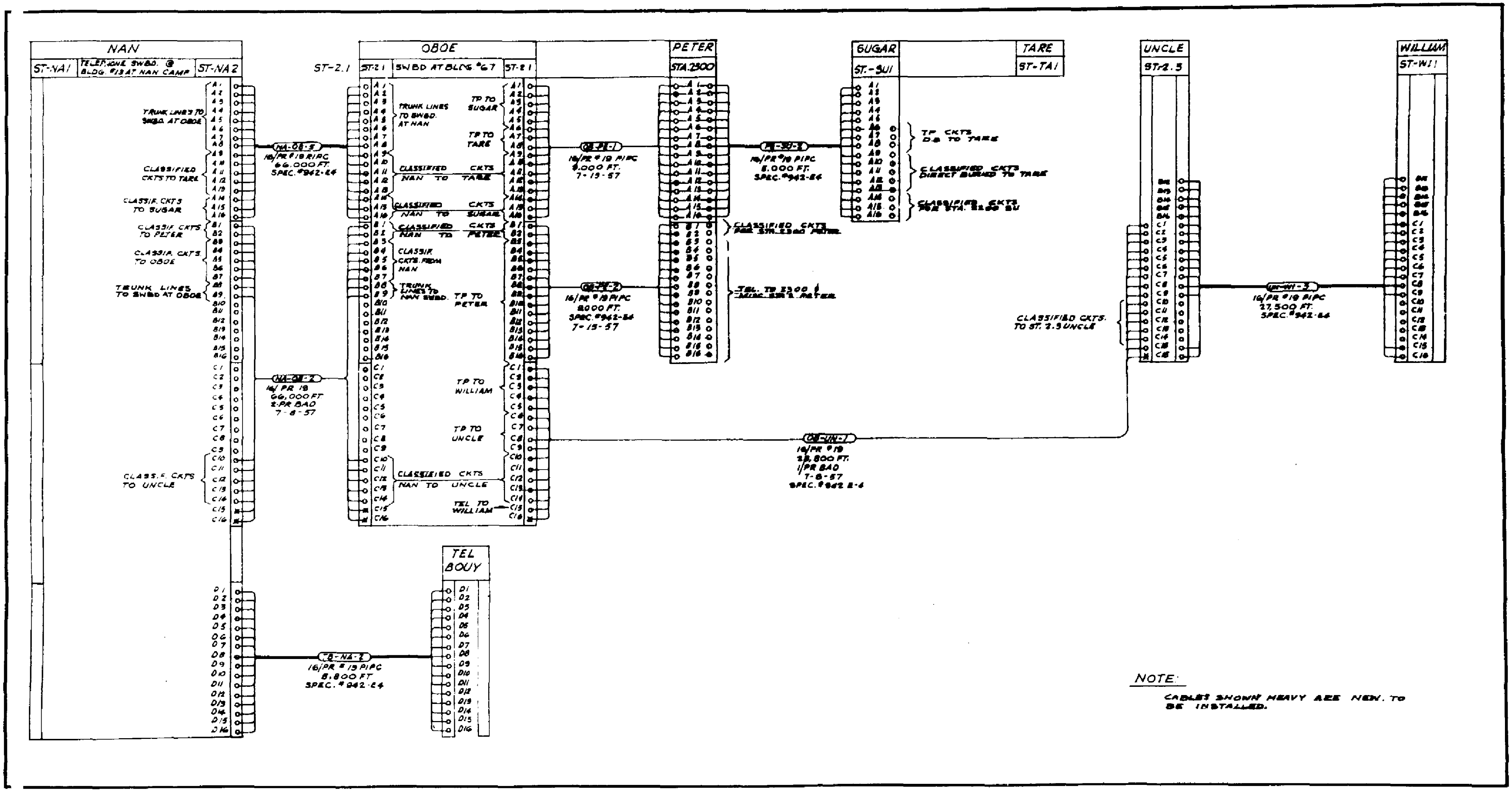


Chart No. 2-10-A. Submarine Telephone Cable System Schematic Diagram — Bikini Atoll — Sheet 2 of 2.

	1957						1958									
CONSTRUCTION ITEM	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	REMARKS
SCIENTIFIC STATIONS - AEC			3.00	10.00	19.00	29.00	9.00	44.00	78.00	89.00	92.00	100.00				
			0.00	1.00	3.00	4.00	9.00	23.00	57.00	80.00	92.00	98.00	99.00	99.00	100.00	
SCIENTIFIC STATIONS - DOD					5.00	10.00	10.00	34.00	73.00	90.00	92.00	100.00				
					0.00	7.00	10.00	31.00	68.00	91.00	98.00	99.00	100.00			
CAUSEWAYS			15.00	40.00	70.00	40.00	70.00	80.00	85.00	100.00						
			0.00	1.00	25.00	40.00	70.00	78.00	80.00	85.00	95.00	99.00	100.00			
ELECTRICAL DISTRIBUTION TELEPHONE & SIGNAL CABLE (INCLUDING SUBMARINE CABLE)				10.00	25.00	30.00	10.00	20.00	45.00	90.00	100.00					
				0.00	1.00	2.00	10.00	16.00	27.00	72.00	91.00	93.00	96.00	100.00		
INTER-ATOLL COMMUNICATIONS				15.00	38.00	75.00	41.00	52.00	75.00	100.00						
				1.00	4.00	19.00	41.00	85.00	95.00	97.00	99.00	100.00				
OTHER SCIENTIFIC FACILITIES				15.00	27.00	57.00	32.00	50.00	75.00	100.00						
				2.00	8.00	24.00	32.00	39.00	62.00	83.00	96.00	98.00	99.00	100.00		
USER TEST PROGRAM CONSTRUCTION			10.00	15.00	20.00	40.00	0.00	18.00	36.00	68.00	92.00	100.00				
			0.00	0.00	0.00	0.00	0.00	0.00	31.00	35.00	65.00	86.00	90.00	98.00	100.00	
NON-PROGRAM DOD-REIMBURSABLE	5.00	10.00	15.00	20.00	30.00	40.00	60.00	75.00	85.00	90.00	95.00	100.00				
	0.00	10.00	15.00	20.00	30.00	40.00	60.00	75.00	85.00	90.00	95.00	98.00	99.00	99.00	100.00	
OFF-ATOLL CONSTRUCTION		10.00	30.00	60.00	80.00	80.00	80.00	90.00	100.00							
		0.00	58.00	59.00	62.00	65.00	95.00	96.00	97.00	98.00	100.00					
CAMPS - TEMPORARY & FLOATING	18.00	49.00	79.00	90.00	92.00	94.00	91.00	94.00	98.00	100.00						
	18.00	34.00	46.00	56.00	60.00	90.00	91.00	94.00	95.00	96.00	98.00	100.00				
MISC. EXPENDABLE CONSTRUCTION	1.00	2.00	4.00	19.00	34.00	40.00	60.00	75.00	83.00	87.00	95.00	100.00				
	0.00	2.00	4.00	19.00	34.00	40.00	60.00	75.00	83.00	87.00	95.00	98.00	99.00	99.00	100.00	
75.00 CONSTRUCTION SCHEDULE PREDICTED PERCENT																
CONSTRUCTION IN PLACE 75.00 PERCENT COMPLETED																
JOHNSTON ISLAND											12.00	65.00	95.00	98.00	100.00	
											12.00	71.00	99.00	99.00	100.00	
SUMMARY	10.00	14.00	20.00	29.00	38.00	40.00	35.00	53.00	78.00	89.00	90.00	96.00	98.00	99.00	100.00	REVISED AS OF 4-15-58 TO INCLUDE NEW CONSTRUCTION AT JOHNSTON ISLAND.
	10.00	12.00	16.00	18.00	23.00	30.00	35.00	46.00	67.00	85.00	90.00	96.00	98.00	99.00	100.00	

Chart No. 2-11. Construction Progress — Expendable Test Facilities FY 1958 & FY 1959.

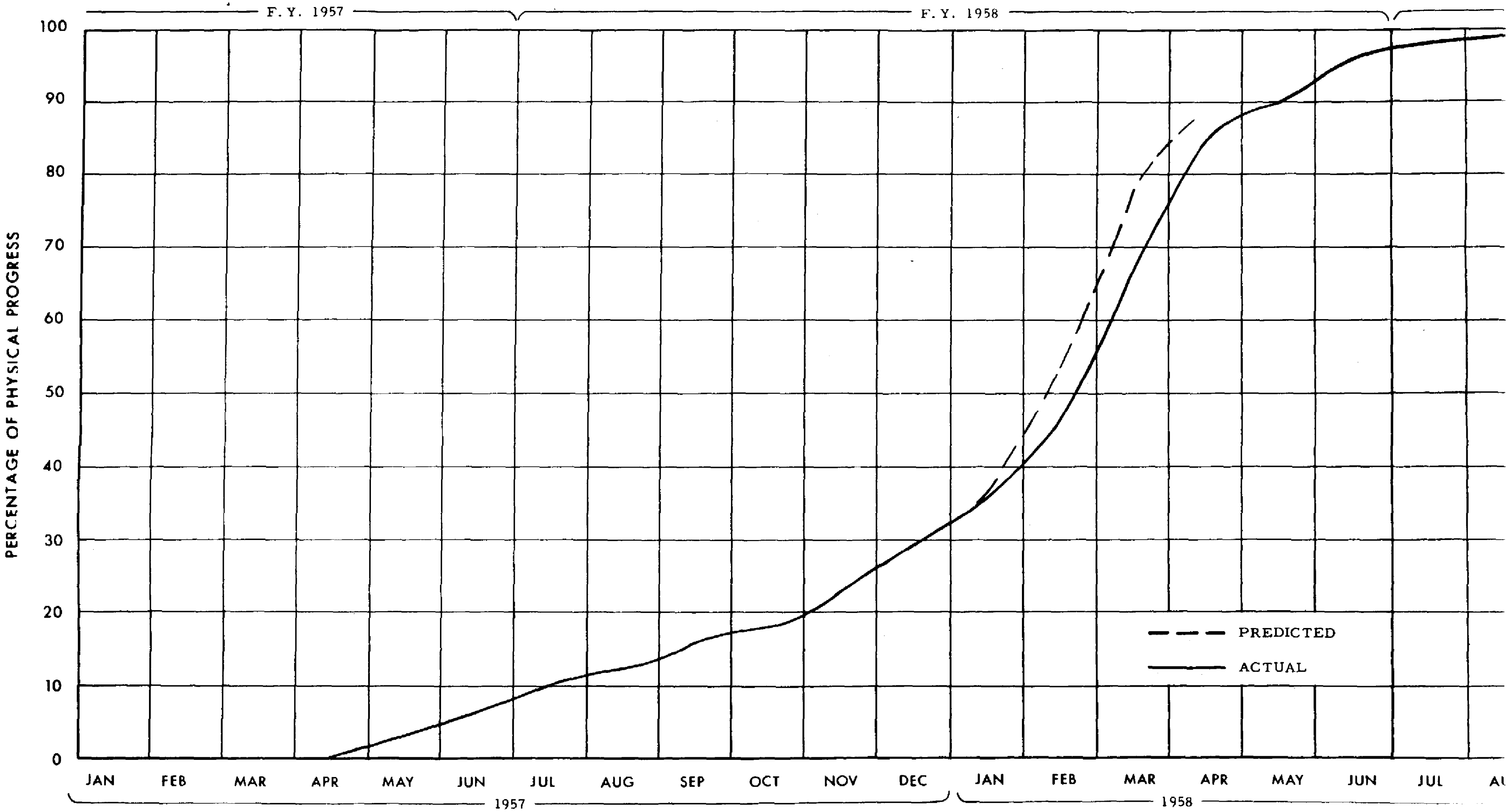
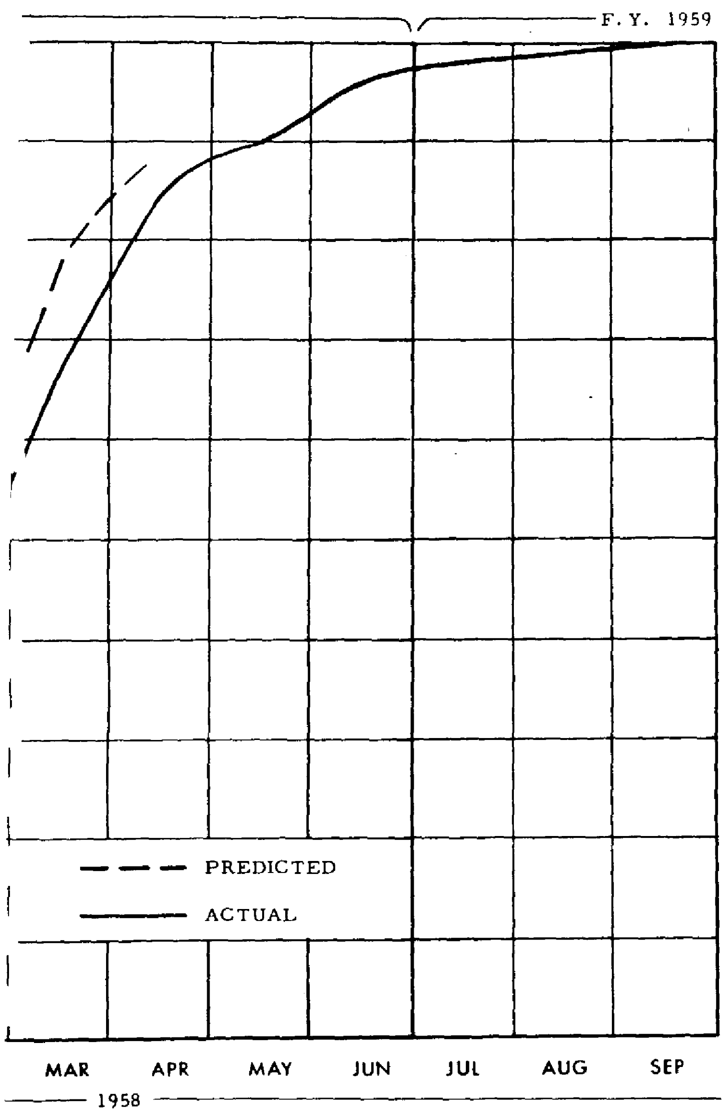


Chart No. 2-12. Total Budgeted Construction Program — Expendable Test Facilities — FY 1957, FY 1958 & FY 1959.

(Revised as of 4-15-58 to incluc construction at Johnston Islan



(Revised as of 4-15-58 to include new construction at Johnston Island.)

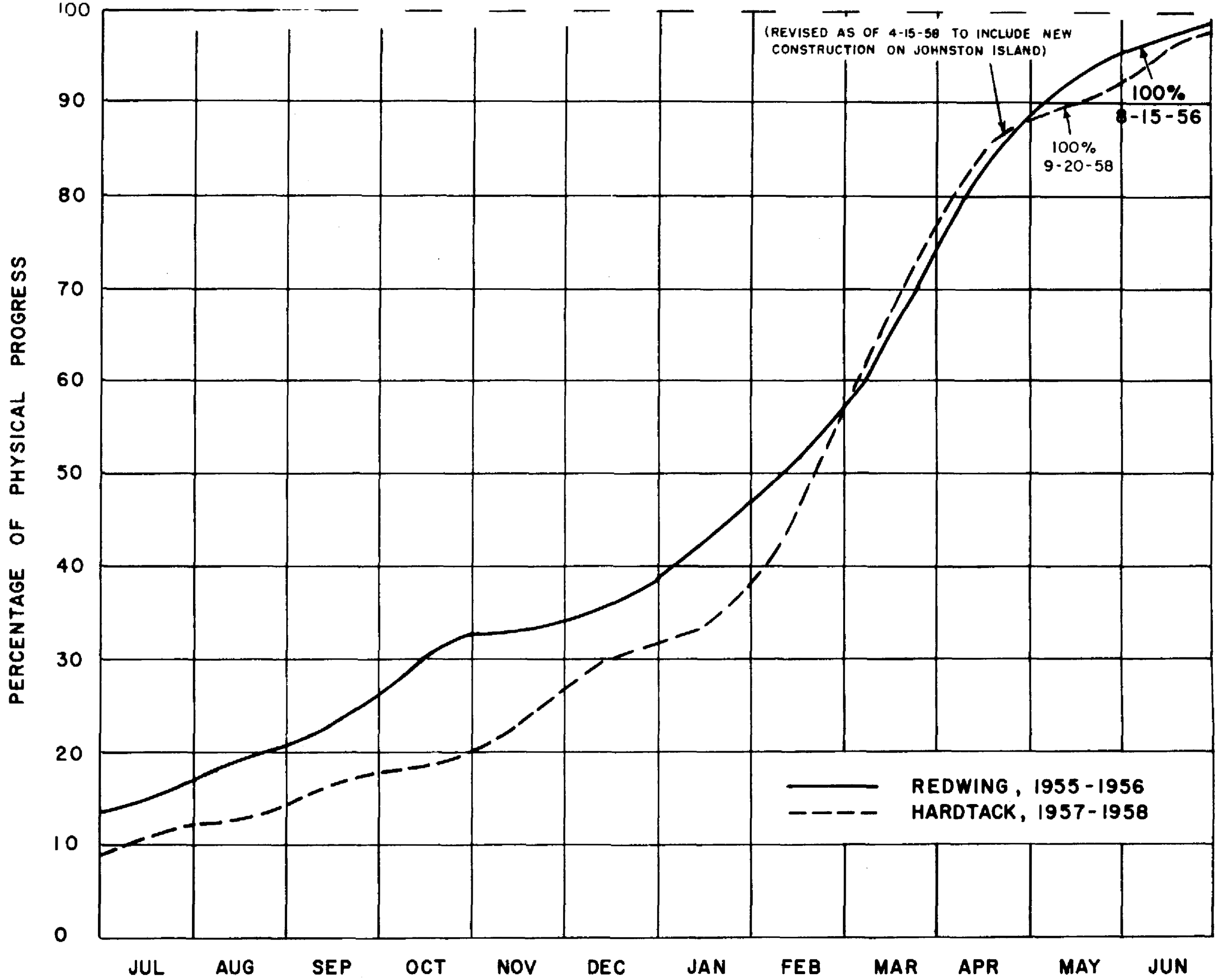
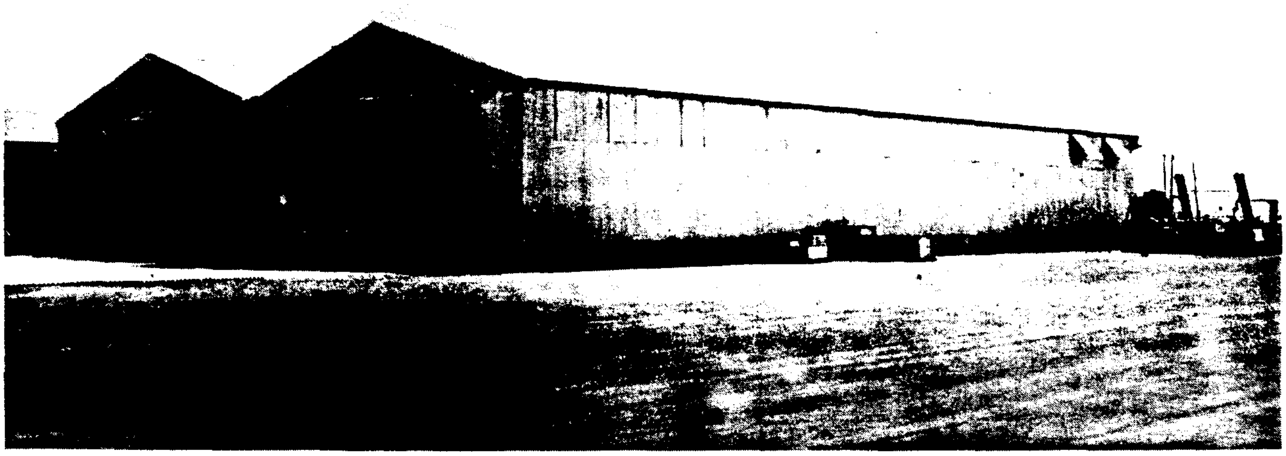
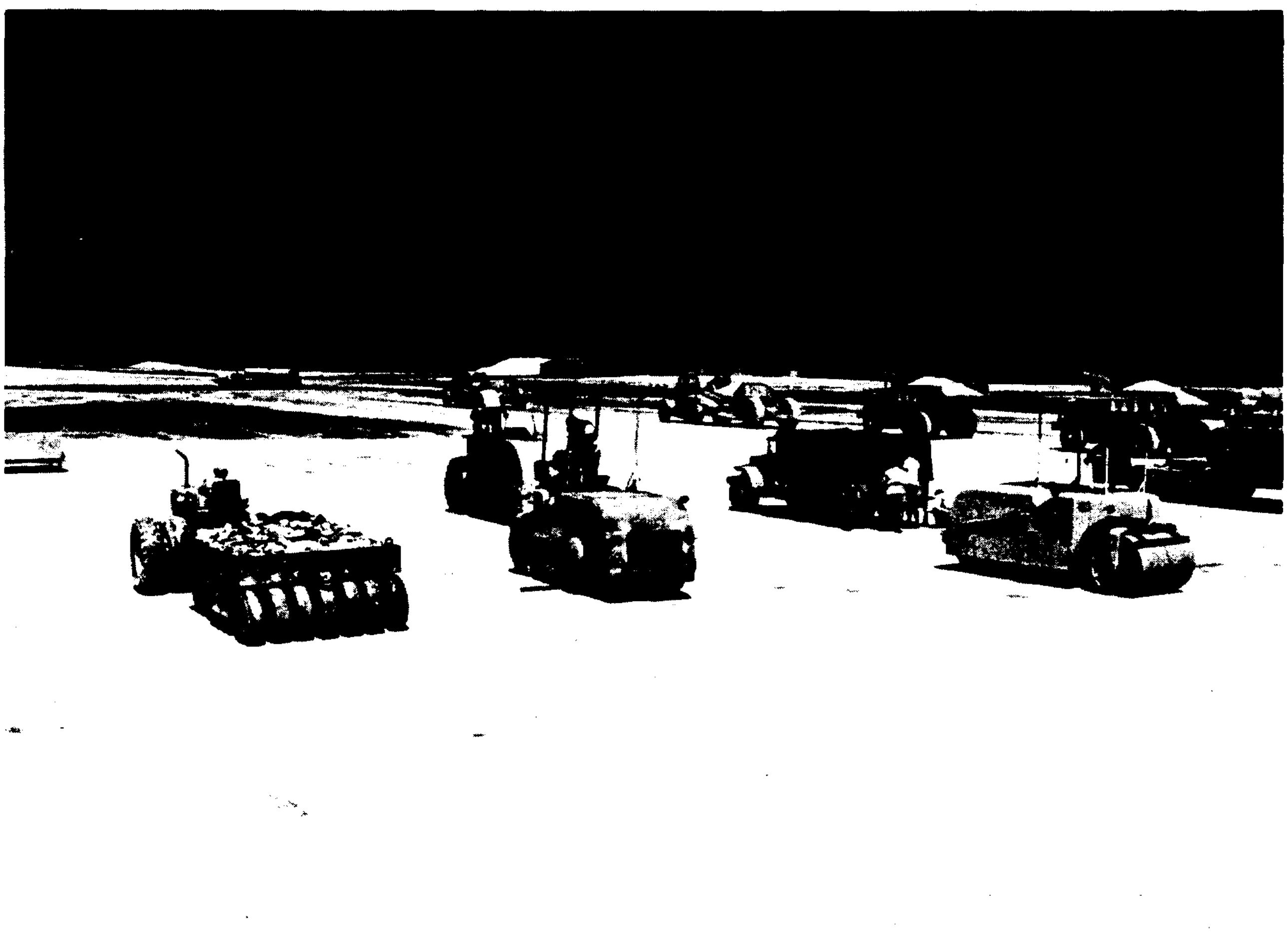


Chart No. 2-13. Total Budgeted Construction Program — Expendable Test Facilities — HARDTACK vs. REDWING.



(Neg. No. W-706-11)

Figure No. 2-138. Quartermaster Warehouse, Building 643 — Fred.



(Neg. No. W-649-6)

Figure No. 2-139. Compacting Sub Grade — Fred Airstrip.

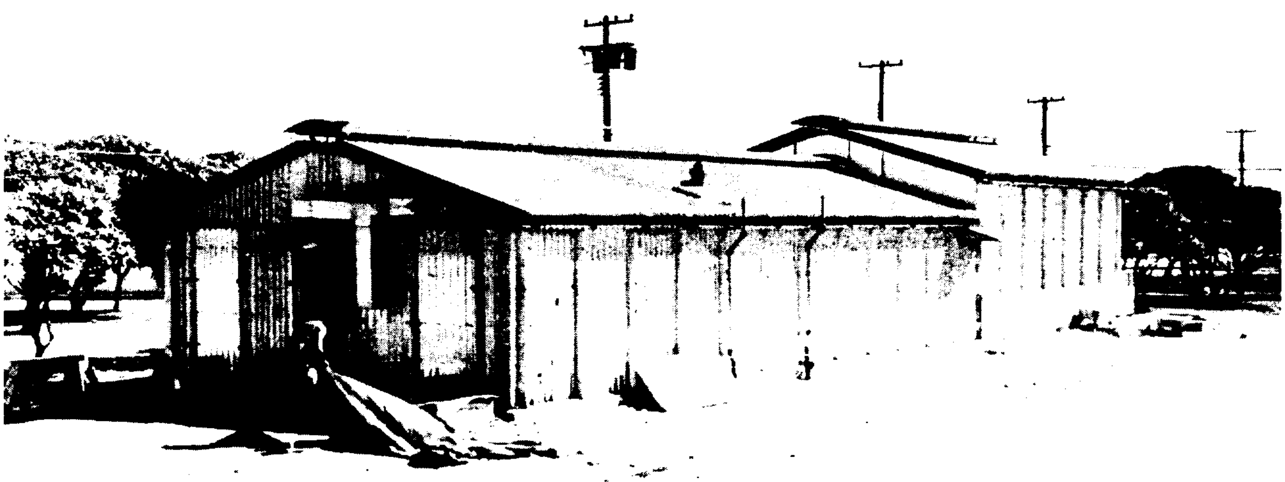
SECTION 5
PERMANENT CONSTRUCTION

Quartermaster Warehouses, Buildings 643 and 644, on Fred and the Receiving Warehouse, Building 515, on Elmer, were completed in the early part of August 1956. All three buildings were of a rigid steel frame structure known as the Butler-type. The chapels on Elmer and Fred were completed by September 1956.

The construction completed in 1957 on Fred provided additional storage space with Butler-type Buildings 592, 594, 596, 597, and 599. All buildings were part of the warehouse program and were completed between 24 June and 21 August 1957. In addition, a Generator Shed at Building 15, a Dental Laboratory at the hospital, and a 200,000-gallon concrete, fresh-water reservoir were completed in 1957. On Elmer the Hobby Shop-Building 243, the Gymnasium-Building 244, the Hot Locker addition to Building 310, and a sawmill were completed during the latter part of 1957. Most of the facilities scheduled for use during Operation HARDTACK were started in the latter months of 1957.

Increased operational requirements for HARDTACK touched off a building boom to meet the space needs desired by the Client by certain dates in 1958. As of February 1958, firm dates were set for the beneficial occupancy of barracks, laboratories, the IBM Building, warehouses, and other facilities that were to be used. The very limited time allowed for the manufacture and delivery of dehumidification and other mechanical equipment resulted in Using agencies moving into the buildings on a "beneficial occupancy" basis before final construction was completed.

In general, most of the permanent facilities on Elmer were standard Pacific Iron & Steel or Butler-type buildings. Because of the extremely tight occupancy schedule of the existing Administration Building by TG 7.1 and more advantageous material delivery dates, a Butler-type structure was selected for the H&N Administration Building in lieu of the standard PI&S structure. The 18-man barracks, Buildings 144 and 145, and CJTF-7 Guest House, Building 497, were manufactured by the Pasco Steel Company, with the latter building having plywood partitions installed in order to expedite completion. The 2-story barracks — Buildings 456, 457, 459, and 460 — were designed requiring precast concrete bents and second-story slabs with metal interior and exterior walls and roofs. Existing barracks, Buildings 109, 115, 116, 122,



(Neg. No. W-V-117-8)

Figure No. 2-140. Communications Building 224, Elmer — 55% Complete.

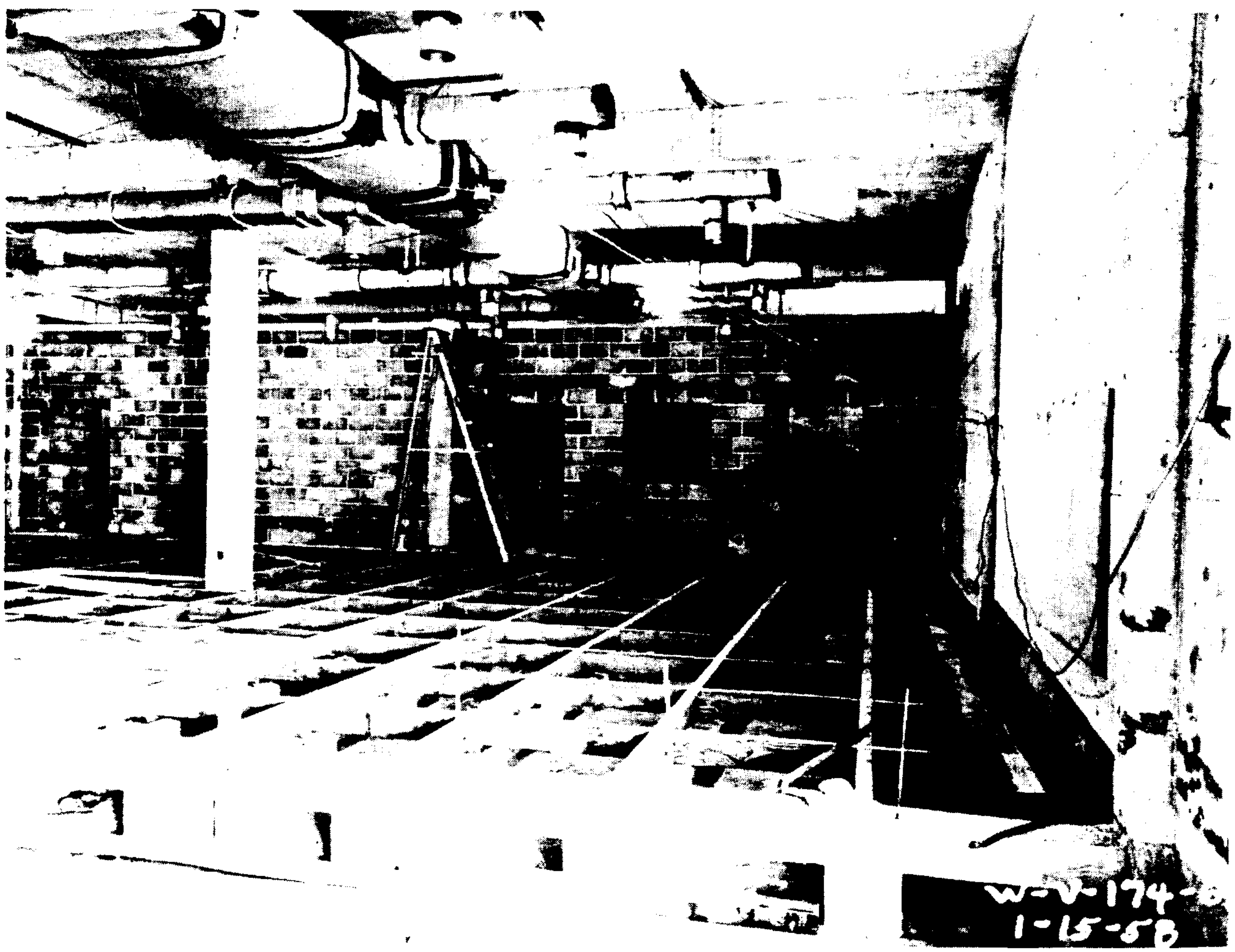
123, 125, and 127, were modified to provide dayrooms.

THE IBM Building 453 was a re-inforced concrete building 63x90x14-foot high with an 8-inch-thick concrete roof slab supported by 12-inch walls, concrete beams, columns, and pilasters. A mechanical equipment room, computer room, four offices, engineering room, tape storage room, latrine, Electronic Data Processing Machine room, and an Electronic Analysis Machine room were provided in this building. The Electronic Data Processing Machine room required 1330 square feet of removable plywood floor panels with openings for air intake and cables built over wood joists on concrete piers. All floors, except the compressor and mechanical equipment rooms, were covered with 4775 square feet of vinyl tile, with rubber base at the walls and partitions. The ceiling was acoustic panels suspended from the roof. The entire building, except for the compressor and mechanical equipment rooms, was air-conditioned, with air flow through the walls and under the floors.

On Fred, Laboratory Building 582, Enlisted Men's Club Building 693, Inflammable Storage, Building 653, and the lean-to additions to Building 118 were all of Butler-type construction. The Explosive Storage Magazine, Building 191, was a re-inforced concrete bunker covered with coral fill. The Decontamination Facilities, Building 143, includede two new wash-down pads for aircraft, as well as a double PI&S building provided with shower and laundry facilities.

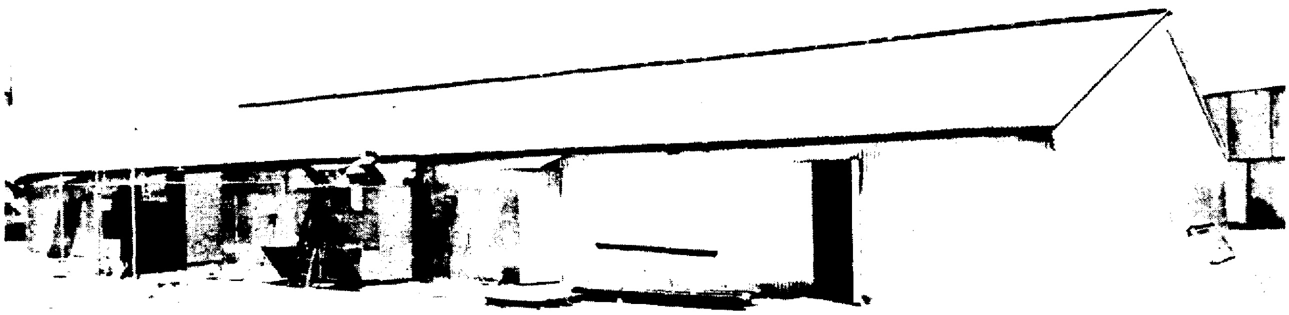
Pipeline work for the Fire Protection Systems was started on 24 September 1957 on Elmer, and on 2 October on Fred. The design purpose was to increase the firefighting capacities of the systems and resulted in laying 10-inch transite pipe lines parallel to the existing 6-inch lines, with cross-over connections which made both pipelines a part of the system. Pressure on the lines was maintained at 30 psi.

By far the most extensive project undertaken between Operations was the improvement made to the Fred Airfield. Prior to receipt of



(Neg. No. W-V-174-6)

Figure No. 2-141. IBM Equipment Building 453 — 61% Complete.



(Neg. No. W-V-285-2)

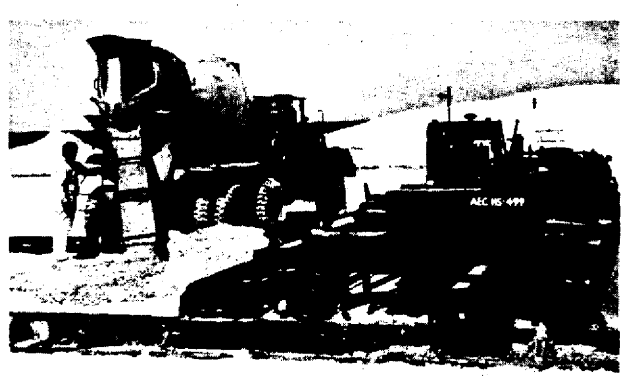
Figure No. 2-142. DOD Laboratory Building 582, Fred — 98% Complete.

authorization for the extension of the runway, work was started on the rehabilitation of portions of the existing runway requiring repair. Stockpiling of materials for the project was started on 16 January 1957, with all aggregate being furnished by the Elmer plant. Initial work on removing old pavement was started by ripping out parts of Blocks 6 and 7. Joints removed were cut straight and vertical. Following removal of the old pavement and base course, the sub-base was recompacted to a 50% CBR value. A 4-inch crushed, graded base course was then placed and compacted to 80% CBR. A seal coat was applied over the base course, which consisted of ¼ gallon of asphalt emulsion per square yard of surface; beach sand was then applied, rolled, and broomed. The 2½-inch surface course was made up of 87% aggregate, 8% fine beach sand, and 5% filler. Aggregates were all graded crushed rock, and the filler was made up of 62% mineral rock dust and 30% portland cement.

Preliminary work on the runway extension project started in October 1957. Prior to this date a study was made at Jobsite to determine the quantity and types of materials required for fill and hydrographic surveys of the Elmer and Fred lagoon areas and to determine concentrated material locations. As a result of this study, a Sauerman dragline was installed at Fred to scoop material from the lagoon floor for use as a fill under the sub-base; all graded aggregates were produced and hauled from Elmer. A sea wall, 855 feet in length, was constructed to retain the extension fill at the northeast end of the runway. Holes were drilled and blasted which provided a start for pile driving; a total of 91 bearing piles were driven to a 20-foot minimum embedment. Following piling emplacement, pre-cast concrete blocks were set and bolted to the piles and then grouted in. A concrete cap was then laid atop the entire length of the retaining wall.

Earth fills of the runway extension and additional parking aprons were made in 8-inch lifts and compacted to the specified degree with grid and rubber-tired rollers, and watered to optimum moisture content. When proper elevations were reached, a 6-inch sub-base course was applied and compacted, followed by a 4-inch base course of 2-inch-minus coral aggregate compacted to 95% CBR. Concrete pours for the airstrip averaged about 400 cubic yards daily. On 3 April 1958 the cross-over taxiways and parking aprons were completed, with the latter having 159 more aircraft tie-downs than were included in the original plans.

The southwest end of the runway was extended for a distance of 395 feet, and the northeast end extended 1220 feet. Sloping concrete over-runs were poured at both ends of the runway, with a retaining sea wall formed and poured to protect one corner of the southwest extension. An entirely new runway lighting system was part of the extension project, including runway marker lights, warning and threshold lights, a new regulator for control of the system, and floodlights on the parking ramps. A new surfaced road along the ocean side of the runway was also an additional airfield improvement.

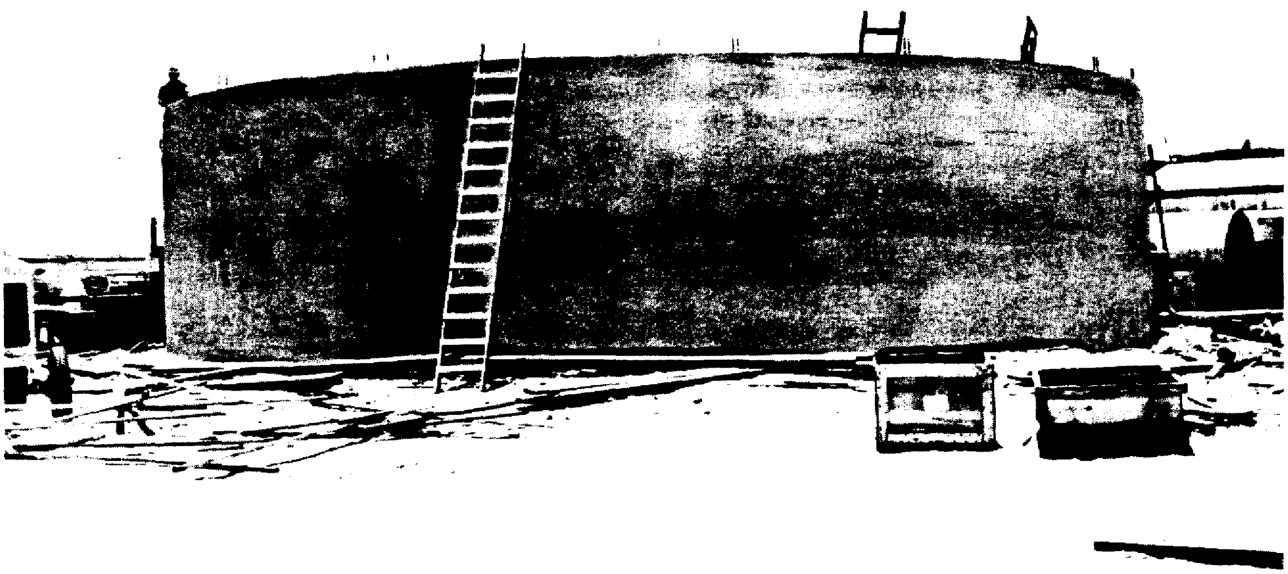


(Neg. No. W-V-160-9)

Figure 2-143. Concrete Spreading at West End of Airstrip — Fred.

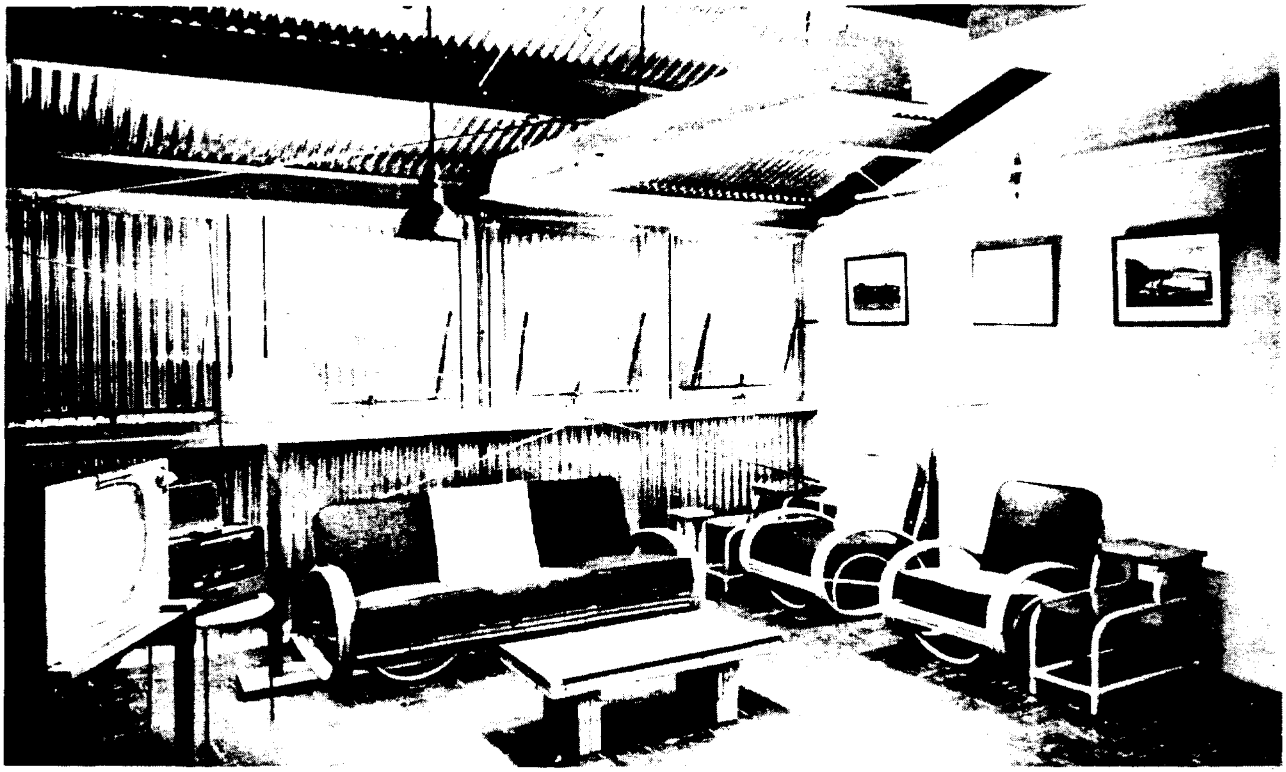
(Neg. No. W-617-9)

Figure No. 2-144. Stripping Asphalt Runway — Fred Airstrip.



(Neg. No. W-770-6)

Figure No. 2-145. 200,000 Gallon Concrete Reservoir,
75% Complete — Fred.



(Neg. No. W-V-275-10)

Figure No. 2-146. Lounge in JTF-7 Guest House — Elmer.

(Neg. No. W-885-6)

Figure No. 2-147. Site Fred Showing New Road on Ocean Side.

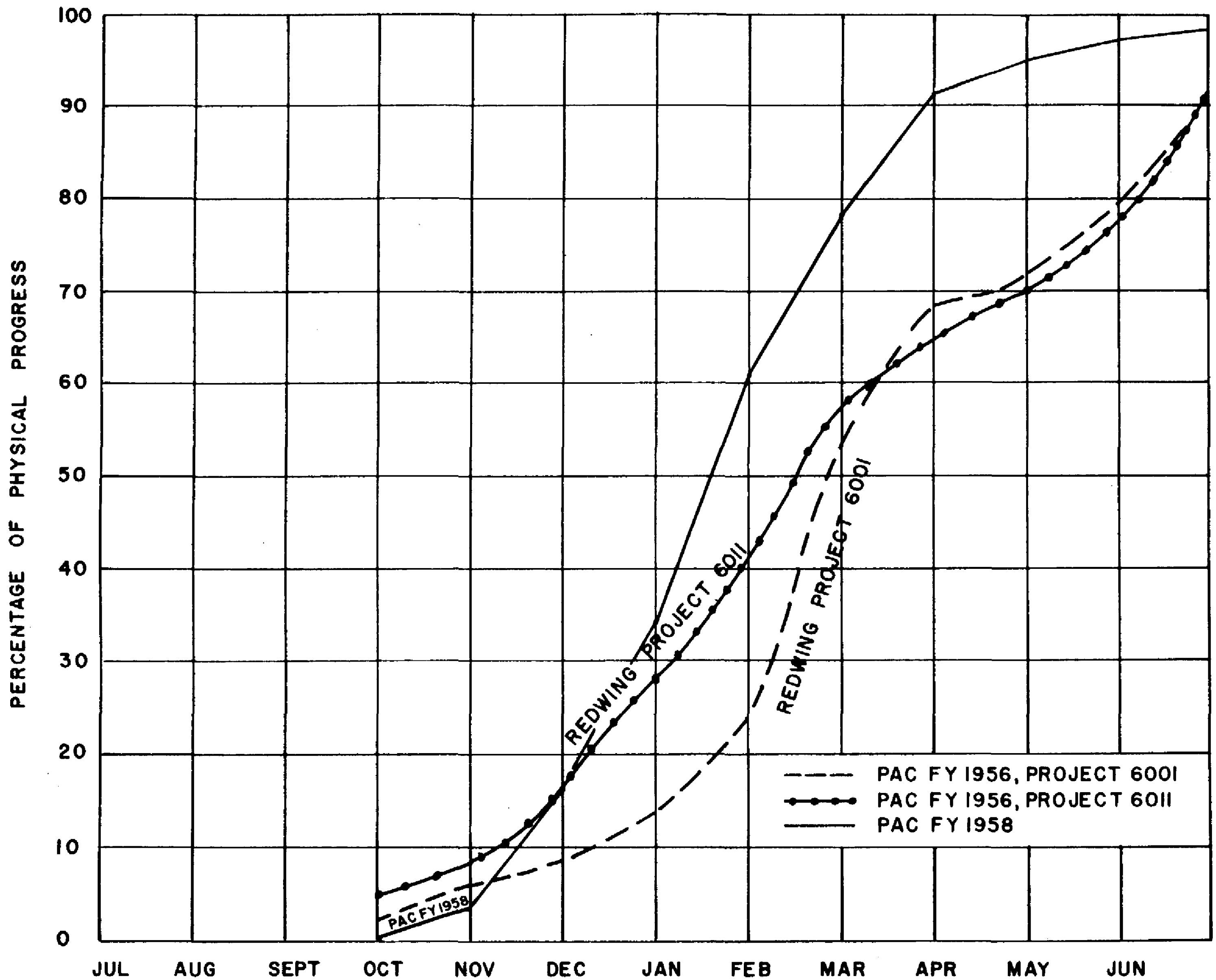


Chart No. 2-14. Total Budget Construction Program — PAC.

CONSTRUCTION ITEM		1957 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1958 JAN	FEB	MAR	APR	MAY	JUN	JUL
REVAMP ELECTRICAL DISTRIBUTION - ELMER	Schedule										25.00	30.00	75.00	100.00						
	In place									5.00	8.00	12.00	20.00	25.00	80.00	90.00	90.00	94.00	94.00	100.00
SMALL CRAFT RAMP - ELMER	Schedule	50.00	100.00																	
	In place	20.00	100.00																	
RECREATION FACILITIES BUILDINGS (3) - ELMER	Schedule				25.00	75.00	100.00													
	In place				6.00	95.00	97.00	98.00	100.00											
VEHICLE, TIRE & WELDING SHOPS - ELMER	Schedule					10.00	55.00	- -	80.00	90.00	95.00	100.00								
	In place					13.00	40.00	64.00	80.00	88.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	100.00		
DIAL TELEPHONE SYSTEM - ELMER	Schedule								20.00	50.00	65.00	35.00	40.00	75.00	100.00					
	In place								20.00	30.00	33.00	37.00	95.00	96.00	97.00	97.00	97.00	99.00	100.00	
FIRE PROTECTION - ELMER	Schedule										40.00	25.00	75.00	100.00						
	In place										2.00	3.00	25.00	45.00	53.00	54.00	62.00	87.00	90.00	100.00
MISCELLANEOUS CONSTRUCTION - ELMER	Schedule	5.00	15.00	46.00	46.00	46.00	61.00	85.00	100.00											
	In place	5.00	15.00	46.00	46.00	46.00	61.00	85.00	100.00											
POST EXCHANGE WAREHOUSE - FRED	Schedule					25.00	50.00	100.00												
	In place					25.00	95.00	100.00												
FOOD WAREHOUSE - FRED	Schedule			7.00	35.00	65.00	100.00													
	In place			7.00	30.00	80.00	92.00	100.00												
EXPLOSIVE STORAGE MAGAZINE - IGLOO TYPE - FRED	Schedule						30.00	60.00	100.00			85.00	100.00							
	In place						0.00	30.00	30.00	40.00	60.00	90.00	92.00	92.00	94.00	96.00	96.00	99.00	100.00	
MISCELLANEOUS SUPPLY WAREHOUSE - FRED	Schedule				20.00	50.00	100.00													
	In place				21.00	50.00	90.00	90.00	95.00	99.00	100.00									
GENERAL SUPPLY WAREHOUSE - FRED	Schedule					10.00	40.00	85.00	100.00											
	In place					10.00	75.00	100.00												
ENGINEERING SUPPLY WAREHOUSE - FRED	Schedule				10.00	50.00	100.00													
	In place				10.00	45.00	90.00	100.00												
FIRE PROTECTION - FRED	Schedule										40.00	25.00	75.00	100.00						
	In place										3.00	3.00	10.00	25.00	65.00	76.00	76.00	83.00	87.00	100.00
MISCELLANEOUS CONSTRUCTION - FRED	Schedule	5.00	12.00	43.00	58.00	58.00	62.00	85.00	100.00											
	In place	5.00	12.00	43.00	58.00	58.00	62.00	85.00	100.00											
SUMMARY OF PROJECT 57F2	Schedule	1.00	3.00	8.00	13.00	22.00	50.00	75.00	57.00	60.00	72.00	72.00	88.00	96.00	100.00					
	In place	1.00	3.00	8.00	12.00	24.00	40.00	51.00	57.00	60.00	62.00	64.00	70.00	76.00	88.00	91.00	92.00	97.00	98.00	100.00

75.00 CONSTRUCTION SCHEDULE ESTIMATED PERCENT

75.00 CONSTRUCTION IN PLACE PERCENT COMPLETED

REVISED 11-

Chart No. 2-15. Construction Progress — Project 57F-2 (PAC-FY 1957).

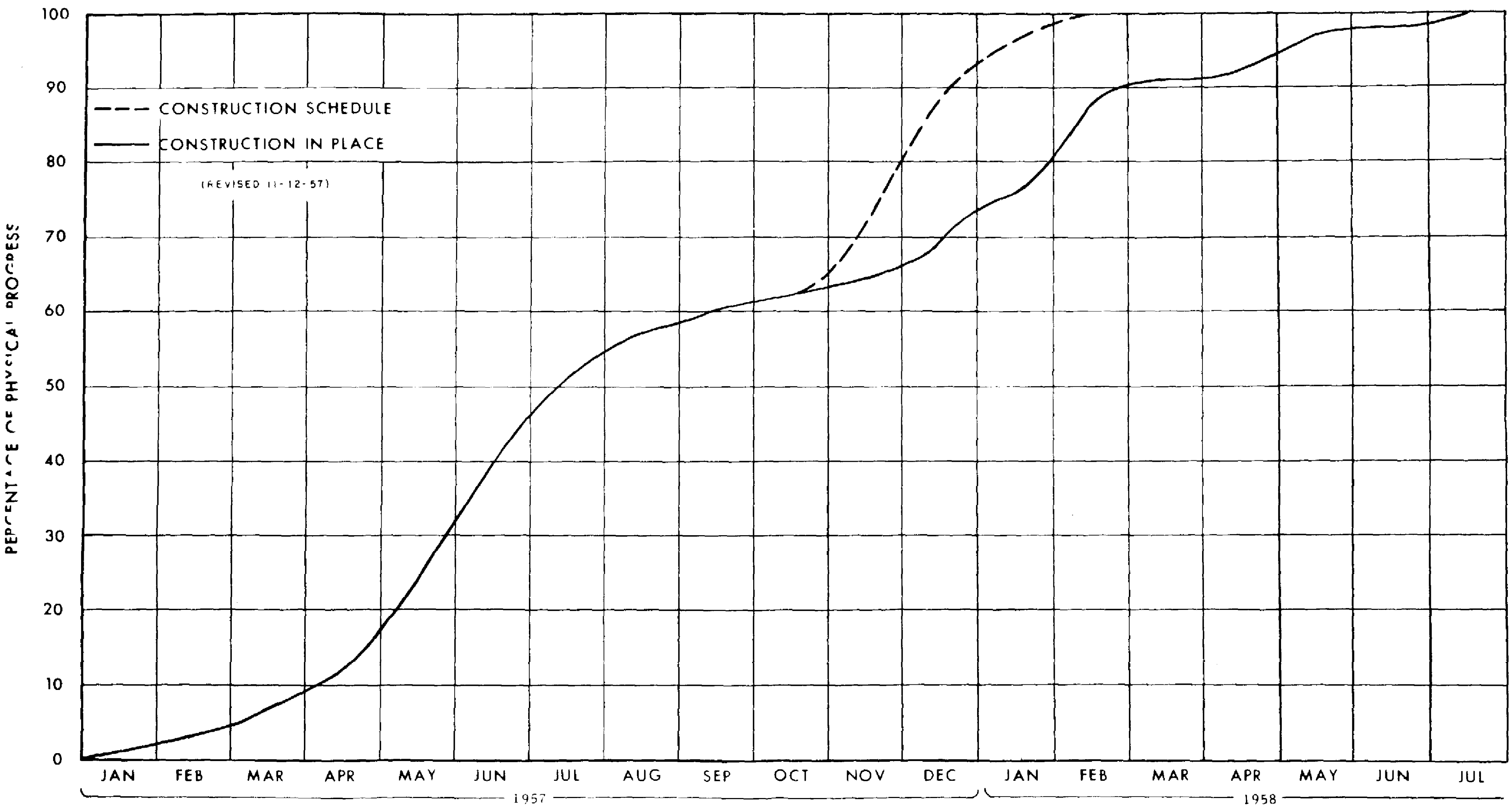


Chart No. 2-16. Total Budgeted Construction Program — Project 57F-2 (PAC-FY 1957).

1957 — 1958

CONSTRUCTION ITEM	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	REMARKS
4 - 128 MAN BARRACKS SITE ELMER LDGS. # 456, 457, 459, & 460		3.00	15.00	35.00	75.00	95.00	100.00						
		3.00	15.00	30.00	48.00	62.00	89.00	96.00	97.00	98.00	100.00		
- 18 MAN BARRACKS LDGS. # 144, 145, & 451		20.00	30.00	45.00	95.00	100.00							
		19.00	23.00	23.00	25.00	62.00	95.00	100.00					
IBM EQUIPMENT BUILDING #453		6.00	15.00	75.00	100.00								
		6.00	50.00	61.00	93.00	93.00	93.00	94.00	98.00	99.00	100.00		
ADMINISTRATION BUILDING #437			7.00	50.00	100.00								
			24.00	50.00	85.00	90.00	93.00	97.00	97.00	97.00	100.00		
HIP RESUPPLY BUILDING #517			3.00	30.00	85.00	100.00							
			0.00	17.00	27.00	74.00	95.00	99.00	100.00				
UEST HOUSE BLDG. #452			3.00	30.00	90.00	95.00	100.00						
			0.00	6.00	26.00	50.00	75.00	99.00	100.00				
DDITIONAL TELEPHONE ACILITIES			15.00	25.00	50.00	100.00							
			15.00	62.00	73.00	87.00	95.00	98.00	100.00				
EHAB. BUILDING 81		3.00	60.00	75.00	90.00	100.00							
		3.00	30.00	52.00	82.00	82.00	90.00	94.00	94.00	95.00	98.00	100.00	
EATHER ADD'N. JTF 7 HQ BLDG. #221			10.00	50.00	95.00	100.00							
			0.00	10.00	80.00	90.00	95.00	99.00	100.00				
ADD'L. LAB. - TG 7.1 LDGS. #464, 465, 466		3.00	60.00	60.00	80.00	100.00							
		2.00	2.00	11.00	30.00	46.00	91.00	95.00	98.00	98.00	100.00		
EXTEND TRAILER PARKING AREA			15.00	60.00	100.00								
			0.00	0.00	22.00	70.00	85.00	95.00	98.00	98.00	100.00		
REHAB. OLD CARGO PIER #137				25.00	75.00	100.00							DELETED FROM PROJECT DURING MONTH OF SEPTEMBER
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
ADD'N. TO RAD-SAFE BLDG. #323		2.00	15.00	75.00	95.00	100.00							
		1.00	7.00	7.00	7.00	20.00	75.00	98.00	99.00	100.00			
DD'N. TO PX, PO. & BARBER SHOP #204									0.00	15.00	75.00	100.00	ELECTRICAL WORK IN PROCESS, REEFER INSTALLED, ROOF BEING COMPLETED.
									0.00	15.00	20.00	50.00	
G 7.1 HEADQUARTERS (BLDGS. 208 - 209)			5.00	50.00	100.00								
			0.00	2.00	12.00	80.00	95.00	99.00	100.00				
ULK STORAGE WAREHOUSE BLDG. #516		3.00	15.00	50.00	85.00	95.00	100.00						MISCELLANEOUS ITEMS REMAIN TO BE COMPLETED.
		1.00	1.00	28.00	28.00	30.00	44.00	98.00	98.00	98.00	98.00	98.00	

Chart No. 2-17. Construction Progress — Project 331-58-F8
(PAC-FY-1958) Sheet 1 of 2.

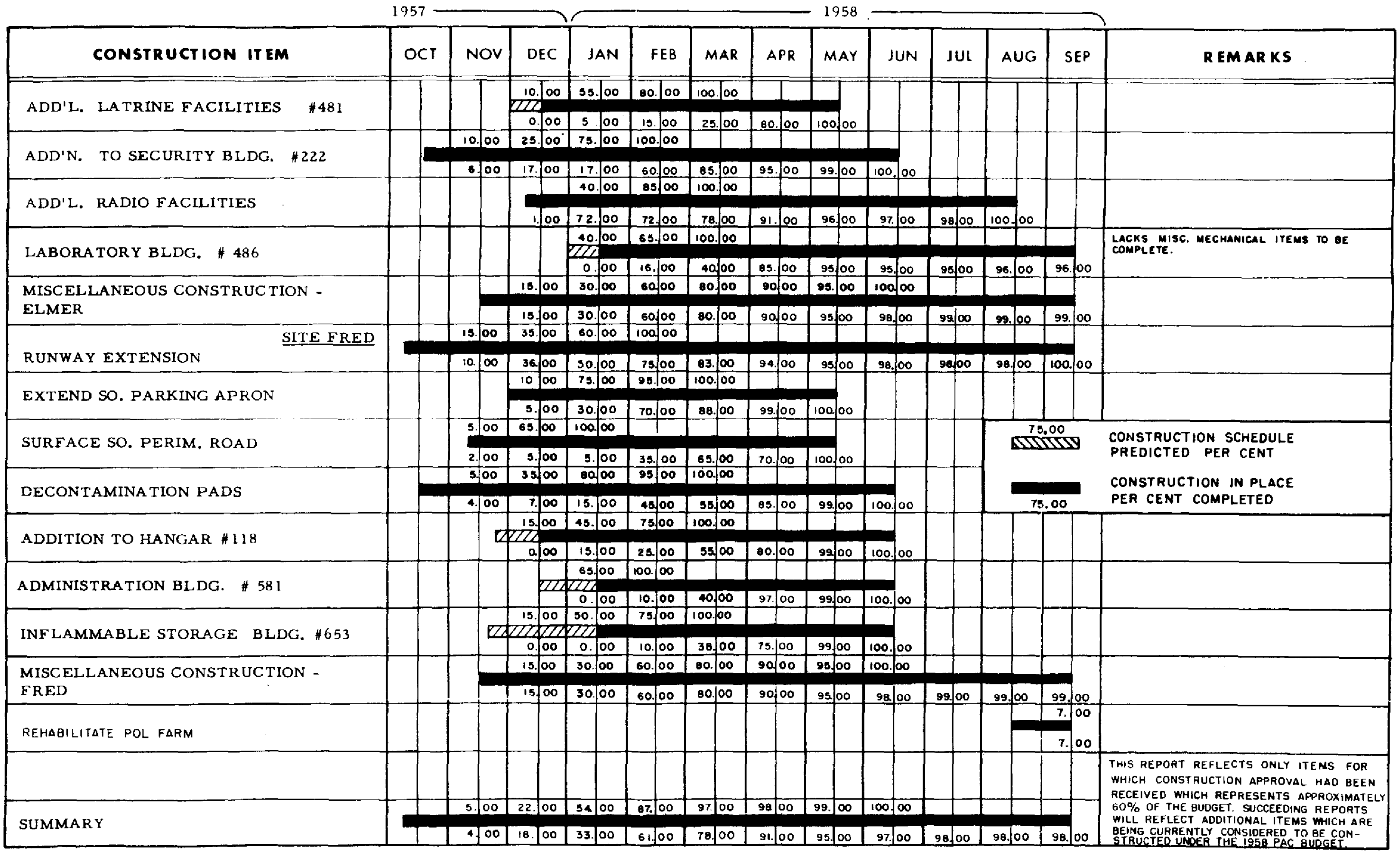


Chart No. 2-17-A. Construction Progress — Project 331-58-F8 (PAC-FY 1958) Sheet 2 of 2.

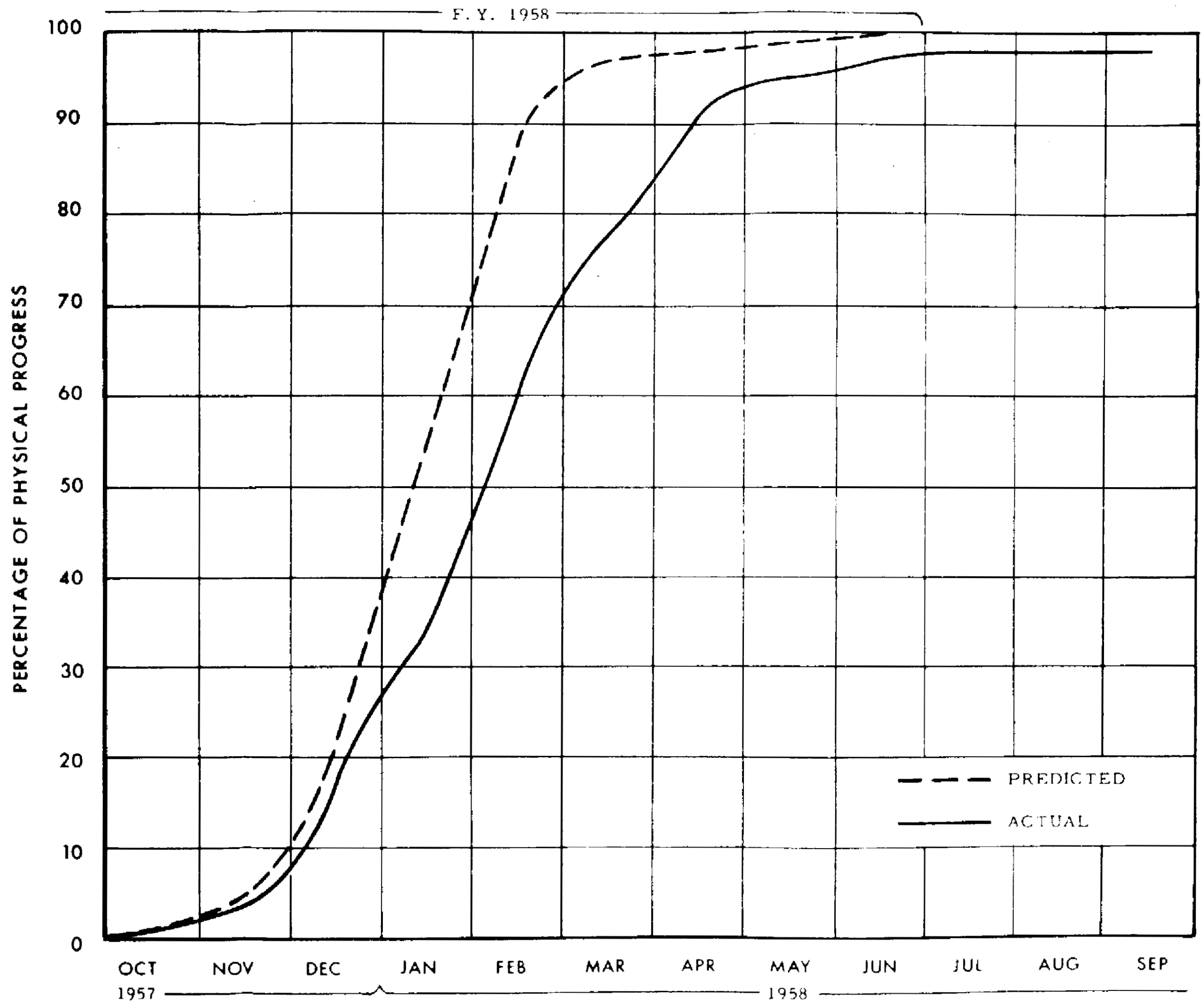
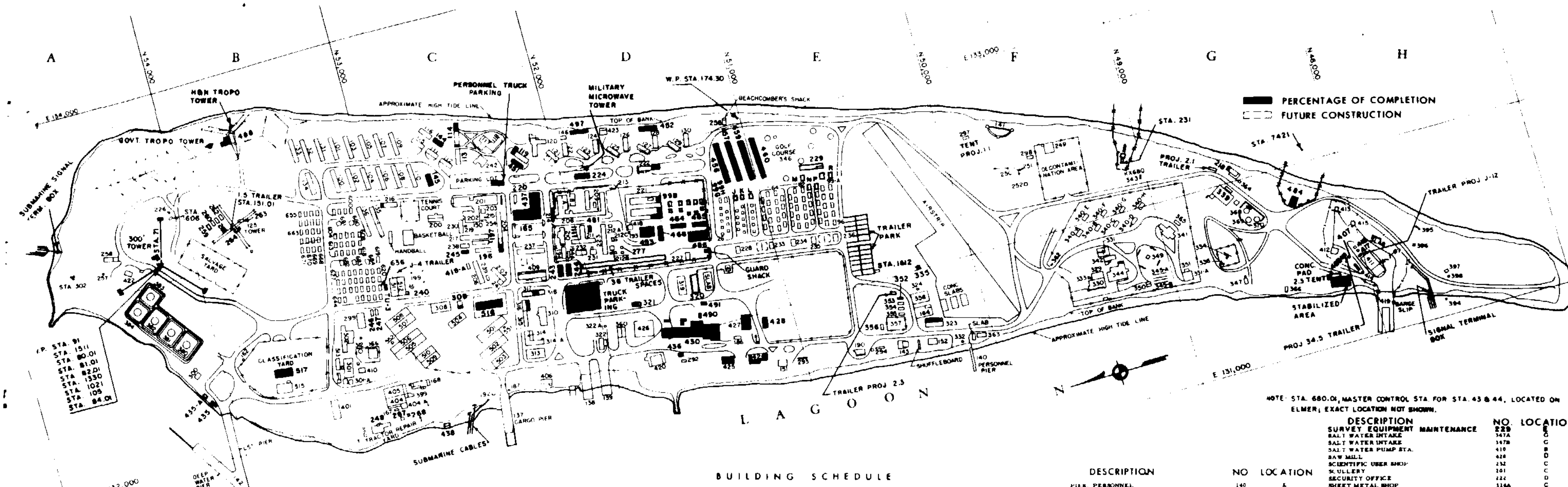


Chart 2-18. Total Budgeted Construction Program
Project 331-58-F8 (PAC-FY 1958).



NOTE: STA. 680.01, MASTER CONTROL STA. FOR STA. 43 & 44, LOCATED ON ELMER; EXACT LOCATION NOT SHOWN.

BUILDING SCHEDULE

DESCRIPTION	NO	LOCATION
AC BLDG., CMA	333	F
ACETYLENE STORAGE	258	A
AEC ADMINISTRATION	209	D
AEC MOTOR POOL DISP (DEMOLISHED)	189	
ANNOUNCERS BOOTH	251	F
	199	C
ASSEMBLY BUILDING	413	H
AIR OPERATIONS	164	E
BACKSTOP	250	F
BAKERY	202	C
BARGE SLIP, "U" SHAPE ASS'Y AREA	419	H
BASEBALL FIELD	199	C
BATTERY & TIRE SHOP	168	B
BEACH CLUB (RIVIERA)	190	E
BEACH CLUBS (LAGUNA - MIRAMAR)	151	D
	152	E
BIO-MED BUILDING	218	C
BOS'N'S LOCKER (DEMOLISHED)	174	C
BOILER HOUSE	203	C
BOILER HOUSE	268, 301-301A	B
BOILER HOUSE	303	B
BOILER HOUSE	513	B
BULK STORAGE WHSE. (ASSIGNED)	516	
BARRACKS, 18 MAN	144, 148, 481	C
BARRACKS, 2-STORY	456, 457, 459, 460	D & E
BULK STORAGE WAREHOUSE	516	C
CARPENTER SHOP	477	D
CALIBRATION FACILITIES	484	G
CHAPEL (DEMOLISHED)	175	C
	242	C
CHILL STORAGE	238	C
COMMISSARY	210	C
COMMISSARY OFFICE	219	C
COMMUNICATIONS CENTER	224	D
COMMUNICATIONS (INTERATOLL) (FORMERLY STA 81)	488	B
COMM-RADIO REPAIR SHOP	317 - 318	C
CONTROL TOWER	335	E
*BLACKSMITH SHOP	491	D

DESCRIPTION	NO	LOCATION
COUNTING & SAMPLING LAB	212A	D
COUNTING & SAMPLING LAB	212B	D
COUNTING & SAMPLING LAB	212C	D
CYLINDER RACKS	345A & F	F
CYLINDER SHELTERS	340A to H	F
CJTF 7 GUEST HOUSE	497	D
DAY ROOM & LIBRARY	216	C
DECON AREA	249	F
DECON BUILDING	243	E
DEEP WATER PIER	142	A
DENTIST OFFICE	118	C
DIESEL STORAGE (DEMOLISHED)	371-375	
DIESEL STORAGE	380	A
DIESEL STORAGE	381	A
DIESEL STORAGE	382	A
DIESEL STORAGE (TANK)	192	C
DISTILLATION PLANT	513	B
DISTILLATION MAINT. SHOP (ASSIGNED)	514	
DUKW REPAIR SHELTER	360	D
ELEC. OVERHAUL & STOR.	310	C
ELECTRICAL REPAIR SHOP	315	C
ELEVATED WATER STORAGE (FRESH)	220	C
ELEVATED WATER STORAGE (SALT)	349	F
ENG. EQUIP. STORAGE	226	A
	241	C
EQUIPMENT ROOM	194A	C
FIRE PROTECTION PUMP HOUSE	438	C
FIRE STA. & QUARTERS	205	C
FREIGHT CARGO PIER	137	C
FRESH WATER STORAGE	312	B
FRESH WATER STORAGE (DEMOLISHED)	326	
GENERATOR HOUSE	264	B
GALLEY	201	C
GARBAGE BUILDING	254	C
GARBAGE CAN BUILDING	150	C
GASOLINE STORAGE (ABANDONED)	376-379	
GREASE RACK (RAZED)	191	
GUEST HOUSE	452	D
GEAR LOFT	435-A	A

Figure 1. Site Elmer - Eniwetok Atoll

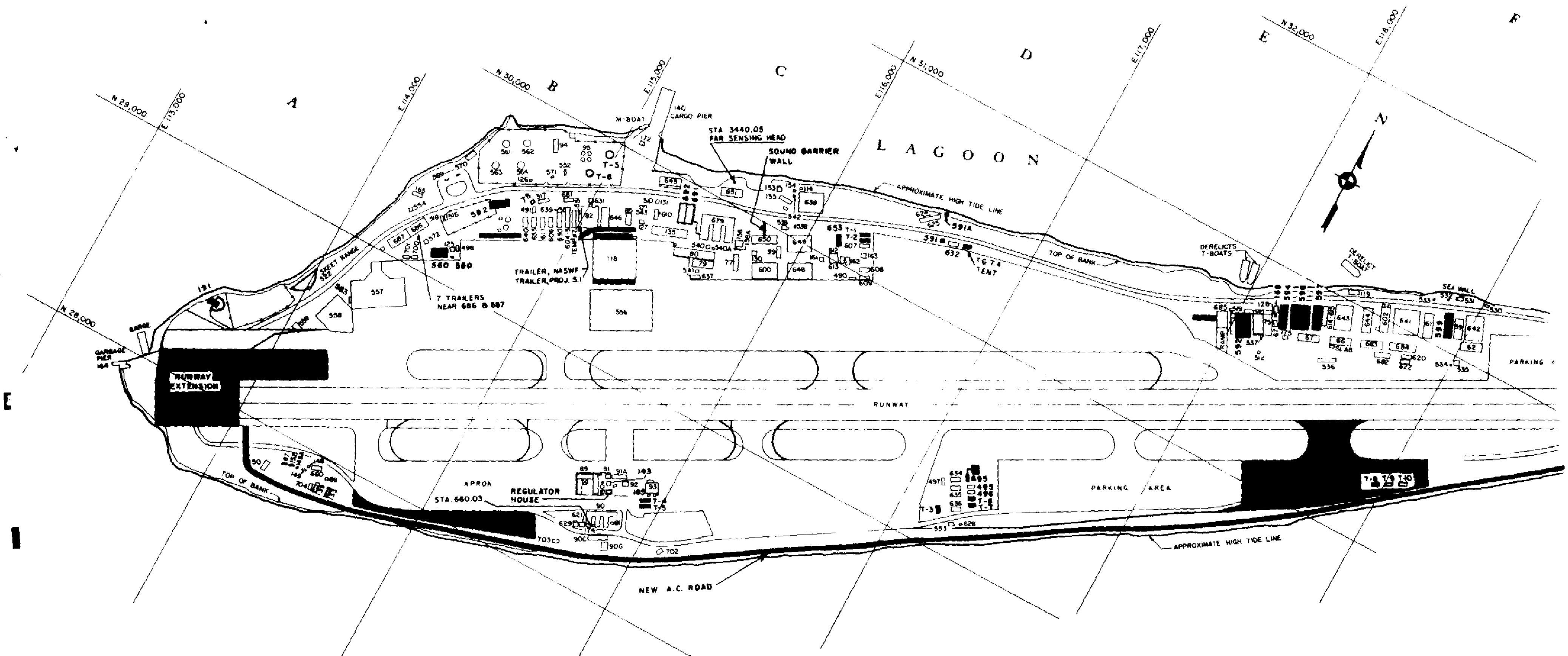
DESCRIPTION	NO.	LOCATION
GUARD & CONST. OFFICE (DEMOLISHED)	177	C
GUARDHOUSE, ASS'Y AREA	414	G
GUARD POST	213-214	D-C
GUARD POST	332	E
GUARD SHACK	408	
GUARD SHELTER (CMR)	362	F
GUARD TOWER	336	G
GYMNASIUM (DEMOLISHED)	179	C
GYMNASIUM	244	C
HEAVY EQUIP. RIGGING LOFT	321	D
HEAVY EQUIPMENT	188	
HEAVY EQUIPMENT MACHINE SHOP	405	B
HEAVY EQUIPMENT REPAIR (SLAB)	421	
HEAVY EQUIPMENT REPAIR SHOP	404	B
HEAVY EQUIPMENT SHOPS (ASSIGNED)	430	
H. E. RIGGERS LOFT	181	D
HIGH EXPLOSIVES BUILDING	412	G
HOBBY SHOP (DEMOLISHED)	176	C
HOBBY SHOP	243	C
H&N ADMINISTRATION	208, 437	C
H&N ADMINISTRATION	208A	C
H&N PERSONNEL	208B	D
I. B. M. BLDG.	455	D
INFIRMARY	117	C
INSTRUMENT LABORATORY	211	D
*IRON WORKERS SHED	199	B
LABORATORY	485	G
LABORATORY	486	D
LABORATORY	464, 465, 466	D
LABORATORY	223	D
LABORATORY	231	D
LABORATORY	329	F
LABORATORY	330	F
LABORATORY	344	F
LAB. MATERIAL TEST'G.	309	C
LANAI	120	C
LATRINE	165	C
LATRINE (BALL PARK)	240	C
LATRINE & SHOWERS	227-228	D
LATRINE & SHOWERS	233-236	E
LATRINE	461	D
*IRON WORKERS BLDG.	490	D

DESCRIPTION	NO	LOCATION
LATRINE (55-MAN)	436	D
LATRINE (MESS HALL)	215	C
LATRINE (100MAN)	680-684	B
LATRINE, WAREHOUSE AREA	551	C
LATRINE, WAREHOUSE AREA	552	B
LAUNDRY	307	B
LUBRICATION PIT	167	B
MARINE RIGGING LOFT	420	D
MACHINE SHOP	426	D
MAGAZINE	351 & 351A	G
MAGAZINE	413	G
MAGAZINE	415	G
MARINE INJECTOR SHOP (ASSIGNED)	325	
MARINE OPERATIONS	406	C
MARINE WELDING SHOP (ASSIGNED)	429	
MATERIALS TESTING LAB.	309	C
MESS HALL, 4 WINGS	201	C
MILL & SAW SHED	186	D
MILL & SAW SHED (ASSIGNED)	428	
MOGAS STORAGE	383	A
MOGAS STORAGE	384	A
MOTOR POOL AEC (DEMOLISHED)	189	
MOTOR POOL H&N	188	
M-BOAT RAMP	138	C
M-BOAT RAMP	139	C
M. P. GUARDS TENT	239	C
MARINE ENGINE REPAIR	322	C
NITROGEN STORAGE	257	A
NURSES QUARTERS & DENTIST	118	C
OXYGEN TABERNACLE	422	A
PAINT SHOP	424	D
PAINT SHOP & PARTS WAREHOUSE	401	B
PAINT STORAGE	425	D
PASS & BADGE OFFICE	222	D
PERSONNEL PIER	140	E
PHOTO LABORATORY	210	C
PIER, DEEP WATER	142	A
PIER, FREIGHT CARGO	137	C

DESCRIPTION	NO	LOCATION
PIER, PERSONNEL	140	E
PIER, GUARD SHELTER	187	C
PLUMBING & REFRIGERATION	144	C
PO, PX, & SNACK BAR	204	C
POL PUMP HOUSE	300	A
POWER PLANT	159	G
POWER & DISTILLATION PLANT	301 & 301A & 301B	B
PUMP HOUSE	162	B
QUARTERS, & LANAI	120	C
QUARTERS, 4 MAN (TENT)	51-56 55-99A	D
QUARTERS, 4 MAN (TENT)	990—R	D-E
QUARTERS, 18 MAN	111-114	C
QUARTERS, 18 MAN	115-116	C
QUARTERS, 18 MAN	119	C
QUARTERS, 18 MAN	121	C
QUARTERS, 4 MAN (TENT)	122-130	D
QUARTERS, 36 MAN	26-50	D
QUARTERS, 36 MAN	131-134	B
QUARTERS, 36 MAN	206	C
QUARTERS, 36 MAN	100-103	B
	104-110	C
QUARTERS, 48 MAN	135-136	B
QUARTERS, 48 MAN	680-684	B
QUARTERS, 36 MAN (ASSIGNED)	144	
QUARTERS, 8 MAN	400-471	B
QUARTERS, 8 MAN	146	B
QUARTERS, 36 MAN (ASSIGNED)	445	
RADIO REPAIR SHOP (DEMOLISHED)	180	C
RADSAFE BUILDING	323	E
RADSAFE HUTMENT	324	E
RECEIVING & CLASSIF. WHSE.	515	B
RECREATION BLDG.	237	C
REEFER	237	C
REEFER BANKS	196	C
REEFER BANKS	197	C
REFRIGERATION SHOP	316	C
REFRESHMENT BLDG.	409	C
REFRESHMENT STAND	252	F
RESERVOIR (4 SECTIONS)	366	B
RIGGING LOFT FOR STEVEDORES	438	A
SLABS	319, 320	D
SHIP RESUPPLY STORAGE	517	B
STORAGE BLDG. (VENTILATED)	245	C
SCIENTIFIC TENT	259-263	B
SCIENTIFIC TENT	407, 416, 417	B
" "	277	D

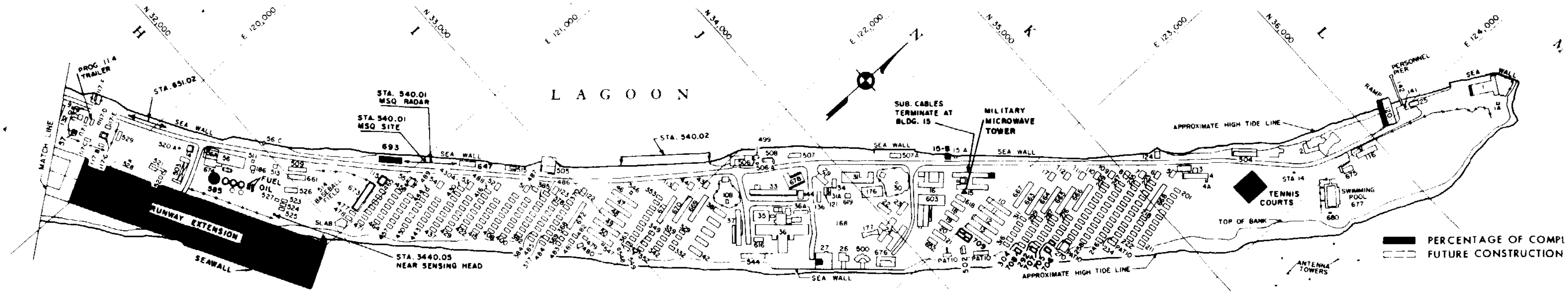
DESCRIPTION	NO.	LOCATION
SURVEY EQUIPMENT MAINTENANCE	229	E
SALT WATER INTAKE	347A	G
SALT WATER INTAKE	347B	G
SALT WATER PUMP STA.	419	H
SAW MILL	428	D
SCIENTIFIC USER SHOP	232	C
SCULLERY	161	C
SECURITY OFFICE	222	D
SHEET METAL SHOP	316A	C
SHELTER	331	G
SHELTER	334	G
SKEET RANGE	161	F
SHOP	342	F
SHOP & LABORATORY	418	H
SHOP AND STORAGE	341	G
SHOP WITH DEHUMID. RM.	194	C
STEAM CLEANING FOR MARINE REPAIR SHOP	322A	D
STOCK BUILDING	298	F
STORAGE BUILDING (CMR)	330	F
STORAGE (PROPOSED) (ASSIGNED)	265	
SUPPLY DIV. OFF. & WHSE.	313	C
TIMEKEEPING OFFICE	317	C
TANK (WATER)	220	C
TASK FORCE HQ	221	D
TRACTOR REPAIR YARD	248	B
*TELEVISION CENTER (ASSIGNED)	158	
*TEST SHELTER (ADMIN. COMP.)	191	D
THEATER, OPEN AIR	200	C
TIRE EQUIP. STORAGE (DEMOLISHED)	207	
TOWER	406	C
TYPEWRITER REPAIR SHOP	318	C
VEHICLE, TIRE & WELDING SHOP	430	D
VEHICLE CLEANING	267	B
WAREHOUSE	319	D
WAREHOUSE, AEC	511	B
WAREHOUSE, AEC	512	C
WAREHOUSE, BULK STORAGE (ASSIGNED)	516	
WAREHOUSE, CAMP SUPPLIES	507	B
WAREHOUSE, DRY STORES	504	C
WAREHOUSE, ELECTRICAL	501	C
WAREHOUSE, FOOD	508	C
WAREHOUSE, GENERAL STORES	500	C
WAREHOUSE, HEAVY DUTY PARTS	505	B
WAREHOUSE, PLUMBING	502	C
WAREHOUSE, PROPERTY	506	B
WAREHOUSE, REC. & CLASS.	515	B
WAREHOUSE, REF. MARINE & POWER	506	B
WAREHOUSE, SHIPPING	503	C
WAREHOUSE, TOOL CRIB & STA. LOCKER	510	C
WATER STORAGE - ELEVATED	220	C
WATER STORAGE, FRESH	312	B
WATER STORAGE, FRESH (DEMOLISHED)	326	
WOOD SHELTER	418-A	C
*TENT, AIRCRAFT MAINT. & STORAGE	352	E
TENT	356	E
"	246, 247	B

Figure No. 2-148. Site Elmer — Eniwetok Atoll.



FOR BUILDING SCHEDULE SEE SHEET 2

Figure No. 2-149. Site Fred — Eniwetok Atoll — Sheet 1 of 2.



BUILDING SCHEDULE

DESCRIPTION	NO	LOCATION
AACS EMERGENCY POWER	145	C
AACS UC STORAGE	150	B
AEC WAREHOUSE	640	B
AG OFFICE	618	K
AIR FORCE AUXILIARY POWER	138	C
AIR FORCE GYM	549	K
AIR FORCE MAIL ROOM	548	J
AIR FORCE PERSONAL GEAR STORAGE	637	C
AIR FORCE TASK GROUP HQ	90	C
AIR WEATHER SERVICE	607 - 609	D
AIRCRAFT DECONTAMINATION OFFICE	78	B
AIRCRAFT ENGINE BLDG. & STORAGE	646	C
AIRCRAFT MAINTENANCE SHOP (2)	82	
AIRCRAFT PARTS	633	B
ALERT CREW OFFICE	91	C
AMMO STORAGE	530	G
ATCOM RESIDENCE	26	K
ADMINISTRATION BLDG.	**582**	**B**
ARMY SEC. MONITORING U.	523 - 525	I
AVGAS FILL STAND	569 - 570	B
B-50 HANGAR	118	C
BAKERY	35	K
BARBER SHOP	547	J
BARRACKS, 48-MAN	663 - 668	L
BARRACKS, 48-MAN	669 - 670	K
BARRACKS, 48-MAN	671 - 672	J
BARRACKS, 48-MAN	673	I
BARRACKS, 40-MAN (ASSIGNED)	654, 658 & 659	
BARRACKS, 48-MAN (ASSIGNED)	662	
BASE OPERATIONS, TOWER, TERMINAL WHSE.	89	C
BASKETBALL COURT	176	K
BOATHOUSE	25	M
BOILER HOUSE	34	K
BOOSTER PUMP HOUSE	131	C
BULK STORAGE	80	C
CGA MAINT. TENT & SLAB	**696**	**E**
CG QUARTERS & STORAGE	675	M
CARGO PIER	140	C
CARPENTER SHOP	631	C
CHAPEL	678	K
COMMISSARY W/6 REEFERS	37	K
CONSOLIDATED SHOP	682 - 684	F
CRASH FIRE STATION & CREW QTRS.	685	E
CRASH TRUCK SHELTER	91A	C
DECONTAMINATION BLDG.-(PERSONNEL)	**560**	**B**
DECONTAMINATION PAD	557 - 558	B
DEPOT SUPPLY	614 - 615	F
DISPATCHER'S SHACK	14	I
DISPENSARY	24	K
DRONE HQ	77	C
DUFFY'S TAVERN	505	J
DECONTAMINATION BLDG.-(STORAGE)	**580**	**B**
EM RECREATION (NAVY)	1	M
ELECTRONIC CONTROL	79	C
ELECTRONICS & COMM. BLDG.	681	B
ELECTRONICS MAINTENANCE	604 - 605	B
ELEVATED WATER STORAGE	121	K
EMERGENCY POWER PLANT	90G	C
ENG. EQUIP. BLDG. & MAINT. SHOP	661	I
ENLISTED MEN'S CLUB	**693**	**I**
ENGR. MAINT. OFFICE	515	J
ENGINEER SUPPLY STORAGE	536	F
ENGINEERS PAINT SHOP	519	E
EQUIP. & STORAGE BLDG.	651	C
EQUIPMENT STORAGE	512	F
EXPLOSIVE STORAGE MAGAZINE	**191**	**A**
FIRE DEPT. STORAGE SHED	513	I
FIRE STATION	29	K
FRESH WATER TANK	572	B
FURNITURE REPAIR	509	I
GARBAGE RAMP	164	A
GEAR LOFT	61	F
GENERAL OFFICER QUARTERS	500	K
GENERATOR BLDG.	**158**	**K**
GENERATOR SHED	114	C
GREASE RACK	521	I
GROUP HQ	15	K
GUEST HOUSE	676	K
H&N INSPECTOR'S OFFICE	175	F
H&N MAINTENANCE OFFICE	169	F
H&N WAREHOUSE	75	F
HANDBALL COURT	177	K
HEAVY EQUIPMENT SHACKS	527	I
HOBBY SHOP	507A	K
HOSPITAL WARDS	22 - 23	K
HOT LOCKER BLDG.	546	J
HQ & HQ DETACHMENT	502	L
HYDROGEN GENERATING BLDG. (ASSIGNED)	145	
HYDROGEN STORAGE	87	B
ICE PLANT	144	K
INCINERATOR (ASSIGNED)	15A	K
INFLATION SHELTER	148	B
INFLAMMABLE STORAGE	**655**	**D**
JET DEFLECTOR PAD	559	B
JET WARM-UP PAD	556	C
L-13 MAINTENANCE	93	C
L-13 OPERATIONS	92	C
LABORATORY	57	H
LATRINE	1A	M
LATRINE	126	B
LATRINE	127, 130	C
LATRINE	128	F
LATRINE	149A	B
LATRINE	185	C
LATRINE (25-MAN)	628	E
LATRINE & DECONTAMINATION SHOWER	125	B
LATRINE & SHOWER	5 - 8	L
LATRINE & SHOWER (OPEN AIR)	9	H
LATRINE & SHOWERS	17	L
LATRINE & SHOWERS	43	K
LATRINE & SHOWERS	44	J
LATRINE & SHOWERS	51 - 55	I
LATRINE & SHOWERS	109 - 112	L
LATRINE & SHOWERS	113	J
LATRINE & SHOWERS	115	I
LATRINE & SHOWERS	122	J
LATRINE & SHOWERS	123	J
LAUNDRY	31	K
LATRINE	**591**	**D**
LAUNDRY WRAPPING PAPER STORAGE	31A	K
LINE MAINTENANCE	611	B
LIVING QUARTERS	499	K
LORAN	116	M
LIFT STATION	**591A**	**D**
M-BOAT RAMP	120	L
MP HEADQUARTERS	647	J
MAGAZINE	165	B
MESS HALL	36	K
MESS HALL STORAGE	616	K
MOGAS FILL STAND	571	B
MOTOR POOL OFFICE	529	H
MOTOR POOL REPAIR SHOP	503	J
MOTOR POOL SHOP OFFICE	520	I
NAVIGATION TOWER	154	C
NAVY BOAT SUPPLY	153	C
NAVY OPERATIONS	634 - 636	E
NCO CLUB	506	K
NRDL	117A to J	H
OFFICE	511	I
OFFICE	537	F
OFFICE	538	C
OFFICE & STORAGE	90C	C
OFFICERS BEACH CLUB	2	L
OFFICERS CLUB	27	K
OPERATIONS & ADMIN.	679	C
ORDNANCE INSPECTION	535	G
ORDNANCE MAINTENANCE	620	F
ORDNANCE WAREHOUSE	59	F
ORDNANCE WAREHOUSE	642	G
PAINT STORAGE	543	C
PARACHUTE DRYING TOWER & BOILER HOUSE	639	B
PARACHUTE REPACK BLDG.	630	B
PERSHING FIELD, PARADE GROUND	168	K
PERSONNEL PIER	142	L
PETROLEUM PRODUCTS SUPPLY	119	F
PHOTO LAB	610	C
PIER OFFICE	172	C
PO, PX & BARBER SHOP	16	K
POL OFFICE	517	B
POL PUMP HOUSE	94	B
POWER & DIST. PLANT	56	I
PUMP HOUSE	56C, 186	I
PUMP HOUSE	540	C
PUMP HOUSE (MOTOR POOL) (ASSIGNED)	501	
PUMP HOUSE (SWIMMING POOL)	680	M
PUMP HOUSE	**583**	**B**
PX WAREHOUSE	526	I
QM EXPENDABLE WAREHOUSE	67, 643	F
QM NON-EXPENDABLE WAREHOUSE	641	F
QM SALES	644	F
QM SALES & STORES	66	F
QUARTERS - 8-MAN TENT	201 - 316	L
QUARTERS - 8-MAN TENT	329 - 332	K
QUARTERS - 8-MAN TENT	339 - 342	K
QUARTERS - 8-MAN TENT	349 - 352	K
QUARTERS - 8-MAN TENT	353 - 363	J
QUARTERS - 8-MAN TENT	368 - 471	J
QUARTERS - 8-MAN TENT	477 - 478	I
QUARTERS - 8-MAN TENT	479 - 489	J
QUARTERS - 8-MAN TENT	490	D
QUARTERS - 8-MAN TENT	491	B
QUARTERS - 8-MAN TENT	495 - 497	E
QUARTERS - 8-MAN TENT	498	B
QUARTERS - 8-MAN TENT	700 - 701	B
QUARTERS - 8-MAN TENT	702	D
QUARTERS - 8-MAN TENT	703	C
QUARTERS - 8-MAN TENT	704	B
QUARTERS, 18-MAN	18 - 21	K
QUARTERS, 18-MAN BOQ	38 - 42	K
QUARTERS, 36-MAN	10	L
QUARTERS, 72-MAN	11 - 13	L
QUARTERS, 72-MAN	46 - 50	J
QUONSETS	**T-1 THRU T-10**	**C, D, E**
RADAR TOWER	621	C
RADIO STATION WXLE	652	K
RAWINSONDE	660	B
RECEIVER	4	L
RECEIVER	85	C
REEFER BANK	33	K
REEFER SHELTERS	36A, 506A	K
REEFER SHELTERS	544	K
RESERVOIR, WATER, 200,000 GAL.	**585**	**I**
SALT WATER PUMP STATION	124	L
SALVAGE WAREHOUSE	62	G
SAND BLAST PAD	554	B
SAND BLAST SHED	531 - 533	F
SENTRY POST	132	H
SERVICE STATION	520A	I
SHED	539, 541	C
SHOWER	149	B
SKEET RANGE	522	A
SLAB	135	C
SLAB	161	D
SLAB	507	K
SLAB	553	E
SLAB	622	F
SLAB	625	D
SMALL BOAT REPAIR	155	C
SPECIAL SERVICES	603	K
SPEC. SERVICES WAREHOUSE	619	K
SPEC. EQUIP. STOR. & MAINT. SHOP	**691, 692**	**C**
STORAGE	551	B
STORAGE	624	D
STORAGE, AVGAS	561, 563	B
STORAGE, AVGAS (100 OCT)	95	B
STORAGE, **JET FUEL**	**T-6**	B
STORAGE FOR 50 GAL. DRUMS	516, 518	B
STORAGE, JET FUEL	562, 564	B
STORAGE JP1 FUEL	96	B
STORAGE, **AVGAS**	**T-8**	B
STORAGE SHEDS	4A, 141	L
STORAGE SHEDS	152	B
STORAGE SHEDS	528	I
STORAGE SHEDS	542	C
STOREROOM	508	K
STORM DETECTION RADAR	629	C
SUPPLY	612 - 613	D
SUPPLY WAREHOUSE	638	C
SWIMMERS TAVERN	504	L
SWIMMING POOL	677	M
TC GEAR LOFT & SECURITY STORAGE	645	C
TG 7.1 ADMIN. BLDG.	687	B
TG 7.1 BLDG. (ASSIGNED)	688	
TG 7.1 LAB. BLDG.	686	B
TECH. SUPPLY & INSPECTION	606	B
TELEPHONE TERMINAL	510	C
TELEPHONE TERMINAL BLDG.	190	C
THEATER (OPEN AIR)	30, 108	K
TOOL SHED	552	B
TOWER	81	C
TRANSMITTER (POWER)	3	L
TENTS	**705 - 709**	**L**
UTILITY OPERATION	167	F
VEHICLE WASH STAND	158	C
VOLLEYBALL SLAB WITH TWO TENTS	**709**	**L**
WAREHOUSE	99	C
WAREHOUSE	162 - 163	D
WAREHOUSE	600	C
WAREHOUSE	602	F
WAREHOUSE (AF SUPPLY)	648	D
WAREHOUSE (AF SUPPLY)	649 - 650	C
WASH RACK UTILITY ROOM	158A	C
WATER TOWER	540A	C
WEATHER RADAR TOWER	174	C
WEATHER STATION	88	B
WEATHER STATION	133, 139	B
WELDING SHED	674	I
WOODS ATHLETIC FIELD	514	I
WRECEP PERSONAL EQUIPMENT (AF WHSE.)	632	D
WAREHOUSE, PX	**594**	**F**
WAREHOUSE, FOOD	**592**	**F**
WAREHOUSE, MISC. SUPPLIES	**597**	**F**
WAREHOUSE, ARMY ENGR. SUPPLY	**699**	**F**
WAREHOUSE, GENERAL SUPPLY	**598**	**F**

Figure No. 2-149-A. Site Fred — Eniwetok Atoll — Sheet 2 of 2.

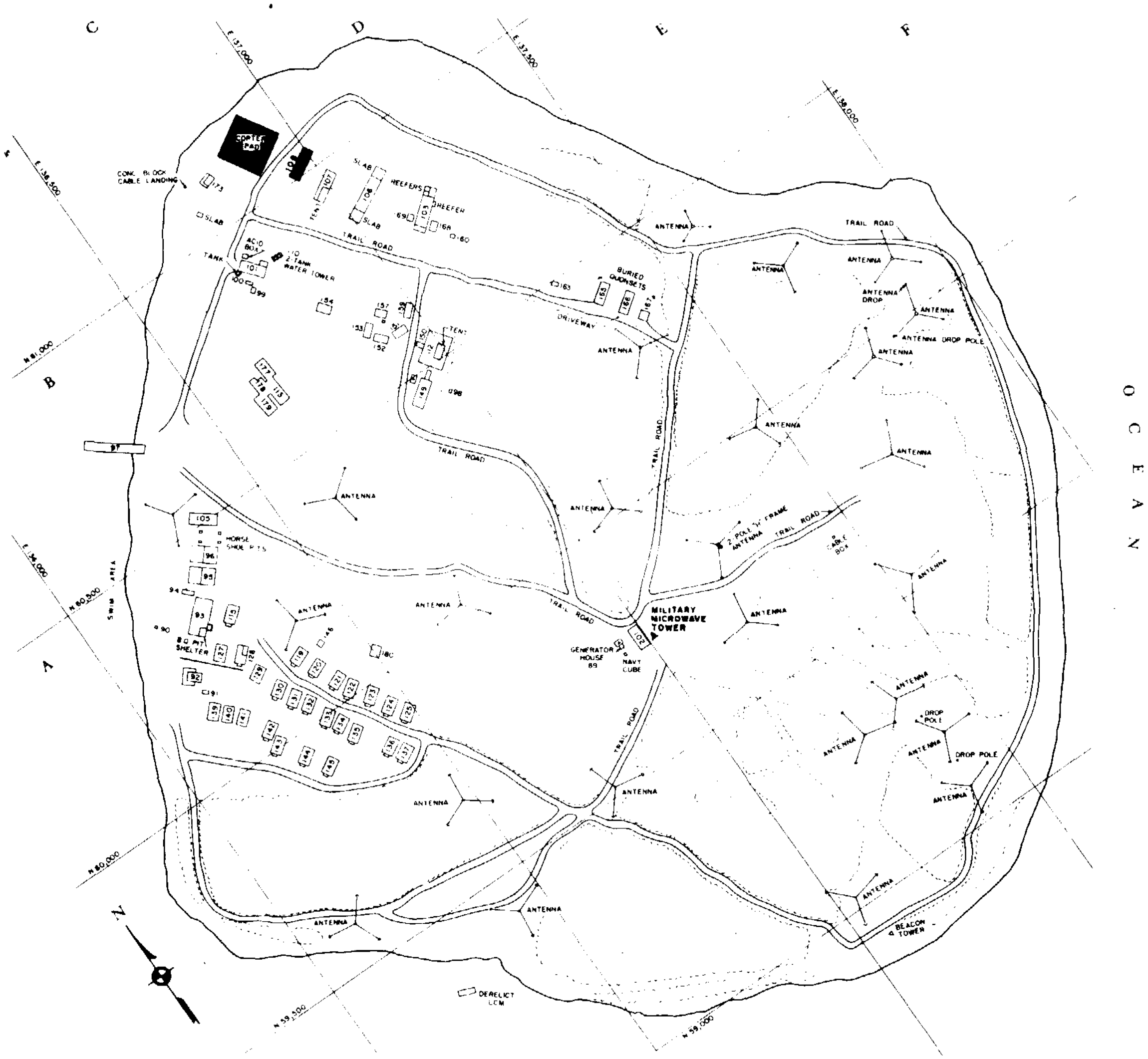


Figure No. 2-150. Site David — Eniwetok Atoll.

PERCENTAGE OF COMPLETION
FUTURE CONSTRUCTION

BUILDING SCHEDULE

DESCRIPTION	NO	LOCATION
ANIMAL HOUSE	115	B
ANIMAL HOUSE	119 - 125	B
ANIMAL HOUSE	127 - 137	B
ANIMAL HOUSE	139 - 145	B
ANIMAL HOUSING & STORAGE	149	C
BAR-B-Q SHELTER	92	B
BEACH & BAR-B-Q SHELTER	93	B
DOCK	97	B
EMERGENCY GENERATOR SHED	180	C
FUEL TANK (HORIZONTAL)	100	C
GENERATOR HOUSE	89	C
GREASE SHED	99	C
JOINT RECEIVER STATION	102	C
LATRINE	91, 94	B
LIFE GUARD TOWER	90	B
MESS HALL	103	D
POWDER MAGAZINE	165 - 167	D
POWER & DISTILLATION	101	C
PUMP HOUSE	173	C
QUARTERS, 24 MAN	106	D
SHACK (12' X 10') ON SLAB	107	C
SHED	146	B
SHED	157	C
SLAB	105	B
SLAB	112, 113	C
SLAB	150 - 154	C
SLAB	159	C
SLAB	163	D
SLAB	168, 169	D
SLAB	177 - 179	C
SLAB & 2 WALLS	160	D
TENT FRAMES	**108**	**C**
VOLLEY BALL COURT	95, 96	B
WATER TOWER (30') AND 2 - 4200 GAL. TANKS	110	C
WIRE CAGE	98	C

SECTION 6
COMMUNICATIONS

GENERAL.

Prior to Operation HARDTACK, communications facilities, with the exception of certain DOD systems, were handled by H&N and other Contractors; a considerable portion of the equipment was leased for each Operation. Severe coordination and orientation problems existed under this arrangement. To achieve increased efficiency and improved operational results at reduced cost, AEC adopted a policy of establishing permanent communications facilities and assigning the responsibility for all aspects of the systems to a single Contractor. H&N was designated as Contractor to assume responsibility for all aspects of the TG 7.5 Communications System covering the following:

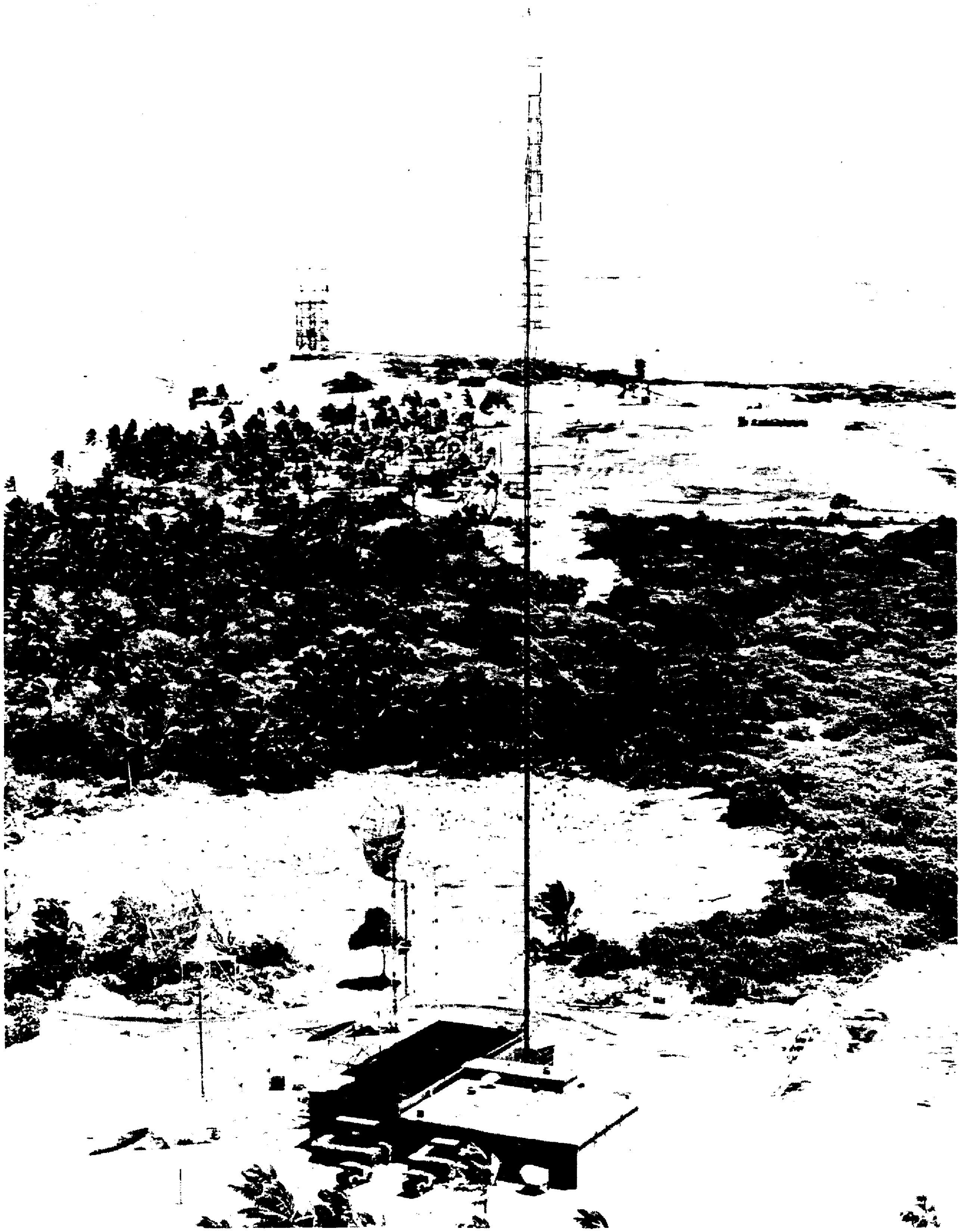
1. Evaluation of AEC directives and User requirements in terms of facilities and systems.
2. Engineering design and preparation of specifications and plans.
3. Equipment procurement.
4. Installation and maintenance.
5. Operation of the systems.
6. Technical assistance to Scientific and Military groups, as required.

New major facilities, together with a general expansion of existing wire and radio installations within EPG, materially increased the Contractor's communications responsibilities for Operation HARDTACK. The inter-atoll Tropospheric Scatter System, three automatic dial telephone exchanges, and the scientific VHF FM networks were commissioned for this Operation. The scope of the Contractor's responsibilities included the engineering, installation, and operation of all radio and telephone communications services for land areas within the Proving Ground, with the exception of the military-operated communications plants on Sites Fred and David. The Contractor was also responsible for the ship-to-shore UHF facilities integrating the USS BOXER, the USS AINSWORTH, and the various smaller naval vessels into the general EPG telephone system. The inter-atoll Tropospheric Scatter System connected the telephone systems at each atoll. The DOD scientific nets, the TG 7.5 boat pool nets, the TG 7.5 air dispatch nets, and the Contractor's guard department net were all installed and maintained by the Contractor, using equipment furnished by the military services.

Radio interference detection was a new responsibility during this Operation. Teams were maintained at Eniwetok, Bikini, and Johnston Island. Recreation facilities, such as the television station, the motion picture theaters, and the TG 7.5 amateur radio stations, were operated and maintained by the Contractor. Communications circuits to Honolulu and Kwajalein were maintained by the Military, but traffic over these circuits was controlled by the Contractor's telephone operators. All TG 7.1 and TG 7.5 teletype traffic within EPG, or between the EPG and Honolulu and Continental U.S., was sent and received by the Contractor-operated Communication Centers. Technical assistance in the repair and fabrication of electronic devices and communications equipment was furnished the Scientific and Military groups.

A Communications Engineering Project Group was formed in the Los Angeles Engineering Office and staffed with engineering specialists in both radio and telephone. This group was responsible for general project coordination and engineering direction. Among the many functions performed were (a) liaison with AEC Communications Representatives and Users; (b) preparation and issuance of detailed plans and specifications for components and systems; (c) provision of technical guidance and recommendations to procurement groups; (d) preparation of test procedures for field installation; and (e) field surveys and tests.

A Communications Division was created at Jobsite on 2 September 1957. An intensive recruiting effort was made to secure skilled personnel to augment the interim period cadre of radio and telephone electricians and telephone and teletype operators. Staffing was scheduled on the basis of equipment and circuit operational deadlines, with Division strength at its peak of 122 personnel on 5 April 1958, during the closing phase of the build-up period. On 5 July, with the operational phase approximately 75% complete, the Division staff had been reduced to 99 men. The Division was divided into two Departments: Installation-Maintenance and Operations. The Installation-Maintenance Department included radio stations, radio shops, and telephone shops at Elmer and Nan; in addition, a teletype shop and a dial exchange maintenance section were located at Elmer. The Operations



(Neg. No. W-934-11)

Figure No. 2-151. Building 204 and 300-Foot Tower — Nan.

Department included telephone and teletype sections at each atoll, plus a directory section and a television section at Elmer. While the communications responsibilities increased several fold during HARDTACK, it was necessary to increase communications personnel requirements only 22% over REDWING.

TROPOSPHERIC SCATTER SYSTEM.

Early in 1957 the planned scope of Operation HARDTACK indicated the need for a new Communications System between Bikini and Eniwetok Atolls. It was essential that the system carry with utmost reliability a large number of radio telephone, teletype, and data channels plus a wide frequency band voice cryptographic system in the process of development by the National Security Agency.

As a result of the efforts of the AEC Communications Engineer and the JTF-7 Communications Section, a 72-channel Tropospheric Scatter System, excess to military requirements, was located. The Air Force experimental system, engineered by Lincoln Laboratories, Massachusetts Institute of Technology, was in operation between North Truro, Massachusetts, and Stewart AFB, Newburgh, New York. A survey was conducted in May 1957 by the Contractor's engineers, and it was determined that the system would meet the requirements at EPG. The system was dismantled and crated under the Contractor's direction and was airlifted to EPG in six C-124 aircraft. The equipment was placed in dehumidified storage to await the completion of the addition to Building 488 at Elmer and the new Communications Building, No. 204, at Nan. Installation of the system paralleled building construction at both sites. The Tropospheric Scatter System was placed in full operation on 8 March 1958.

Two-way service between Elmer and Nan included 10 dial trunks and 6 ring-down trunks for general telephone service, 10 hot-line intercom channels, three teletype channels, one IBM data circuit, and two voice cyphony channels. The dial trunk installation made it possible to dial the Nan operator from any Eniwetok Atoll telephone and allowed the Nan operator to dial any number in the Eniwetok Atoll. Voice quality on both the general service channels and the cyphony channels was comparable to commercial land-line telephone standards.

(Neg. No. W-V-341-3)

Figure No. 2-152. Building 488 and Tropospheric Scatter Antennas — Elmer.

Each of two 10-kilowatt transmitters in combination with 37-decibel-gain parabolic antennas operating at 900 megacycles produced an effective radiated power of approximately 30 megawatts. In addition, the antenna system was designed to provide quadruple diversity reception. The random and uncorrelated received signals were combined resulting in a noise-free signal. Thus reliability of this system was based essentially upon the primary power source. A block diagram of one terminal end of the Tropospheric Scatter System is included as Chart 2-19. During each test detonation, the signal from each receiver at Elmer and from an individual receiver at Nan was recorded. Neither a momentary nor an extended effect to path propagation was noted.

VHF FM COMMERCIAL NETWORKS.

The 164- to 174-megacycle commercial equipment serving TG 7.1 and TG 7.5 consisted of five repeatered networks and two simplex networks at Bikini Atoll and three repeatered nets and three simplex nets at Eniwetok Atoll. Each network consisted of from 5 to 51 individual stations. Stations in the field included 20-watt transceivers, 20-watt mobile units, 60-watt shipboard units, and 5-watt pack sets. Remote units, controlling a common 20-watt transceiver, were used in areas where several fixed stations, close to one another, operated on the same network. Antenna installation and equipment costs were considerably reduced using this method with no degradation of service. Moreover, this arrangement reduced the possibility of radio interference.

Stations were located in administrative offices, Scientific Stations, shot barges, vehicles, and naval vessels. The 60-watt base stations were located at Buildings 204 on Nan, with antennas placed at the top of a 300-foot tower, and at REDWING Station 1518 on Elmer, with the antennas located on top of the 125-foot tower. Base station antenna systems consisted of high-gain, paired corner reflectors. In each pair, one antenna covered the atoll area and the other the ship area. On the repeatered networks an antenna multi-coupler was used with a single receiving antenna pair to feed all receivers. Individual pairs of antennas were used for each repeater net transmitter and for simplex network.

Because of the basic line-of-sight limitation on VHF communications, repeatered operation was adopted to extend coverage of the larger networks and to permit intercommunications between widely scattered units in the field. At Bikini, with the advantage of a 300-foot antenna tower, it was possible for the repeater station to receive and retransmit a pack set signal from any point in the atoll. At Eniwetok, due to the reduced 135-foot height of the repeater antennas, it was necessary either to increase the height of the more remote station antennas (beyond Janet), or to provide the distant field units with a high-gain antenna with some sacrifice of mobility. Charts 2-21 and 2-22 are included to show predicted field strength contours of the Eniwetok and Bikini VHF repeatered transmitters respectively. The contours are chosen to coincide with the expected field strength in the direction of maximum antenna gain at the horizon. The distance to the horizon is contingent upon the repeater's effective antenna height.

Installation was hampered by the late arrival of equipment as a result of delayed release of funds. Also, a high percentage of the equipment was defective upon arrival as the result of factory deficiencies subsequently corrected. However, the defects were rectified, and all networks were commissioned as required and operation was satisfactory. Considerable maintenance was required to keep the units in operation. No interference was experienced between the Contractor-installed networks and those installed by Edgerton, Germeshausen & Grier, working near each other and in an adjacent band. At the start of the Operation, interference was experienced on the Bikini system between individual H&N-installed nets. By the use of cavity resonators installed on the receiver inputs and by physical separation of the base station units, the interference was eliminated.

Traffic studies were conducted during the operational period to determine the use factor of the various networks. Traffic was concentrated on a few of the circuits, with most of the circuits having very low usage. A study of parallel radio and telephone installations was made. At Eniwetok only one out of 69 fixed stations did not have an EPG system telephone. At Bikini 22 out of 88 fixed stations did not have parallel telephone service.

VHF FM MILITARY NETWORKS.

The DOD Task Unit of TG 7.1 used FM military equipment operating in the 38- to 54-megacycle band. At the peak of the DOD participation during the WAHOO and UMBRELLA events, 59 VRC-18 transceivers were in operatior in a constantly changing system of radio nets. Although repeater operation had been provided for in case of coverage difficulties, it was possible to operate all networks simplex successfully. Coverage and reliability were very satisfactory, particularly on the water shots where field units operated under adverse conditions. Few interference incidents were experienced.

The major difficulties encountered in the installation and maintenance of these nets were the late receipt of requirements and frequent changes in criteria. In one case, it was necessary to make 14 shipboard and land installations

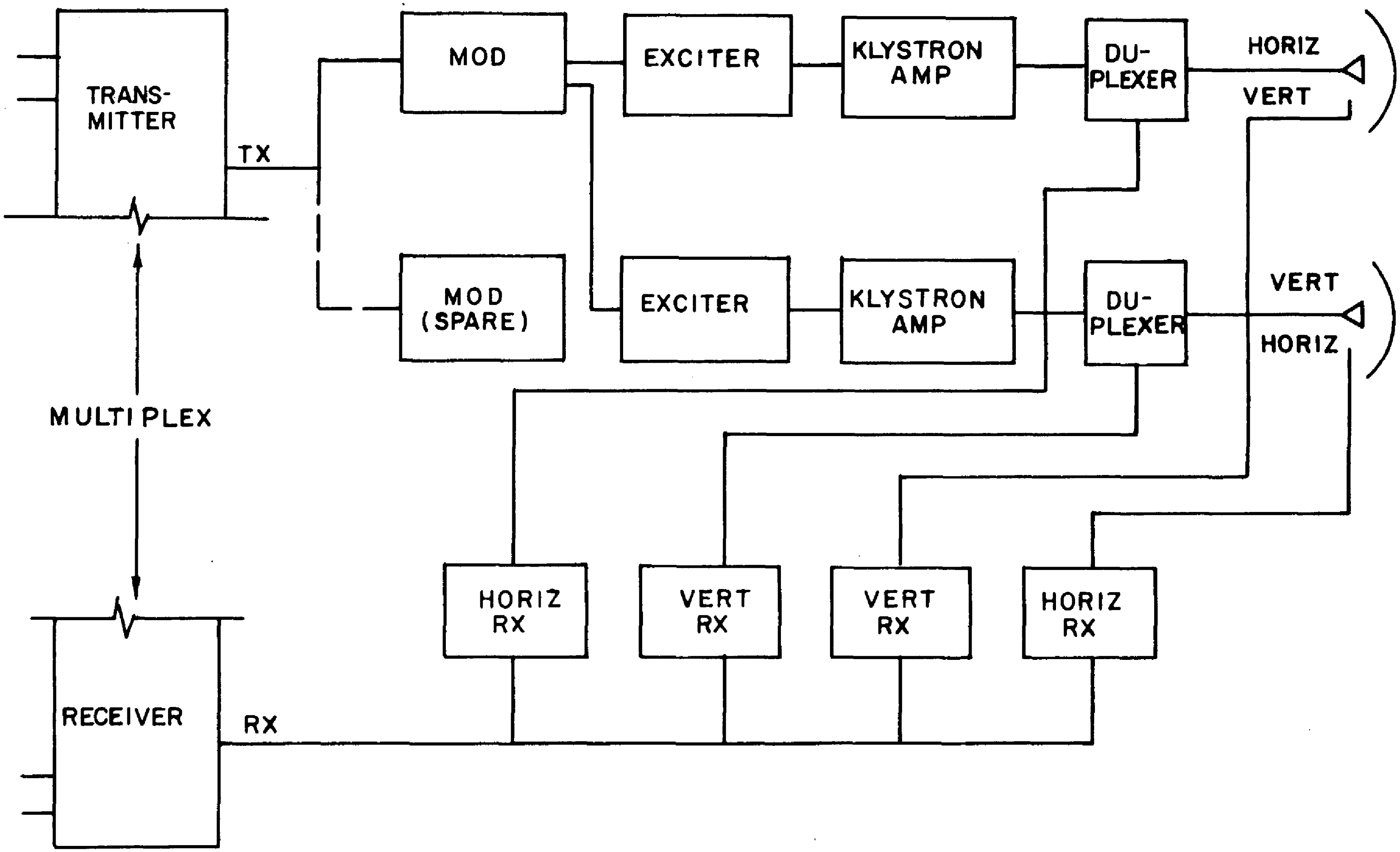
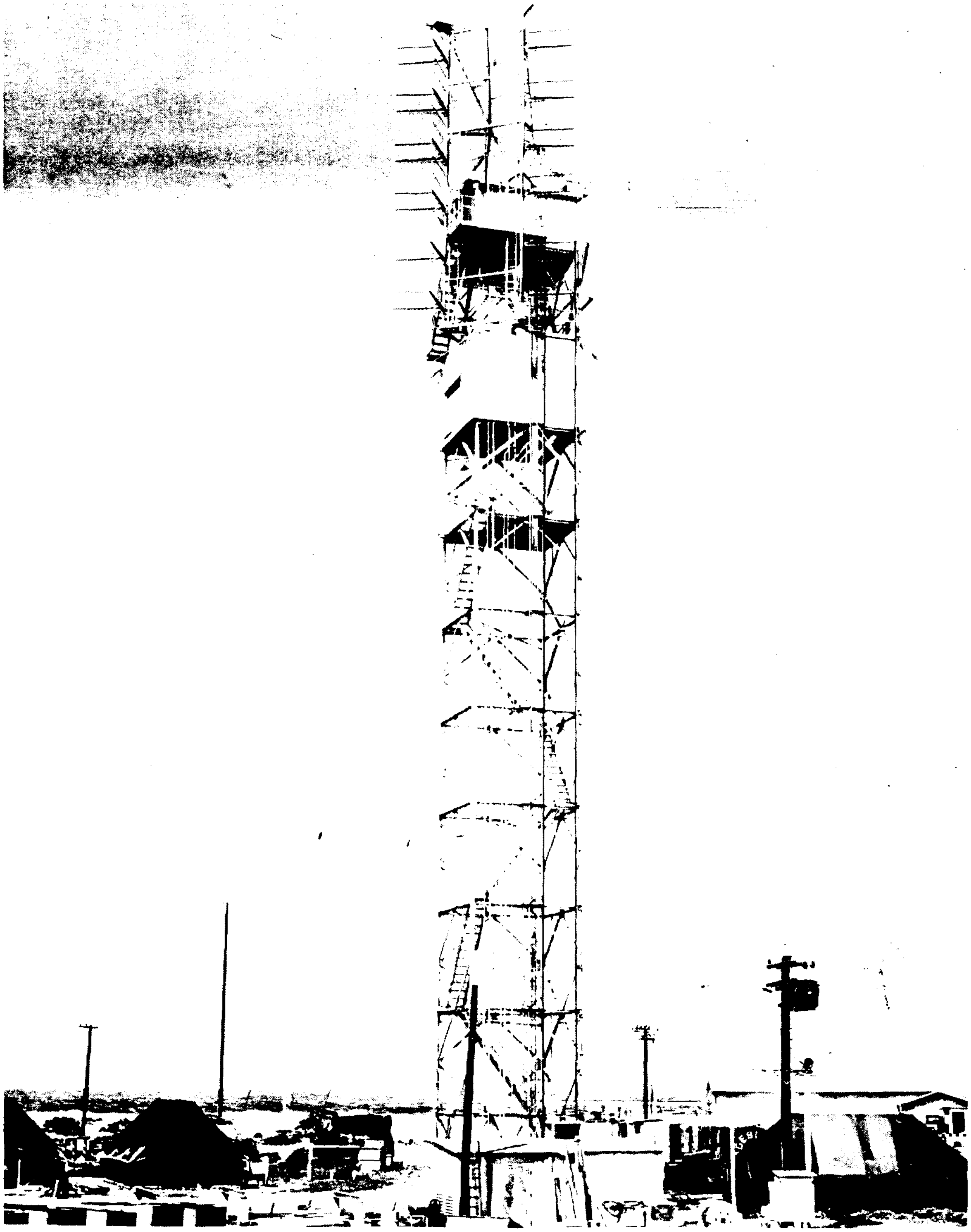


Chart No. 2-19. Tropospheric Scatter Block Diagram.



(Neg. No. W-V-341-1)

Figure No. 2-153. VHF FM Commercial Equipment Repeater Station — Elmer.

(Neg. No. W-935-5)

Figure No. 2-154. Tropospheric Scatter Receivers, Modulator, Drivers, and Monitor Rack, Building 204 — Nan.

within three days of an event. This disrupted radio shop schedules and required considerable overtime. A breakdown of equipment allocation was as follows:

VHF FM NETWORKS — MILITARY EQUIPMENT INSTALLED

ENIWETOK	VRC-18	VRC-7
DOD Networks	42	
Marine Net	37	30
Air Dispatch	3	
Guard Net	2	
BIKINI		
DOD Networks	17	
Marine Net	26	14
Air Dispatch	4	
Totals	131	44

TG 7.5 VHF FM NETWORKS.

Seven VRC-18 marine dispatch stations were in operation during HARDTACK, located at Elmer, Janet, Yvonne, Nan, Oboe, How, and Johnston Island. Fifty-seven marine craft used the same equipment on the marine nets at Bikini and Eniwetok. Forty-four VRC-7 sets were used in the DUKW marine craft operating on the same net. Seven VRC-18 air dispatch stations were in operation connecting the off-island Air Dispatchers to the Chief Dispatchers at Elmer and Nan. A two-station net provided communications between the guard office and the guard jeep. Some interference was experienced with Japanese fishing boats and on-continent stations during the build-up, but a frequency change corrected this situation.

UHF SHIP-SHORE CIRCUITS.

Radio telephone service to the USS AINSWORTH, the USS BOXER, and the BOXER'S replacement, the USS BENNER, was provided by 300-megacycle multi-channel circuits between the ships and Building 204 on Nan and Building 488 on Elmer. Also, a two-channel cyphony link to the BOXER was maintained using additional AN/TRC-24 equipment. The Bikini shore station used three element high gain, corner reflectors located on the 300-foot tower at Nan and beamed on the evacuation rendezvous area. Coverage was excellent to the maximum 45 miles required. By the use of station patch panels, ship's circuits were patched through the inter-atoll tropo system to Eniwetok during the evacuation periods. At Elmer a similar installation was made, excluding the cyphony circuit. Corner reflectors located on the 125-foot tower provided full coverage to the lagoon and the WAHOO operational areas. Charts 2-23 and 2-24 show predicted field strength contours of this system for the ship-to-shore service at the Eniwetok and Bikini Atolls respectively. Again, the contours are based upon the expected field strength at the horizon in the direction of maximum antenna gain. The equipment used proved to be very reliable in operation.

HIGH FREQUENCY CIRCUITS.

During the Weather and Rad-safety Station construction effort contact was maintained with construction parties and the supply ships by the use of a high frequency net. Daily voice contact was maintained with all stations ranging as far as Nauru. This circuit continued to be used to contact the ALOTO after her arrival. Vertical radiators and ET-10 transmitters were added at Elmer and Nan. In addition to providing communications to the ship, the HF channels were used for unattended monitor service of the Bikini radio installation during the interim period.

TELEVISION STATION.

WXLE-TV, an Armed Forces Television Station, was operated and maintained by H&N personnel. The facility consisted of a combined studio and transmitter station in Building 488 on Elmer and a laboratory in Building 330, where film was stored and processed for showing and shipment. The station operated from 1730 to 2255 hours daily and from 1330 to 2255 hours on Sundays and holidays. Coverage of the Fred-Elmer-David area was excellent, with very good voice and video quality. Television sets were supplied to recreation halls and day rooms. Program material consisted of taped commercial network shows and sports events. During the interim period, local productions included a weekly Chaplain's Hour and an occasional Hawaiian musical group. During the operational period, local features were limited to a daily news summary and a five-minute stock market report each evening. With the arrival of a TG 7.3 trailer packaged TV installation at Nan, WXLE-TV was given permission by AFRTS to loan the regular film shipments to the Bikini facility.

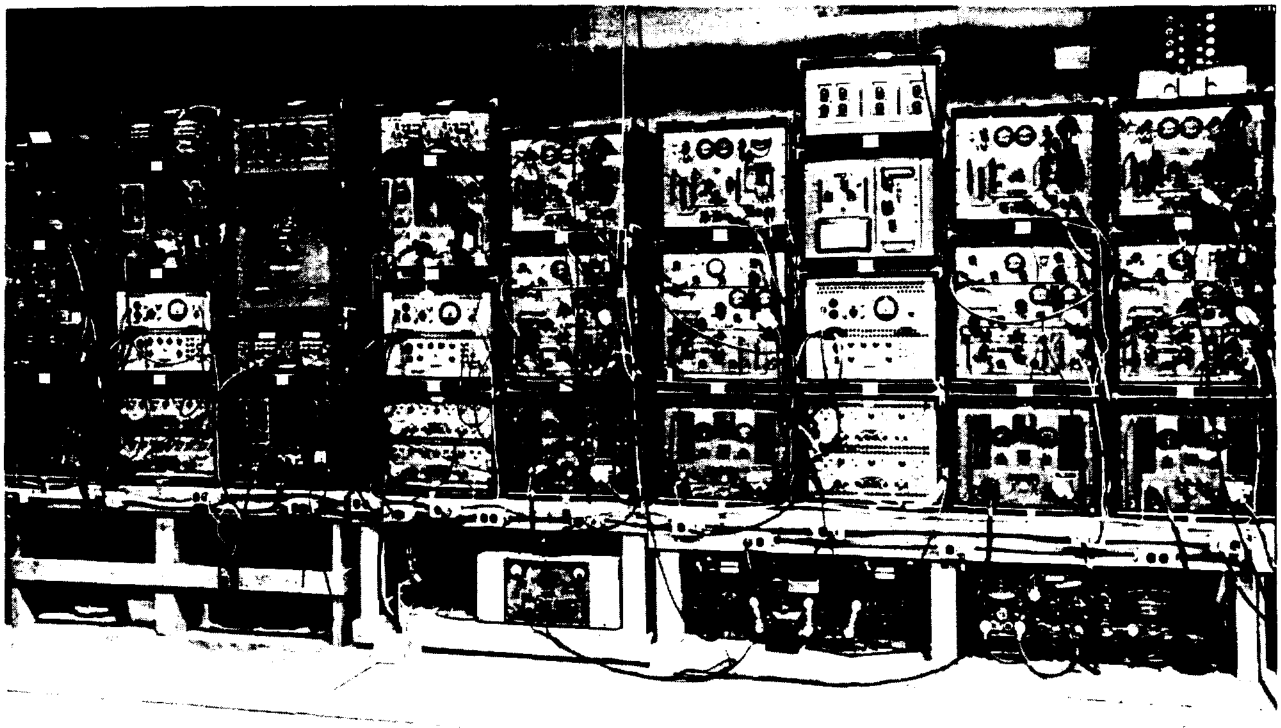
INTERFERENCE DETECTION SERVICE.

Since a considerable portion of the scientific diagnostic data was obtained by Sandia through the use of microwave telemetry, it was of prime importance to protect these channels from interference by radars and other radio signals. At Elmer a Military-furnished interference measuring and locating set was installed in the REDWING Station 1518 tower. This installation protected Sandia circuits on the adjacent 300-foot observation tower. A similar installation was made at Building 204 on Nan which was later transferred to Johnston Island. Portable equipment covering 0 to 300 megacycles was operated at both atolls to locate radio interference to any radio facility reporting difficulties. The interference detection team identified the offending signal, pinpointed its location, and advised JTF-7 of regulatory action. Considerable difficulty was experienced at first in bringing the older type Military-furnished equipment up to satisfactory operating standards. The equipment used for the microwave protection during HARDTACK lacked the sensitivity and operating efficiency of later model equipment.

TELEPHONE.

During the interim period and build-up phase for Operation HARDTACK, the same telephone equipment that had been in use during the two previous Operations remained in service. A three-position manual PBX and a single toll-board were in use at Elmer. This equipment was obsolete and in poor condition. For the operational phase of HARDTACK, a dial exchange was installed at Elmer to serve the anticipated increased traffic load. It is felt that more room for the telephone operators, including a relief operator's lounge, would have resulted in a more efficient telephone program and a greater degree of morale among the operators.

At Janet a one-position manual PBX was placed in service coincidental with the opening of the camp. A similar installation was made at Yvonne for that camp. Components of the 700-line dial exchange for Elmer and the three 70-line dial sub-exchanges for the off-islands began arriving in late November. The Elmer dial exchange was installed in the newly constructed Building 224, and was cut over to dial operation on 1 February 1958. Yvonne was converted to dial operation on 24 February 1958, and Janet became the final link in an integrated dial system for Eniwetok on 6 April 1958. There were 30 inter-office dial trunks between the main exchange on Elmer and the Military-operated dial exchange on Fred. Also, 10 automatic dial trunks and 6 operator-controlled ring-down trunks functioned through the inter-atoll Tropospheric System to Nan. Initially, there were 8 inter-office trunks between the Elmer exchange and both Janet and Yvonne. It became necessary



(Neg. No. W-955-10)

Figure No. 2-155. UHF Ship-Shore Units, Building 204 — Nan.

(Neg. No. W-938-2)

Figure No. 2-156. Main Equipment Room, Building 204 — Nan.

(Neg. No. W-V-340-8)

Figure No. 2-157. Dial Exchange, Building 224 — Elmer.

to disconnect six trunks to each of these sites in order to free cable pairs to meet User requirements. These changes caused numerous "All Trunks Busy" conditions, as the remaining two trunks could not handle the traffic load.

In many of the Scientific Stations and on all shot barges, the Users required a dial line to the nearest local exchange and a dial or magneto ring-down line into the Elmer exchange as an emergency back-up. This duplication of services resulted in the trunk disconnection from the sub-exchanges. Transmission was satisfactory throughout the atoll, with the exception of service to Janet, where voice levels were weak due to the excessive cable attenuation.

Very little trouble was experienced with the Stromberg-Carlson XY automatic dialing equipment located on Elmer, Yvonne and Janet; however, routine trouble was caused by dust from the cement floors of these exchanges. This was eliminated with the installation of floor tile during the middle of the Operation. The Yvonne and Janet exchanges experienced heavy overpressures but remained in operation without interruption or damage.

A late requirement of JTF-7 for the construction of a Command Post in Building 221 had a one-week deadline. The schedule was met, and the communications system was ready at the completion of the construction. A one-position PBX, previously located at Janet, was used to meet the requirements. Fifteen miscellaneous circuits were terminated at this PBX for service to specially lighted fixed and plug-in telephones.

The telephone system at the Bikini Atoll consisted of a two-position, manual, 140-line PBX at Nan and single-position 39-line PBX's at Oboe and How. Another 39-line board was added to the How installation in March 1958 during the ABMA build-up. The switchboards at How were removed when the site was rolled up in April 1958. Telephone service at Bikini Atoll was satisfactory during the major portion of the build-up and early operational periods but became inadequate in late March and early April at the peak of the test activity. The size of the Nan PBX was the limiting factor of the system. In addition, the equipment was in poor condition, and the operating room in Building 14 was too small to permit efficient operation.

Peg count meters, used to accumulate telephone traffic data, were not received until mid-May 1958. Although the peak traffic for this Operation was probably one month earlier, enough information has been compiled since May to evaluate the telephone system in relation to this and future Operations. The maximum number of calls per week occurred during the week ending 2 June, with 87,925 calls, or approximately 12,560 calls per day.

Studies indicated that there was sufficient dial equipment at Elmer to provide a grade of service exceeding commercial standards, even though requirements increased as much as 50%. As noted previously, studies indicated a shortage of cable pairs to Yvonne and Janet. Although the Elmer office had a capability of 686 lines, the maximum number used was 582, leaving approximately 20% of the exchange lines unused during Operation HARDTACK. There were practically no restrictions on requests for service, and lines per User exceeded normal commercial requirements. Traffic studies made at the Nan PBX during the peak of the Operation indicated the need for at least one additional PBX position. The two operators working the board were unable to handle the traffic efficiently during peak usage periods. Due to the size of the operating room, another position could not have been added even if available. The situation was further aggravated by the amount of traffic that could be passed automatically to Nan from Elmer through the Tropospheric System, only to be delayed by the limited capability of the manual PBX board at Nan.

The Honolulu radio telephone circuit transmitting and receiving equipment was maintained by TG 7.2, and toll service was handled through H&N telephone operators at Elmer. This circuit was below commercial grade, with the circuit unsatisfactory 25% of the time and completely inoperative 10% of the time. Calls were prolonged because of the constant speech repetition that was necessary due to low and fluctuating audio levels. Also, the single circuit proved inadequate for the quantity of scheduled traffic.

(Neg. No. W-938-8)

Figure No. 2-158. Radio Shop, Building 204 — Nan.

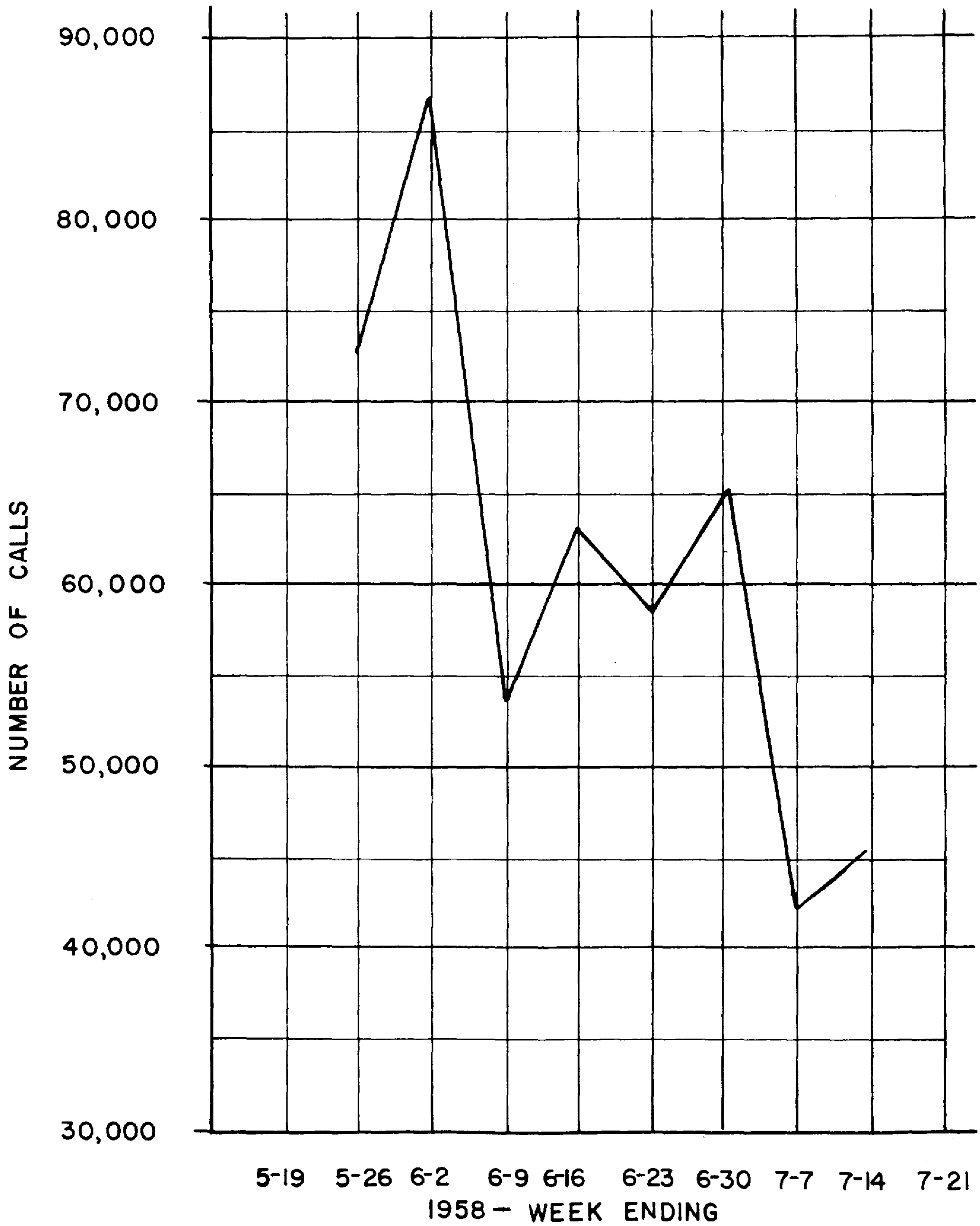


Chart No. 2-20. Telephone Exchange Calling Rate — Elmer.

Backlogs of two to three hours for official calls and up to one week for personal calls was common. The single circuit to Kwajalein, also maintained by the Military, was adequate from a traffic standpoint, and transmission was generally fair.

Telephone information and operator assistance for the entire EPG was a Contractor responsibility, as the Fred Military-maintained exchange did not have operator attendance. The first HARDTACK operational directory was published on 26 March 1958. The format was changed from previous Operational directories to include a consolidated alphabetical section instead of individual Task Group sections. The classified sections were published as submitted by the various Task Groups. Supplements were published to the initial directory, but it soon became apparent that due to the major revision in the operational program it would be necessary to publish a second directory. This directory was published on 22 May and served for the remainder of the Operation. Several innovations were included, such as safety and security slogans and drawings, a map of Elmer, and a descriptive map of the emergency evacuation assembly area points. A total of 2300 copies of the first directory and 2000 copies of the second directory were distributed.

TELETYPE.

H&N-operated TG 7.5 Communications Centers provided teletype service within EPG and into Honolulu and the Mainland for all elements of TG 7.1 and TG 7.5. Six 2-way circuits were terminated in the Elmer Comcenter and three circuits were terminated in the Nan Comcenter. A tributary station was installed and operated in the Nan TG 7.1 compound and was tied into the main comcenter at Nan. A comcenter was installed and operated at How

(Neg. No. W-V-340-6)

Figure No. 2-159. News Comcenter, Building 224 — Elmer.

to handle ABMA traffic and telephone and teletype conferences with ABMA at Huntsville, Alabama. These telecons were conducted with unusual success, considering the transmission path over various military and commercial circuits and the fact that the information was online encrypted.

H&N was delegated installation and operation supervision for the comcenter that was created to process news agency traffic in relation to the PINION event. The installation was made in Building 224 on Elmer with eight teletype machines and one facsimile unit handling traffic. The circuits were connected through military transmitting facilities from Eniwetok to Honolulu and were terminated in Honolulu.

Teletype traffic at Jobsite during the two peak months of HARDTACK totaled 24,312. This compares with a REDWING two-peak-month total of 13,547. Overcrowded conditions in the Elmer Comcenter hampered operations to some degree, and the limited space did not permit a more efficient arrangement of equipment.

RESPONSIBILITIES AT JOHNSTON ISLAND.

A telegraph circuit was established between Johnston Island and Elmer during the initial entry to handle traffic until the projected Military voice and teletype circuits were established in May 1958. Also, a harbor control station was installed for marine dispatch use. FM networks, similar to those described previously, were installed using VRC-18 equipment.

In mid-June a requirement was received to provide and install single side band high frequency transmitters and receivers for a countdown circuit, covering a 90° sector between Johnston Island and the Hawaiian Islands. Emergency procurement action was taken by the Los Angeles office and the equipment was purchased, inspected, air shipped, and placed in operation 10 days prior to the User's deadline.

A mobile interference detection unit was fabricated on a 1½-ton truck bed and placed in service to protect diagnostic and communications circuits. Interference on frequencies up to 5000 megacycles was investigated and reported by the H&N detection team.

MOTION PICTURE SERVICES.

Concurrent with camp activation, H&N maintained six open-air motion picture theaters during the build-up and the operational phases of HARDTACK. Theaters at Elmer and Nan used arc projectors, while those at Yvonne, Janet, How, and Oboe used lamp projectors. All theaters had a free showing of a standard size or cinemascopic feature picture seven nights a week; also, indoor matinee movies were provided for night workers. In addition, equipment and film were supplied to the George camp during its period of occupation, and to Scientific House Boats as required. The film was received from the Army and Air Force Motion Picture Services by special arrangement through the AEC.

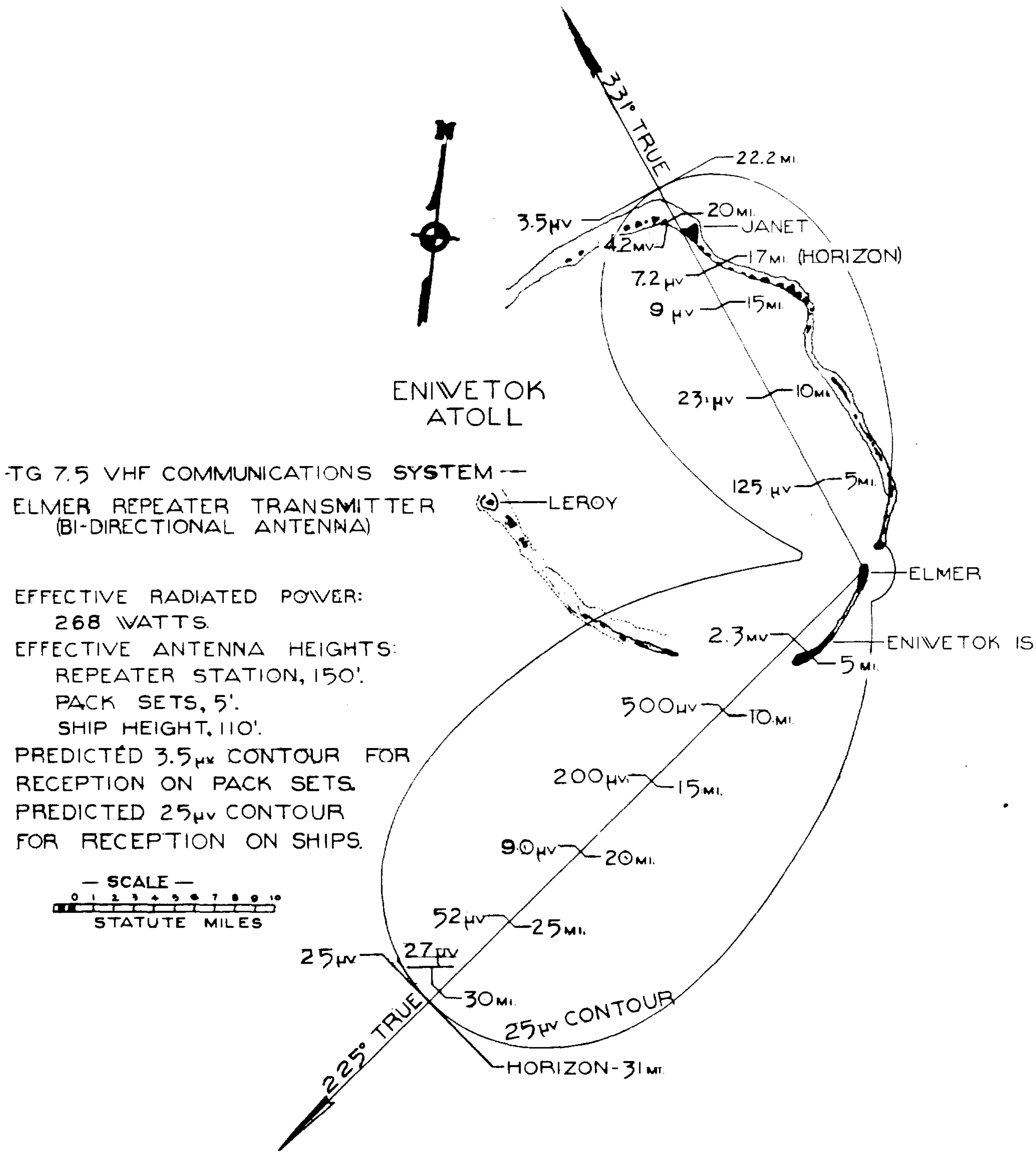


Chart No. 2-21. Predicted Field Strength Contours — Eniwetok VHF Repeater Transmitter.

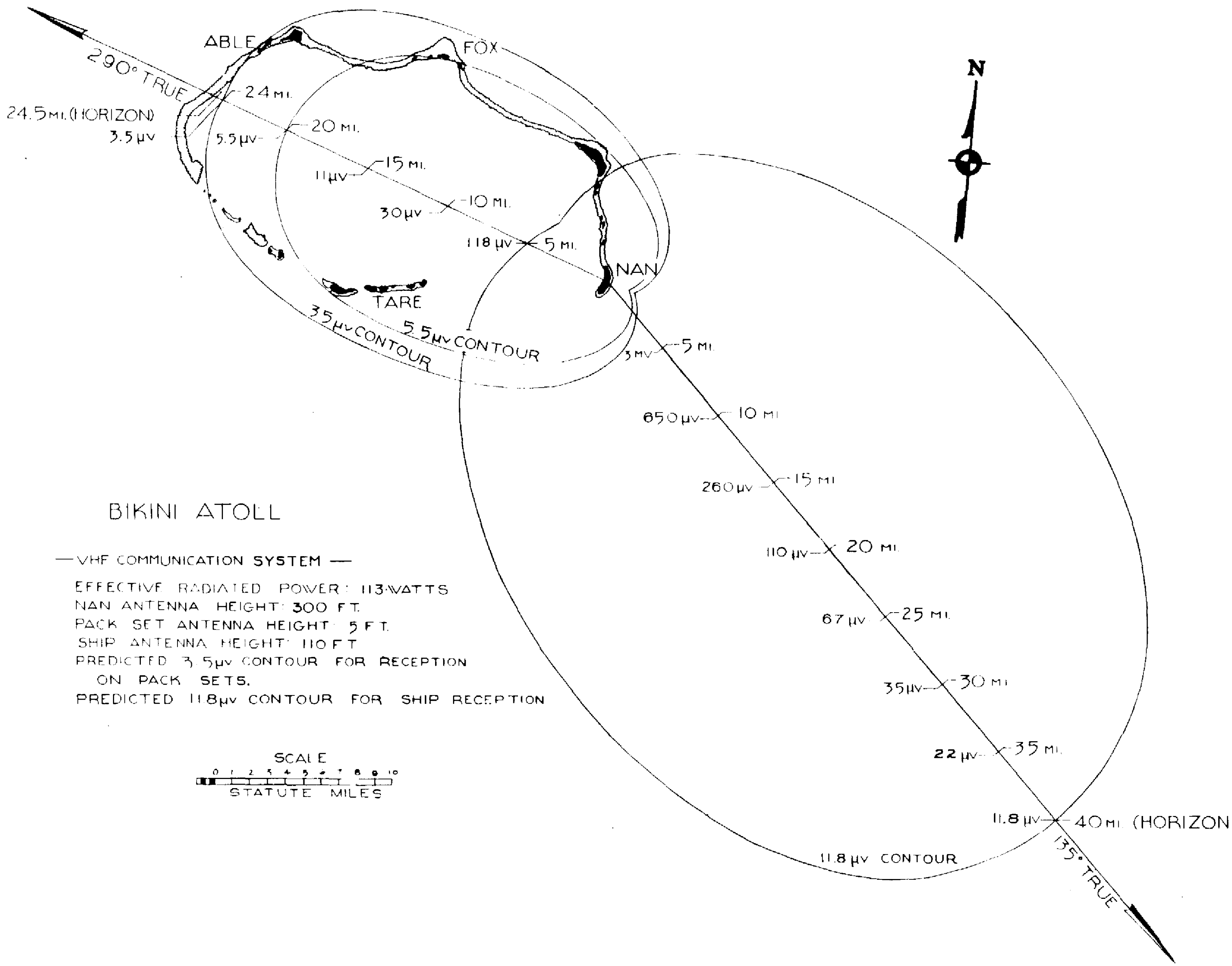


Chart No. 2-22. Predicted Field Strength Contours — Bikini VHF Repeater Transmitter.

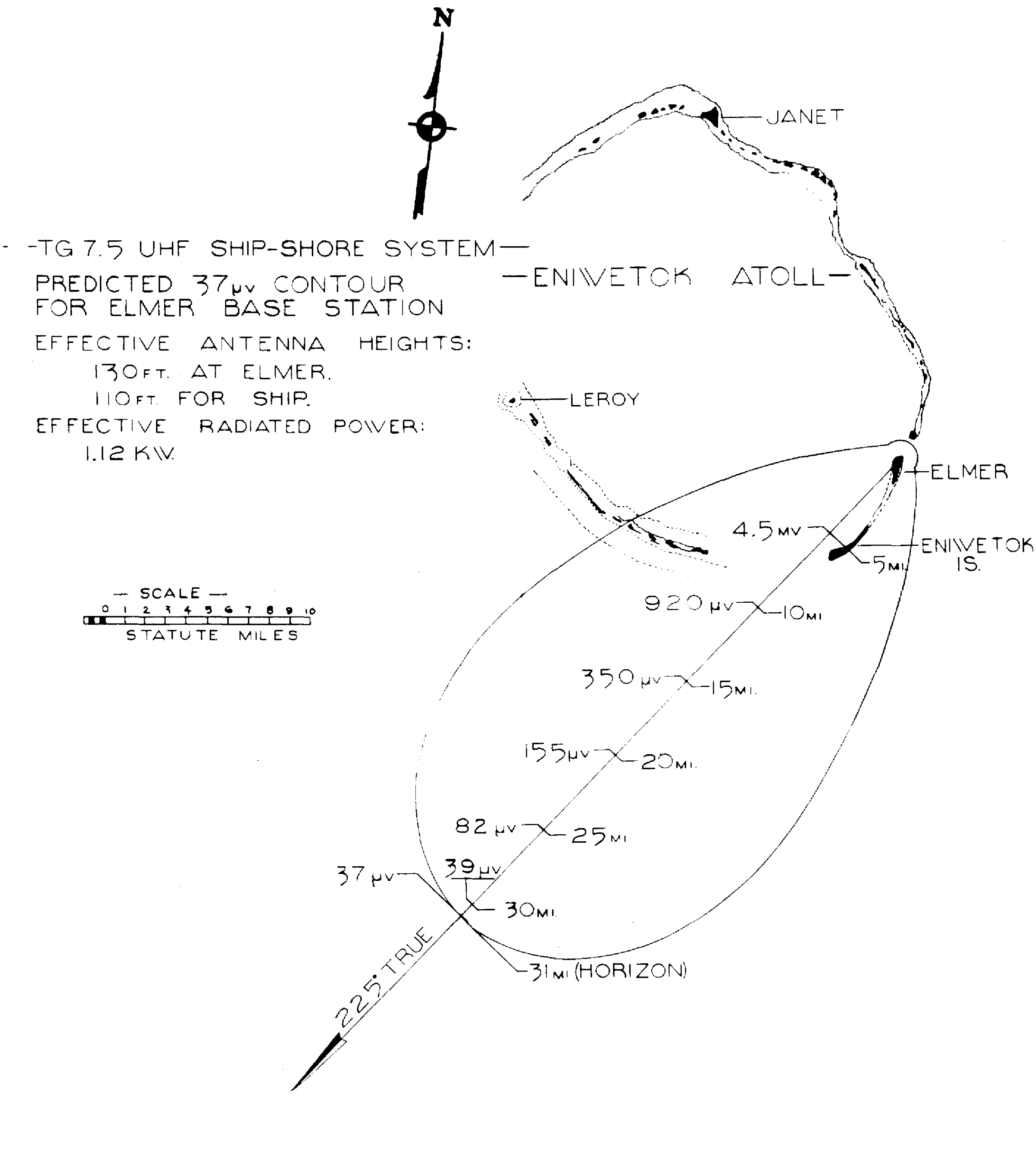


Chart No. 2-23. Predicted Field Strength Contours — Eniwetok UHF Ship-Shore System.

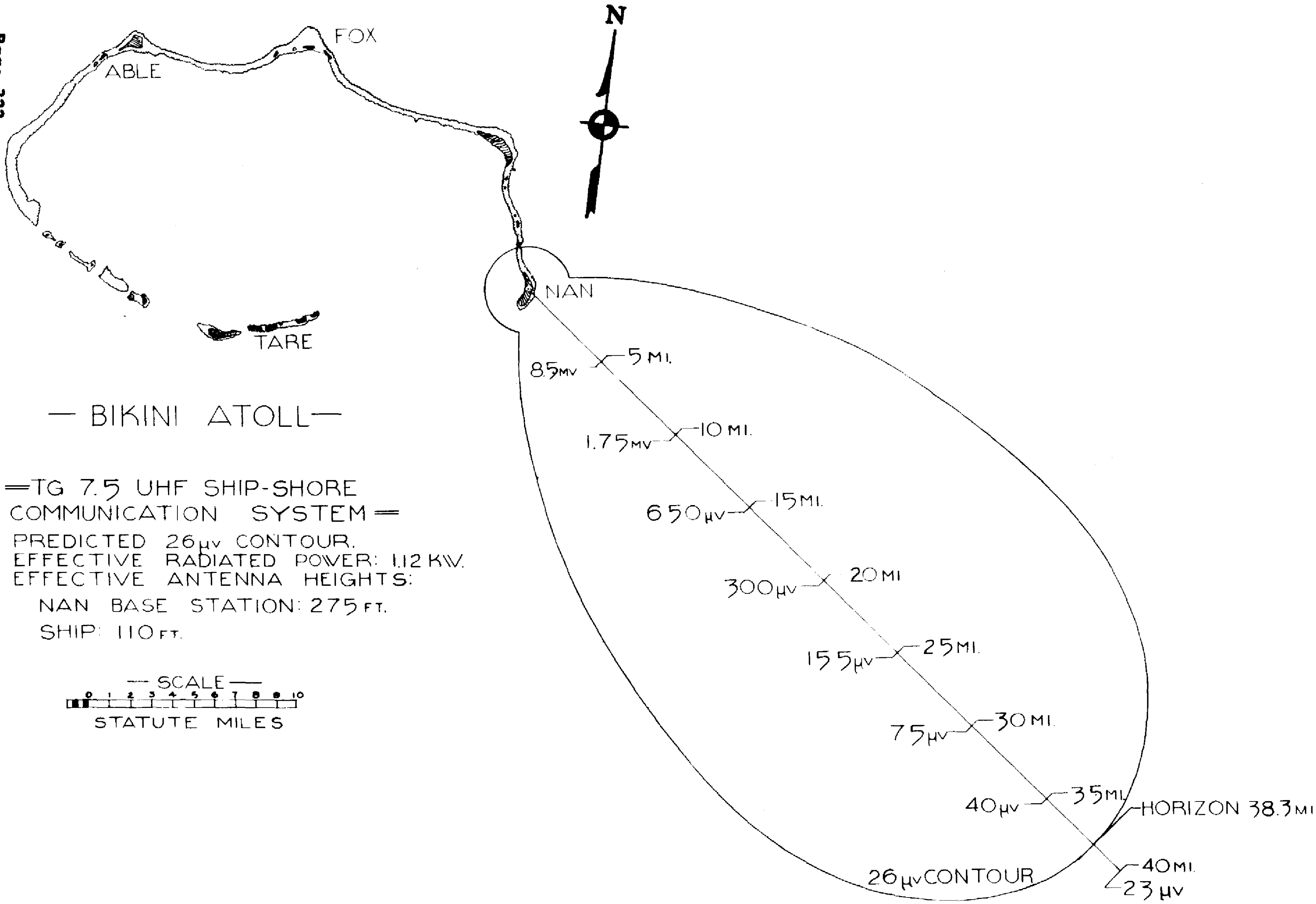


Chart No. 2-24. Predicted Field Strength Contours — Bikini UHF Ship-Shore System.

SECTION 7
CONSTRUCTION AND PLANNING

GENERAL.

The Construction and Planning Department functioned under the general supervision of the Chief, Construction and Planning, who was primarily responsible for the over-all coordination between Home Office Engineering and Procurement and Jobsite Supply and Construction. In addition, this Department was responsible for the publication of various periodic and special reports; standardization of nomenclatures and the publication of material stock lists; construction equipment budgeting, planning, inspections, and recommendations for procurement; Home Office requisitioning; Stateside material and installed-equipment inspections; and maintenance of strict control of all material and equipment shipments to Jobsite.

MATERIAL TAKE-OFF-SECTION.

To meet the construction schedule for Operation HARDTACK it was required that Advance Material Estimates (AME's) be issued by the Material Take-off Section prior to release of engineering drawings and the covering Construction Bills of Material (CBM's). This enabled advance procurement action to be undertaken and in many cases resulted in the receipt of material at Jobsite prior to the approval of design drawings.

Information for the preparation of the AME's was derived from an analysis of items used during REDWING to determine the items and quantities which might be considered standard in any given Operation. These were regarded as stockpile items and were included on AME's as soon as the scope of the Operation was known.

Also, Advance Information Forms, designed by the Material Take-off Section, were used by Engineering to provide descriptions of equipment and material for which a need was known to exist but for which the covering design drawings were not completed. Descriptions contained therein were reviewed and used as a basis for issuing AME's to authorize requisition action in advance of the release of drawings and the covering CBM's for the pertinent facility.

To keep abreast of the HARDTACK scientific program, CBM's were completed at the rate of 2332 line items per month, or approximately twice the rate required to complete the REDWING scientific program. Additionally, the Plant Acquisition and Construction (PAC) program overlapped the Scientific portion of HARDTACK which necessitated the issuance of a combined PAC and Scientific CBM item total of 3663 line items per month, as compared with a total of 1564 line items for REDWING.

MATERIAL CONTROL SECTION.

Prior to the inception of procurement action for Operation HARDTACK, a decisive change was made in the method of maintaining data pertinent to construction progress and scheduling. This was accomplished by revising the Material Status Report used during Operation REDWING in such a manner as to project more realistic delivery dates of materials and equipment. The current delivery information on all major items of construction materials and equipment was furnished to Jobsite daily by the Material Status Report, which reflected all changes of deliveries and estimated Jobsite arrival dates. This was supplemented by daily teletype reports on all critical items which gave Jobsite information for scheduling for an extremely tight construction program.

During the operational period, an Estimated Operations Schedule was used which included information relative to engineering, procurement, and construction progress pertinent to all known Scientific Stations and supporting facilities. This schedule was assembled and distributed to all interested parties, making it possible to coordinate and plan all phases of the build-up program.

In comparision to REDWING, the allowable lead time for delivery to Jobsite for all materials and equipment was reduced by approximately 40%, which required a constant control of all shipments. As the Operation progressed and User occupancy dates became critical, a daily review was made of all material and equipment scheduled for water transportation and, when necessary, diversions to air freight were authorized. As a result of the reduced lead time, intensive expediting action was required throughout, and on various occasions it was necessary to authorize premium payments for overtime on special fabricated items. As a consequence, delays were held to a minimum.

MATERIALS STANDARDS SECTION.

The period corresponding to Operation HARDTACK was one of increasing development in materials standards. Previously, a comprehensive classification of all stores items and commodities in constant use had been designed and substantial progress had been made in compiling a Commodity Stock List covering the activities at EPG. At the commencement of HARDTACK, approximately 11,000 line items had been classified in 35 categories, standardized nomenclature had been drafted for each commodity, and the printed lists had been assembled into books which were issued to the various offices. During HARDTACK, the number of line items identified, described, and assigned numerals totaled approximately 20,000, resulting in 88 complete published stock lists which were in use in the various engineering, procurement, supply, construction, and maintenance offices.

Numbers identifying the published items have been posted to stock cards and bin tags and are in use both in the Home Office and at Jobsite on Advance Material Estimates, bills of material, and documents concerned with procurement, warehousing, and issue of materials.

All items have been assigned a tentative code symbol designating standard warehouse stock, standard for authorized construction only, or non-standard for future procurement. These codes are being reviewed to simplify future supply problems while permitting utilization of existing stock.

REPORTS SECTION.

The Reports Sections produced periodic reports covering activities at the EPG and Home Office. The primary purposes of these reports were (1) to keep AEC and H&N informed of the progress of work at EPG; (2) to furnish a guide for AEC, MATS, and MSTS in planning transportation activities; and (3) to record and document the complete Home Office and Jobsite effort pertaining to work performed by H&N at the EPG.

In addition, to periodic reports, a number of special reports and studies were edited and finalized for the AEC, the Engineering Department, and the Blast Study Group. These studies are listed under Engineering Design (Chapter II, Section 1).

The responsibilities of indexing and maintaining a file of photos of Jobsite work were also functions of the Reports Section. Besides their use in various reports, these photos were used by H&N Executives and Engineers for reference study.

EQUIPMENT SECTION.

The Equipment Section expended considerable effort in anticipating as accurately as possible the equipment requirements for the entire Operation and in planning for the arrival of this equipment at Jobsite in time for required usage. Equipment requirements were scheduled by procurement quarters, with the bulk of the purchases falling within the third and fourth quarters of FY 1957 and the first and second quarters of FY 1958.

Preparation of equipment requisitions was coordinated with Jobsite to permit sufficient time for a thorough review of specifications, types, and quantities before procurement action was initiated.

Special planning was given the over-all equipment program to:

1. Acquire the most versatile, modern, efficient, and economical equipment suitable to Jobsite conditions.
2. Standardize equipment by make, model, engine, etc., as much as possible under existing Government procurement regulations to keep spare parts inventories at a minimum.

Emphasis was placed on the utilization of AEC and other Government excess items which could meet the stated requirements.

The two basic sources of excess items were:

1. AEC excess located by screening excess lists from other AEC Contractors and through personal contact with the Albuquerque, Oak Ridge, and Savannah River Operations Offices.
2. Other Government excess located through a careful review of excess lists provided by:
   - (A) General Services Administration from all regions;
   - (B) Interservice Material Utilization Agency, formerly the Material Redistribution Division of the Navy.

AEC excess equipment having an original acquisition cost of $468,433 was purchased for $107,341, reflecting a saving of $361,092. Moreover, equipment and materials obtained from other Government excess sources with original acquisition costs totaling $967,802 were purchased for $163,333, a saving of $804,469.

In addition to the excess sources, considerable quantities of equipment were purchased from Navy stock under the letter of agreement between the Navy and AEC, whereby AEC or its Contractors may purchase directly from Navy stocks at list prices. However, since a certain amount of the equipment in Navy stock was from three to six years old, the following method of pricing was established: depreciation was computed according to the age of a piece of equipment and this amount of depreciation was deducted from the estimated replacement cost. Using this method of pricing, equipment with original acqusition costs totaling $1,021,000 was purchased for $653,329, showing a saving of $367,671.

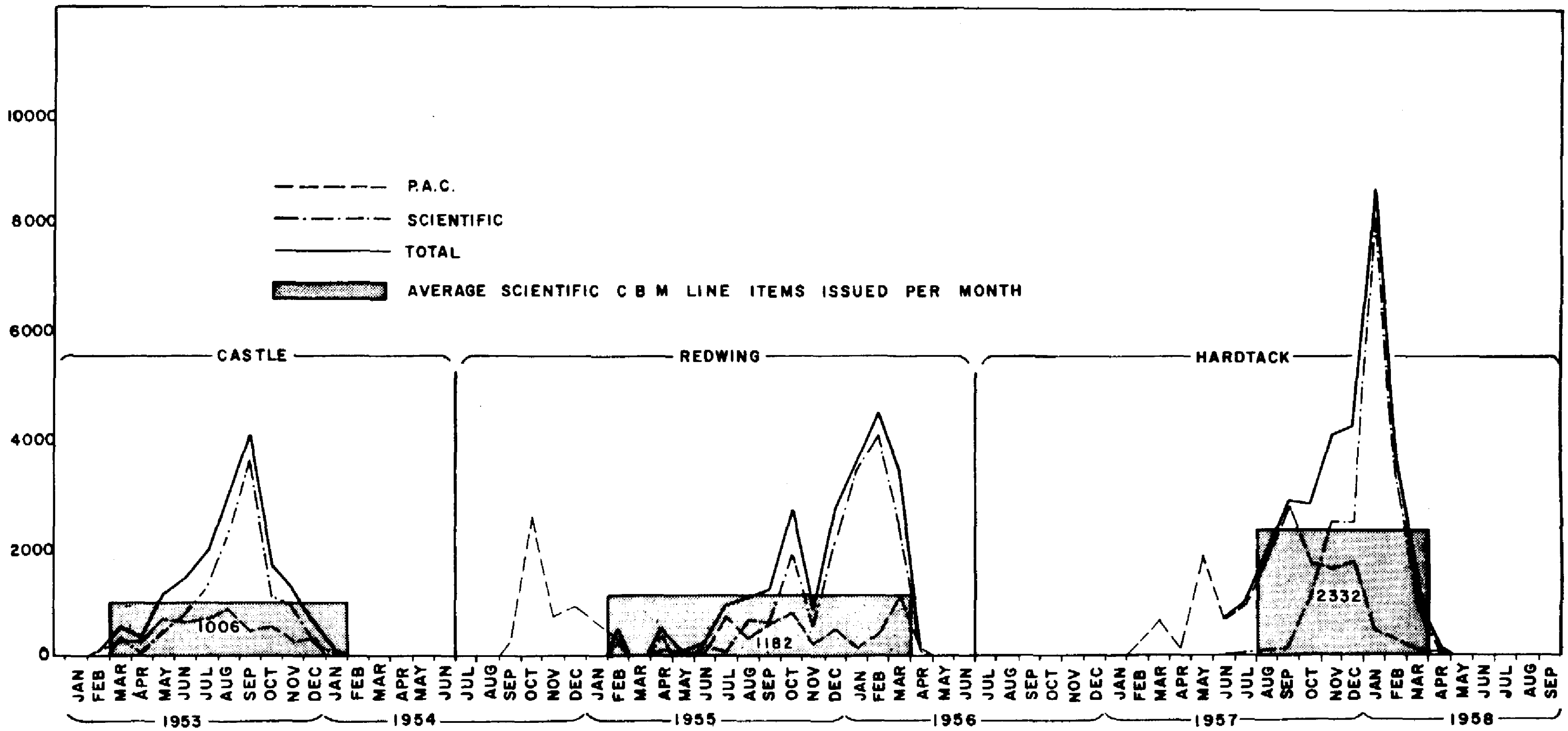


Chart No. 2-25. CBM Line Item Comparison.

Throughout the Operation equipment having an original acquisition value of $2,457,235 was purchased for $924,003, reflecting a saving of $1,533,232, or approximately 62% of the cost.

Expenditures for all equipment during Operation HARDTACK from both commercial and Government excess sources totaled $3,156,000, of which $924,003 was spent for excess items, representing approximately 30% of the total purchases of equipment.

Acquiring equipment from Navy stock and Government excess lists proved invaluable, since immediate delivery was possible on emergency items which normally have long lead-time requirements when purchased from commercial sources.

In addition to the purchase of equipment for Operation HARDTACK, it was necessary to borrow on a "no charge" basis seven pieces of heavy equipment valued at approximately $200,000 from the Navy at Pearl Harbor for use at Johnston Island. The locating, arranging for the loan, inspecting, preparing for shipment, and the shipping of this equipment were accomplished in seven days. Also arrangements were made with the Chief, BuDocks, U.S. Navy, for the loan of two 500-kw and two 600-kw diesel-driven portable generators for EPG and one 500-kw portable diesel-driven generator for Johnston Island. Total acquisition value of these generators was approximately $400,000; however, as a result of these arrangements, no costs were incurred other than transportation and rehabilitation upon return to the Navy.

INSPECTION SECTION.

To insure a high quality of materials and workmanship in the fabrication of special items and to aid further the over-all construction effort, the Inspection Section assisted certain of the Vendors in job planning and production control.

On several occasions it was necessary to transfer Inspectors from the Home Office for a period of weeks to carry out prolonged fabrication inspection duties at Vendors' plants. Included among the important installations on which inspection was expanded throughout fabrication were the ABMA service tower on Johnston Island, the LSM-444, (now called the ALOTO), and the diesel generators and other equipment for the Weather Stations.

REQUISITION SECTION.

Preliminary requisition action was undertaken in support of the anticipated construction program based on advance criteria. While this advance action was small in scope compared with the activity during construction, it involved construction and operational materials, equipment build-up and replacement, and various service functions, such as export packing, pre-employment medical examinations at Los Angeles, San Francisco, and Honolulu, reproduction for thousands of feature drawings, etc. Through this action, solicitation of bids covering all major services was released far enough in advance of the Operation to ensure complete coverage of known requirements.

During the program, similar construction materials, not covered by AME stockpiling action but called out in small quantities against separate CBM's, were grouped in accumulated totals, and requisitions were issued for standard package quantities. This procedure enabled the Purchasing Department to take advantage of lot prices and better delivery time and decreased the necessity for duplication of orders in small quantities.

Requisitions for long delivery items, such as telephone and power cable, dehumidification units, generators, power panels, and special fabrication items, were released to the Purchasing Department early in the program. Delivery was scheduled to accept partial quantities over a predetermined period of time to provide Jobsite with adequate quantities of materials at all times.

In addition to Home Office-initiated material and equipment requirements, all requisitions prepared in the field were reviewed for quality, description, justification, and conformance to the construction schedule prior to transmittal to Procurement for the required action.

The following table shows the work accomplished by the Requisition Section during HARDTACK as compared with that during REDWING:

ITEM	REDWING	HARDTACK
AME's, CBM's, and Revisions	2,260	4,957
CRE's, FRE's, and Revisions	9,380	15,272
CRE's, FRE's, and Revisions (Line Items)	55,000	74,895

During HARDTACK it was evident the preliminary preparation for entry into the construction phase had laid a firm foundation for the requisition activity. Advance procurement on long delivery items of materials and equipment, good coverage of stockpile items by AME's, a clear and concise nomenclature using H&N Materials Standards Catalog Reference data, and streamlined paperwork, and the use of the H&N Standard Operation Procedure enabled the Requisition Section to keep abreast, and in many cases ahead, of construction requirements.

CHAPTER III
ADMINISTRATION

SECTION I
MANAGEMENT

Contract No. AT(29-2)-20 is an Architect-Engineer - Construction - Management contract providing for the engineering, construction, operation, and maintenance of all base and test facilities at the EPG and at such other sites as may be specified by the AEC. The contract is administered on a Cost-Plus-Fixed-Fee basis by the Manager, Albuquerque Operations Office, of the AEC through the Assistant Manager, Office of Test Operations, and the Director, Pacific Operations Division. The centralization of authority and responsibility for all elements of the facilities and support program under a single contract served to minimize the difficulties inherent in simultaneous or overlapping design, procurement, and construction services and expedites the satisfactory completion of the construction programs.

The extensive construction program for Operation HARDTACK, carried out on a "crash" basis at a remote location more than 5000 miles from the Home Office, necessitated unusually effective planning and administrative controls. The organizational structures of both the Home Office and Jobsite were designed to provide the necessary strong supervision and adequate crossties between departments.

Following REDWING several significant changes in both the Home Office and Jobsite organizations were effected to improve supervision and control and to provide adequate depth of Management for the increased volume of work anticipated for Operation HARDTACK. The principal organizational changes affecting the management of the EPG project were the following:

HOME OFFICE—CORPORATE LEVEL

Over-all Corporate responsibilities and authorities for the prosecution of work under Contract AT(29-2)-20 were centered in four Corporate officers:

1. Executive Vice President
   Corporate level supervision of the AEC Facilities Project
2. Vice President, Engineering
   Establishment of engineering standards, and staff review
3. Treasurer
   Personnel and Security
   Wage and Salary Administration
   Office Services
4. Corporate Controller
   Contract Administration
   Procurement

HOME OFFICE—PROJECT LEVEL

The number of functions reporting directly to the Project Manager was reduced from six to three by:

1. Transfer of the Personnel Department from the Project to the Personnel and Security Department at the Corporate level.
2. Creation of the position of Manager, Construction and Facilities, with jurisdiction over the Purchasing, Estimating, and Construction and Planning Departments, as well as over-all supervision of Jobsite operations and the Honolulu Office.

JOBSITE

1. Construction and maintenance functions were separated and each placed under a General Superintendent. To the newly-created position of Manager, Construction and Maintenance, was assigned responsibility for both operations.
2. A separate Communications Division was established.
3. The position of Technical Facilities Coordinator, reporting directly to the Resident Manager, was activated during the peak period of design and construction.

Primary responsibility for the entire AEC Facilities Project rested with the Vice President, Construction Division, to whom were delegated broad powers for independent action. Through authorities delegated to the Vice President, Construction Division, the Manager, AEC Facilities Project, coordinated all activities affecting the engineering, construction, and operation of facilities at the EPG. The Project organization supporting the Manager was functionally self-contained with the exception of Personnel and Security, Wage and Salary Administration, and Office Services. Certain other functions, such as Purchasing, Estimating, Accounting, and Contract Administration, while operationally self-sufficient within the Project organization, were governed by policies and procedures promulgated at the Corporate level. In addition, major engineering design was subject to review by the Vice President, Engineering, and the Chief Design Engineer (Corporate) to insure a high level of professional quality.

The Project organization in the Home Office was divided into three major divisions based upon the functions to be performed in support of the overseas operations: (1) Engineering and Design, headed by the Engineering Manager; (2) Accounting, Contract Administration, and Budgets, headed by the Project Controller; and (3) Estimating, Purchasing, Construction & Planning, Honolulu Office, and Field Operations, headed by the Manager, Construction & Facilities. Each of these Division Heads in turn was assisted by Department Heads who exercised the close supervision and control of detailed functions necessary for the satisfactory prosecution of a "crash" program of extreme magnitude.

The Jobsite organization was headed by the Resident Manager, reporting directly to the Manager, Construction & Facilities. The complexity of the EPG activities necessitated a breakdown of functions to seven divisions, headquartered at Elmer. Four of these divisions — Supply, Communications, Service Operations, and Industrial Relations — were supervised by the Assistant Resident Manager, Eniwetok Atoll, while the other three division — Accounting, Engineering, and Construction & Maintenance — reported directly to the Resident Manager. Because of the distance separating Eniwetok and Bikini Atolls it was necessary to assign an Assistant Resident Manager at Bikini Atoll for supervision and control. Later in the Operation, when the TEAK and ORANGE events were relocated, an Assistant Resident Manager was appointed for Johnston Island.

General planning for Operation HARDTACK was initiated soon after completion of REDWING, and several conferences during the winter of 1956-1957 touched on anticipated HARDTACK requirements. Principal among these conferences was the AEC-H&N Management meeting on 11-12 December 1956 which outlined the problems experienced during the support of REDWING and offered recommendations for changes to be effected before HARDTACK. These early conferences referenced HARDTACK in only a general way, and it was not until the early part of 1957 that specific conferences for the approaching Operation were initiated.

A Logistic and Construction Conference was held at Headquarters, JTF-7, Washington, D.C., on 19 February 1957 followed by a conference on Preliminary Support Requirements on 20 and 21 February. Thereafter, conferences pertaining to specific facets of the Operation were frequent. Numerous other conferences for planning and review purposes were held with representatives of the AEC, DOD, and Scientific Users and within the Holmes & Narver Project Management staff in the Home Office and Jobsite. Liaison groups were established on a full-time basis at both UCRL and LASL, and two former Resident Engineers were assigned the responsibility for keeping Project Management and the Engineering staff fully informed of scientific criteria changes.

Among the major Management problems of the Operation were those resulting from the late availability of funds. Procurement of long lead-time materials and equipment was retarded and construction was delayed well beyond the starting dates necessary for orderly and economical prosecution of the work. It was necessary to order a temporary delay in the shipment of personnel to Jobsite, thus causing the loss of a number of highly qualified applicants and later increasing the burden of overtime work and the cost of construction. At the AEC-H&N Management meeting held 11-12 December 1956 in Los Angeles, the necessity for the early release of funds, among other things, was emphasized. It was pointed out that the expansion of electrical generating facilities and additional water distillation equipment were items of prime importance in the FY 1958 program. The early release of funds would have obviated many logistic and construction problems that existed.

Coordination of the various elements of the project, both in the Home Office and at Jobsite, was effected through frequent conferences of supervisory personnel, close supervision and review of all important functions by the Project Manager, the Resident Manager, and the Department Heads, and frequent liaison and coordination trips of Home Office personnel to Jobsite. In the case of Engineering, at approximately the time that the Users moved to Jobsite, the Assistant Engineering Manager, with a small staff of Engineers, was dispatched to EPG to serve as Technical Facilities Coordinator on the staff of the Resident Manager. This move greatly simplified the interpretation of criteria and designs and provided additional skilled professional personnel to assist in the rapid design of facilities for Johnston Island. During the height of the build-up, the Project Manager and the Manager, Construction and Facilities, were at Jobsite for extended periods assisting in the direction of H&N activities. Through adequate supervisory staffing, wide dissemination of pertinent data, and constant liaison with User agencies, H&N Management was able to cope with the myriad problems of a "crash" program thousands of miles from the Home Office.

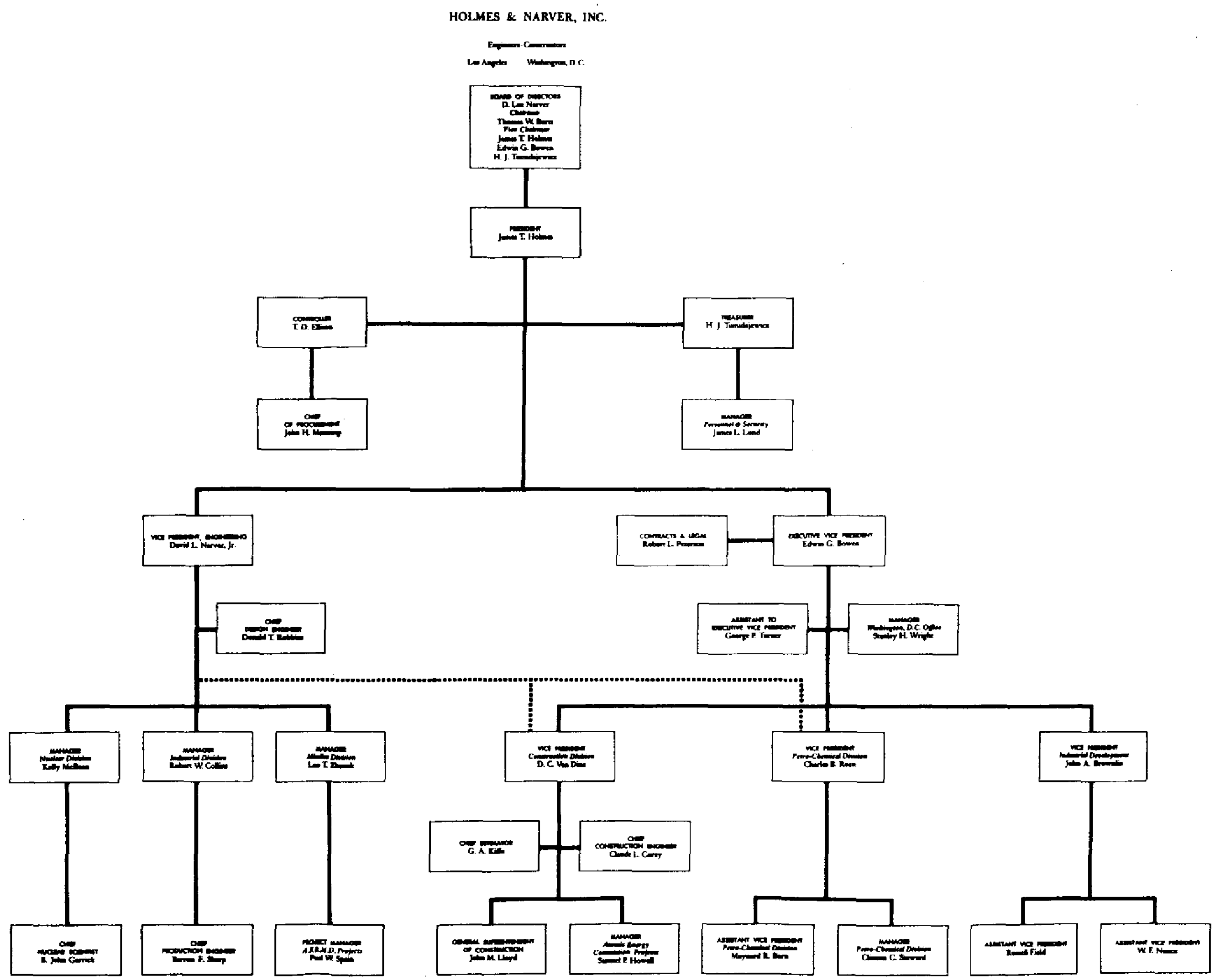


Chart No. 3-1 H&N Corporate Organization Chart.

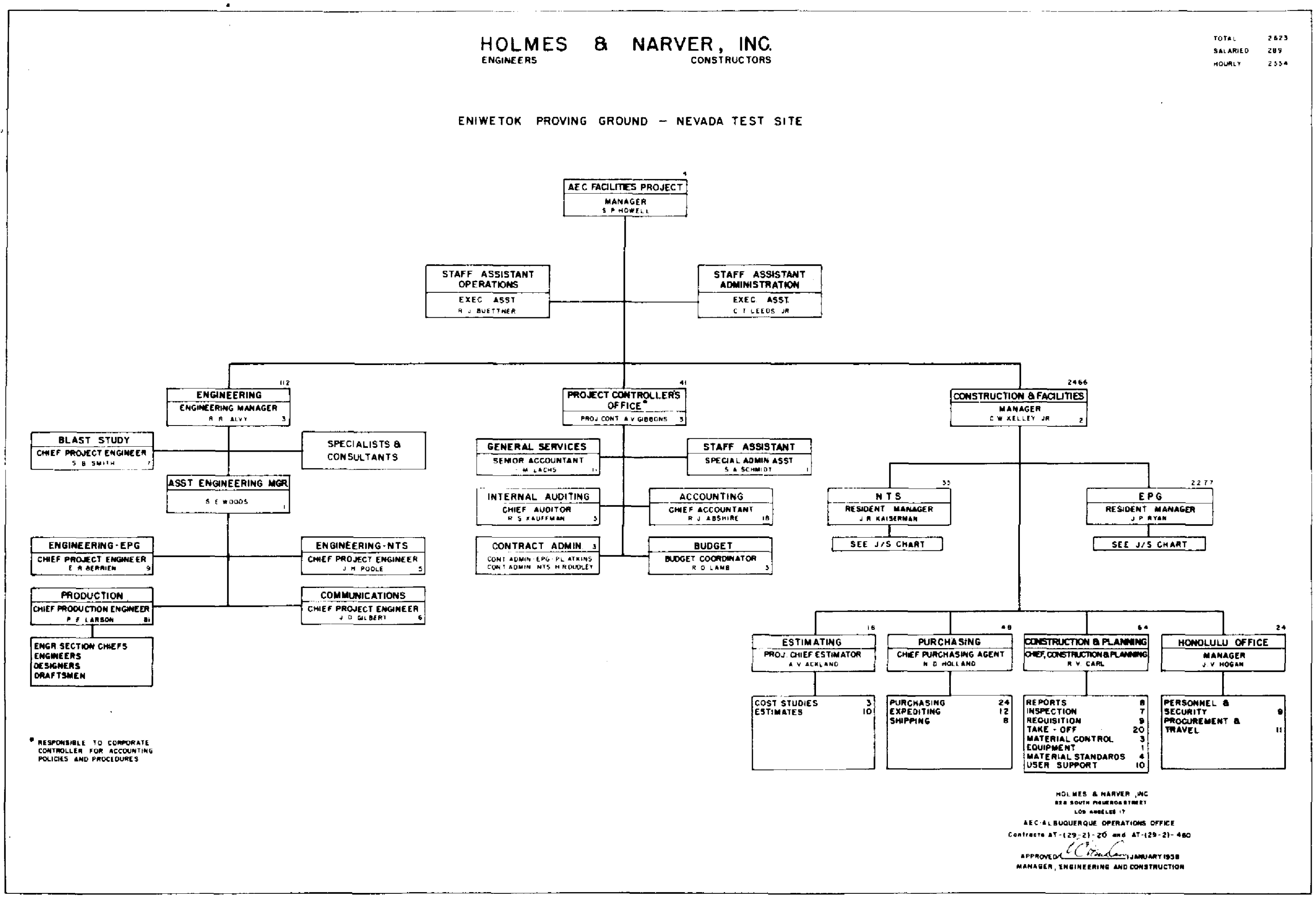


Chart No. 3-2. H&N AEC Facilities Project Organization Chart.

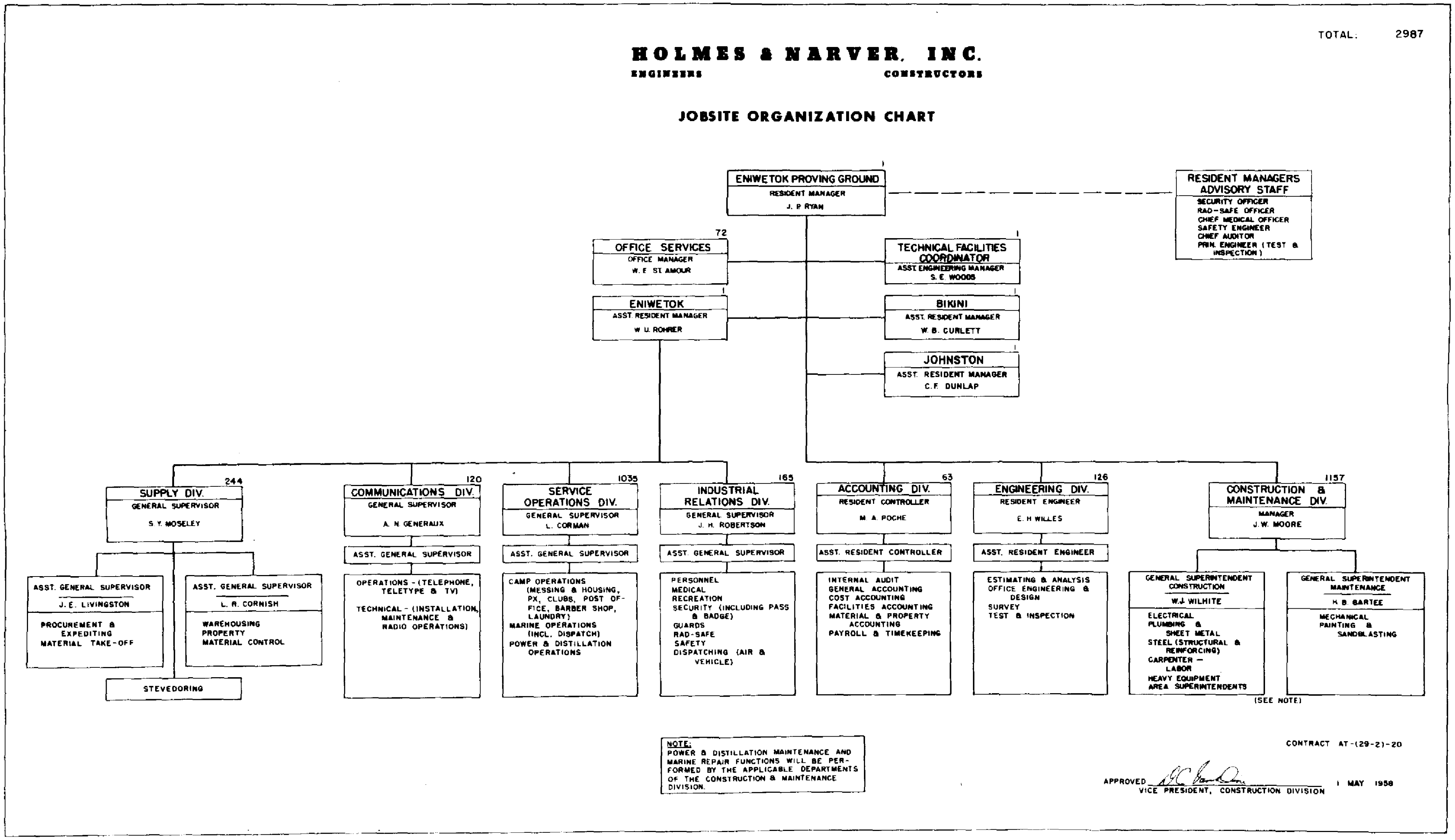


Chart No. 3-3. Jobsite Organization Chart.

SECTION 2
ACCOUNTING

GENERAL.

For accounting purposes, Operation HARDTACK, Phase I, covered the period from 1 September 1956 through 30 September 1958.

Modification No. 55 to Contract AT (29-2)-20, dated 29 June 1956 and effective 1 July 1956, established the Commission's accounting requirements under Article IX, Section 1, Accounts; Section 4, Reports; and Section 8, Internal Audit. Accounting records, books of account, systems of accounting, internal control, auditing, etc., were to conform to generally accepted accounting principles satisfactory to the Commission. Accounting records under the Contract were maintained as a separate and distinct set of accounts which supported all costs incurred, revenues earned, fixed-fee accruals, and the receipt, use, and disposition of all Government-owned property under the management of H&N.

Accounting statements and reports required by the Commission were prepared and submitted in accordance with the applicable provisions of the AEC manual. Additional and special reports for the Commission were prepared and submitted when requested.

The Jobsite accounting offices maintained all basic records of time-keeping and payroll, cost accounting, property and material inventory accounting, token payments, travel advances, revenue accounts, etc., and transmitted this information to the Home Office monthly for consolidation with the firm's records. Except for an Interim Special Test Cost Report initiated during Operation HARDTACK, all financial statements and cost reports required by the Commission were released by the AEC Project Home Office Accounting Departments.

BUDGETS, FINANCIAL PLAN, MID-YEAR REVIEW.

The first budget relative to Operation HARDTACK was submitted in April 1955, covering FY 1956, 1957, 1958, and a portion of FY 1959. In October 1955 and April 1956, revised budgets were submitted, each one giving effect to progressively refined plans based on decisions of the Commission. Experience gained during previous Operations permitted H&N to estimate more closely the budgetary requirements involved as plans became more definitive. The April 1956 budget estimate became the basis for FY 1957 Financial Plan, which covered the initial stages of Operation HARDTACK.

FY 1958 was devoted entirely to Operation HARDTACK. Progressively refined budget estimates for the year were prepared in October 1956 and April 1957. The April estimate was applicable as of 1 July 1957, the start of FY 1958, but detailed operational plans were still subject to change. Accordingly, decisions of the Commission were translated promptly by H&N into plans, which were steadily furnished to the Budget Section. This enabled the Budget Section to interpret the plans into monetary requirements and to issue semi-monthly recapitulations giving the status of known criteria and the estimated result of cumulative changes on total year costs. After several months, the operational program became sufficiently stabilized to permit AEC/ALO, to formulate a Financial Plan, which served as the framework for FY 1958 cost limitations. Concurrently, the Budget Section went to a monthly basis for issuing recapitulations and year-end forecasts.

Each monthly forecast was compared with the existing Financial Plan, and an explanation was submitted as to why each item in the Plan was at that time considered satisfactory or inadequate. These monthly forecasts served the purpose of notifying all concerned of the current financial picture and were used by ALO as the basis for revising the Financial Plan, when advisable.

The final phase of Operation HARDTACK, falling within the first several months of FY 1959, was included within the structure of the total estimated cost for that year.

GENERAL AND COST ACCOUNTING.

Three additional monthly reports were prepared by Jobsite during this Operation, primarily for the use of the JTF-7 Controller, AEC, and the User personnel. These reports were:

1. The Estimate Report, which compared the latest working estimates to the Official Estimates of Expendable Construction, showing percentage of completion in the following categories:

   Scientific - Zero Stations

   Scientific - Numbered Stations

   Scientific - Other Than Numbered Stations

Temporary Camps

Auxiliary Facilities

Construction Equipment Procurement

The preceding were divided into DOD Reimbursable, DOD Non-Reimbursable, and other User groups.

2. The Estimate and Cost Report, which included the same information as in "1" and in addition indicated the cost to date by major elements of the JTF-7 program and project.

3. The Special Test Cost Report, which summarized the Cost Estimate Report and reflected the costs to date of the Operation as compared to the Working Estimates indicating the total costs for the major Users.

During March 1958, a revised Chart of Accounts was issued, which listed additions and deletions to date. During the latter part of that month, a change in the method of handling the charges for advance equipment procurement was instituted. Instead of charging the Identification Number for which equipment was procured, an inventory was maintained and the charge was made to the construction item as the equipment was installed. The equipment remaining uninstalled at year-end was reflected in the Current Use Inventory.

Effective November 1957, a redistribution of FY 1958 engineering costs was accomplished.

	10 MONTHS FY 1957	FY 1958	3 MONTHS FY 1959	TOTAL
FULL SCALE WEAPONS, EXPENDABLE TEST FACILITIES, ENIWETOK PROVING GROUND				
Hardtack, Phase I	$ 2,169,014.34	$22,242,784.04	$ 909,709.91	$25,321,508.29
TEST SITE OPERATIONS, ENIWETOK PROVING GROUND				
Maintenance of Proving Ground	4,755,472.40	7,114,212.44	1,931,135.56	13,800,820.40
Operation of P.G. Facilities (Net)	6,554,279.86	12,307,845.76	3,382,904.40	22,245,030.02
Scientific Support	358,214.33	1,082,660.25	536,995.62	1,977,870.20
Total Construction & Operations	13,836,980.93	42,747,502.49	6,760,745.49	63,345,228.91
Reimbursable Work (Credit)	(150,621.70)	(3,304,698.51)	(351,498.79)	(3,806,819.00)
Net Total Construction & Operations	13,686,359.23	39,442,803.98	6,409,246.70	59,538,409.91
Biology & Medicine	7,299.28	4,032.53	-0-	11,331.81
Total Operating Programs	13,693,658.51	39,446,836.51	6,409,246.70	59,549,741.72
PLANT & EQUIP. CHANGES				
Construction	686,054.92	5,638,647.76	63,612.10	6,388,314.78
Equip. Not Incl. In Constr. Projects	75,925.46	829,808.75	83,414.39	989,148.60
Total P & E Programs	761,980.38	6,468,456.51	147,026.49	7,377,463.38
TOTAL PROGRAM COST	$14,455,638.89	$45,915,293.02	$6,556,273.19	$66,927,205.10

Table No. 3-1. Program Costs From September 1956 Through September 1958.

The prior method of distributing engineering costs on a percentage of construction cost basis was discontinued, and design costs were charged directly to the item of construction being designed. Engineering indirect expenses and Los Angeles administrative expenses were then charged to a direct cost on a pro rata basis. Construction engineering was charged to Job I construction on a predetermined percentage of the direct costs.

Effective December 1957, special order work was segregated into three classifications on the cost reports: namely Construction, Camp Operations, and Maintenance.

Beginning in December 1957, Jobsite began using standard labor rates for the distribution of engineering labor, and in April 1958 standard labor rates were used for the distribution of general and administrative expense labor.

PAYROLLS AND TIMEKEEPING.

Payroll and timekeeping functions were divided between Jobsite and Home Office. The Jobsite function consisted of maintaining primary payroll records such as daily and/or weekly time cards (approved by the employee's supervisor), daily brass records, employee field checks, and overtime authorizations and of preparing employee weekly payroll summary cards from these basic records.

The employee weekly summary cards from both EPG and Johnston Island were consolidated into weekly overseas payroll by the Home Office, and checks were drawn and forwarded to the employee-designated allottee. Each Jobsite employee was advanced two successive weekly pay checks for the amount stated in the Employee Agreement, and at time of termination the amount advanced was deducted from that due for the final two work weeks. This method permitted the employee's allottee to receive payroll checks weekly from the time of hiring without regard to the time lag caused by transmitting weekly payroll cards from Jobsite by mail.

In accordance with Modification No. 41 to the contract, the cost of transportation to Jobsite was advanced to each employee, and weekly deductions were made from the earnings of the employee until the amount advanced was repaid.

From September 1956 through June 1958 a total of 167,031 payroll checks in the amount of $32,224,000 for overseas employees were processed. In April 1958 the overseas payroll operation served a peak of 3209 personnel.

ACCOUNTS PAYABLE.

The Accounts Payable Section was responsible for the expeditious processing and payment of all accounts, with the exception of travel expenses covering employees traveling to Jobsite under Employee Agreements which were paid at Jobsite.

The majority of materials purchased was shipped by vendors directly to Oakland, California, for export packing and reshipment to Jobsite. The packer was required to transmit receiving information immediately to enable the Accounts Payable Section to remit to vendors promptly and thereby avoid the loss of cash discounts. From 1 September 1956 through 30 June 1958 this section processed and paid vendors' invoices totaling approximately $28,263,000, after deducting cash discounts in excess of $113,600.

Procedures and methods used in processing per diem and travel expense payments were in accordance with established company policy and in compliance with the provisions and requirements of the contract. From 1 September 1956 through June 1958, a total of 4135 travel orders were processed covering single and multiple movement of personnel. Travel expenses of approximately $294,000 were processed and paid. Approximately 21,500 checks were issued in payment of travel expenses, vendors' invoices, and other miscellaneous accounts payable.

PROPERTY.

In August 1957, a physical inventory of on-continent property was taken, and records were adjusted accordingly. New methods for recording and identifying property were instituted. Policing and periodic test checks were made to ensure the proper use of all property. That which was of no use to the project was declared as excess in accordance with AEC Manual instructions and was disposed of, when possible.

On 2 June 1958, new standard service life rates, for depreciation purposes, were approved by the AEC. Generally, the AEC Manual rates, plus some additions and a few changes, were the basis for an adjustment to the Reserve for Depreciation currently recorded. Present year adjustments were accomplished on 30 June 1958.

INTERNAL AUDIT.

The function of the Internal Audit Section was to conduct a comprehensive audit program in accordance with the provisions of the contract and the AEC Manual which would provide the basis for determination relative to the effectiveness of internal controls and the reliability of records and reports.

Audits were performed of the following functions:

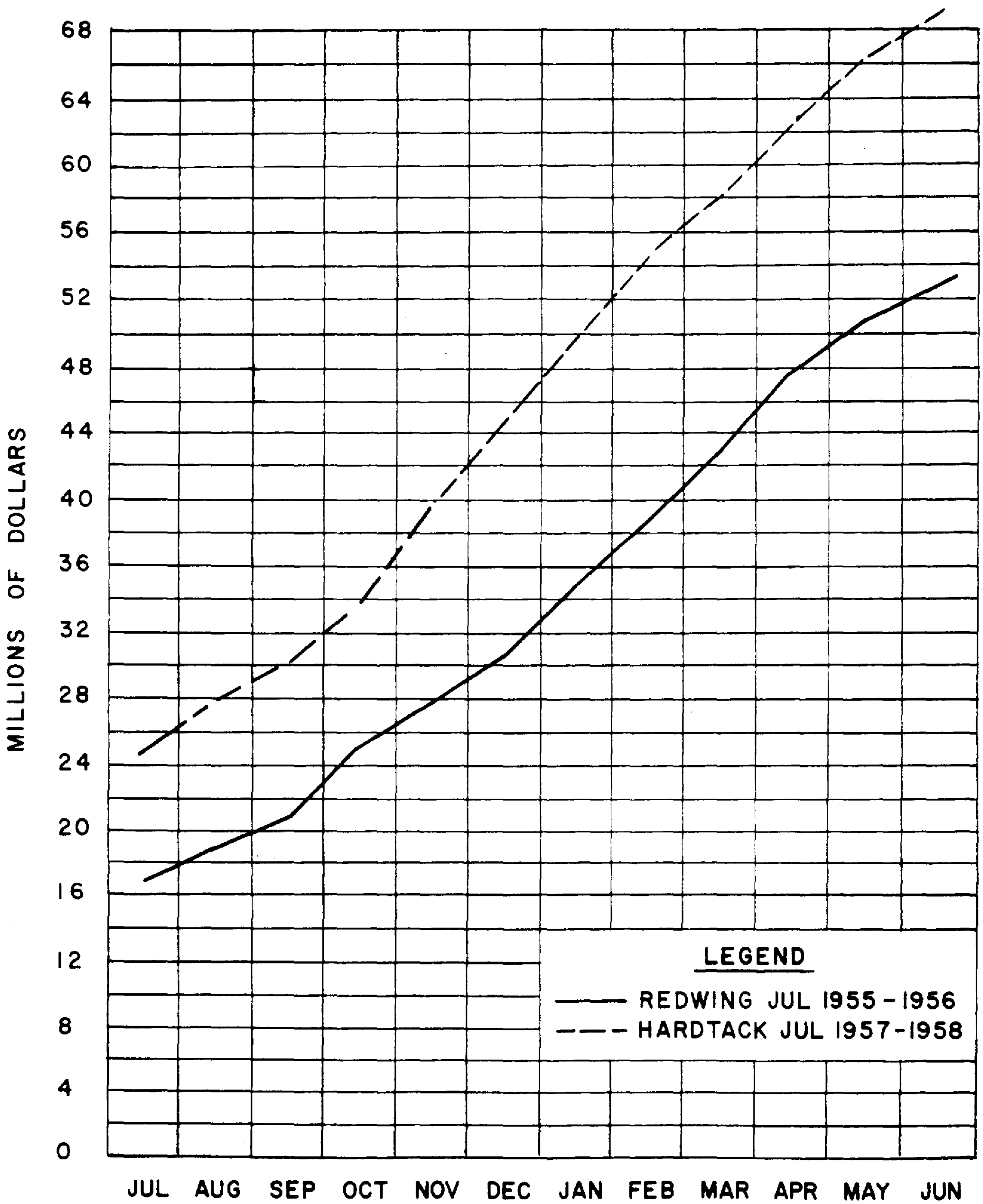


Chart No. 3-4. Actual Commitments — HARDTACK vs. REDWING.

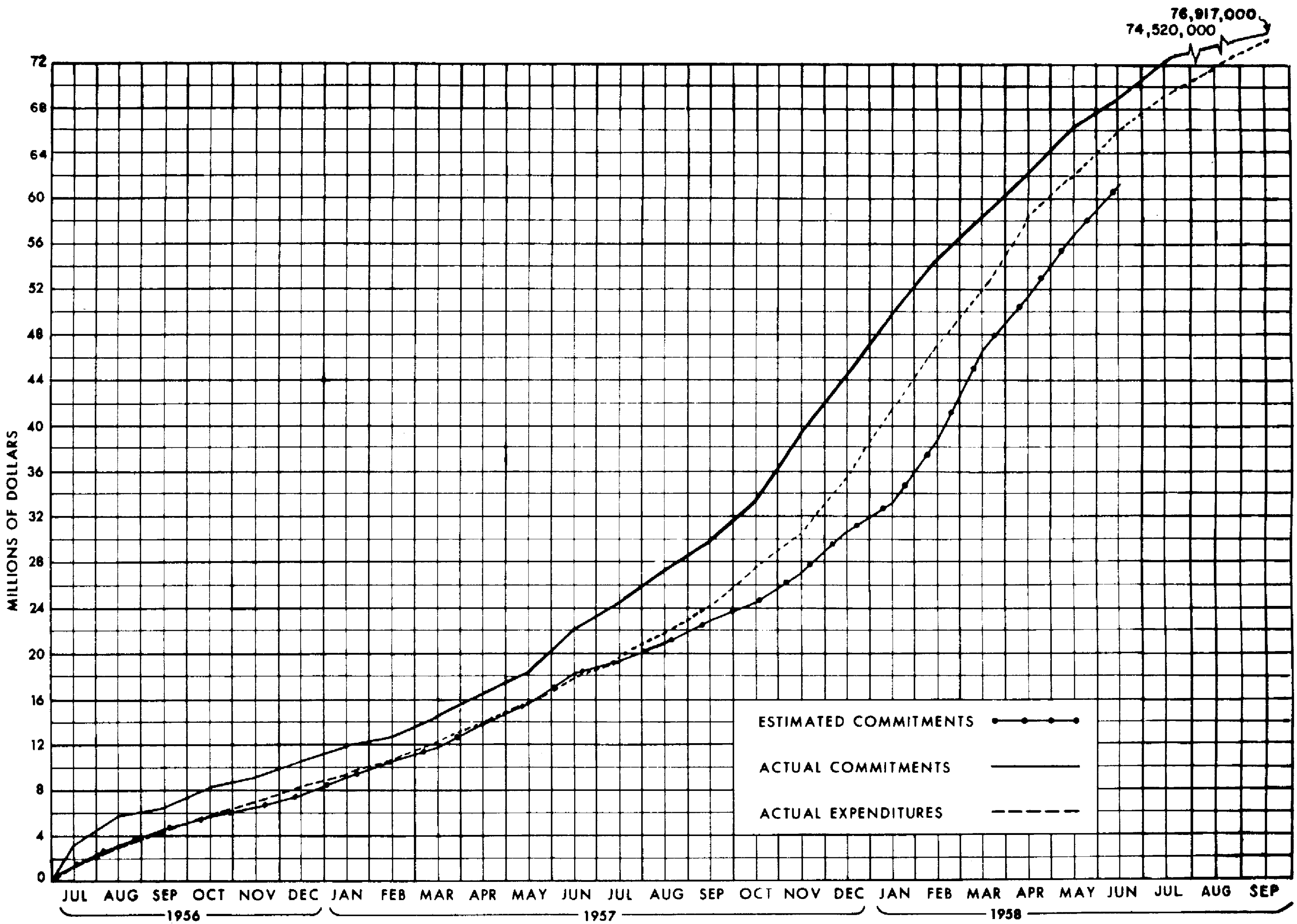


Chart No. 3-5. Expenditures and Commitments.

HOME OFFICE

Budget Forecasting
Budget Execution
Contracting and Procurement
Receiving and Inspection
Traffic
Management of Capital Assets
Surplus Property
Motor Pool
Administrative Services
Personnel Administration, Payroll, and Travel
Cash Controls
Control of Income
Cost Distribution
Financial Accounting and Reporting

JOBSITE

Procurement
Receiving and Inspection
Warehousing and Inventory Control
Management of Capital Assets
Surplus Property
Service Operations
Personnel Administration, Payroll, and Travel
Cash Controls
Control of Income
Cost Distribution
Records and Reports

TELETYPE SECTION.

The functional responsibility for teletype communications from Home Office to Jobsite was transferred from Office Services to the Project Controller in November 1957. During the early stages of Operation HARDTACK, the services of three operators were sufficient for handling all teletype traffic originating in the Home Office; however, a steadily increasing volume of teletype communications required a fourth operator in November 1957.

After a temporary discontinuance early in 1957, unattended teletype service was again provided for the receipt of messages transmitted by the ACAN network. By means of this service, messages received during non-working hours were available for delivery upon the return of operators to duty. The monthly volume of traffic handled by the Home Office teletype room increased steadily from 2000 messages in April 1957 to a peak of 4085 in January 1958.

SECTION 3
ESTIMATING

Cost estimating and related work were performed by two Project Estimating Groups, one located at the Home Office and the other at EPG. The Home Office Group, directly responsible to the Manager, Construction and Facilities, worked under the supervision of the Project Chief Estimator for AEC activities. The Jobsite Group functioned as part of the Jobsite Engineering Division under the control of the Resident Engineer. Basically, the Home Office Group prepared estimates for work designed in the Home Office, and the Jobsite Group prepared estimates for work designed at Jobsite.

The more accurate and the more precise the criteria on which estimates were based, the closer the estimates were to the actual costs. Because original criteria were usually incomplete and subject to change, a series of estimates was prepared starting with original criteria and progressing to final criteria. The various types of Construction Cost Estimates referred to in the table below indicate the sequence in which they were prepared and also the type of criteria upon which the estimates were based.

SEQUENCE	CRITERIA	TYPE OF ESTIMATE
1	Letters, one-line diagrams, sketches, etc.	Preliminary
2	Unapproved drawings considered to be approximately complete	Original
3	Approved, complete drawings	Current
4	Approved, complete drawings, plus indication of cost trends from actual progress reports and costs	Working Estimates and Analyses

Preliminary Cost Estimates were used as a basis for Construction Budget Submittals, Long Range Reports, and Special Reports and Studies. They were also used for scientific and other types of construction where a general indication of cost was desired.

Original Cost Estimates were submitted with requests to AEC for approval of drawings, together with requests for approval to proceed with construction. They were also used as a basis for "Preliminary Proposals" for PAC work which was estimated to cost $20,000 or more.

Current Cost Estimates were based on final approved drawings. When these estimates were approved by the AEC, they became the official estimates which were used for computing fee, determining construction progress, and for controlling cost. All of these types of estimates were revised when the scope of work, as defined by the drawings, was changed.

Working Estimates and Analyses, prepared by the Jobsite Estimating Group, provided a means of job labor control which enabled Management to undertake corrective measures, when necessary. They also acted as an aid to future cost estimating, the establishment of current measurements of actual performance, and the provision of data for use in preparing reports.

Working Estimates and Analyses were prepared at intervals as follows:

1. Plant Acquisition and Construction Work.
   a. Under $10,000, at 100% completion.
   b. Over $10,000, at 33%, 66%, and 100% completion stages.
2. Expendable and Reimbursable Work.
   a. Under $10,000, at 100% completion.
   b. From $10,000 to $50,000, at 50% and 100% completion stages.
   c. Over $50,000, at two-week intervals and 100% completion.

In addition, "Special Report Cost Estimates" were prepared to reflect the total estimated cost involved for the preparation of special studies and reports as requested by AEC, and "Cost Studies" were prepared to reflect differences in cost for various designs of construction. The latter were prepared primarily to assist Design Engineers and others in the selection of construction methods and designs.

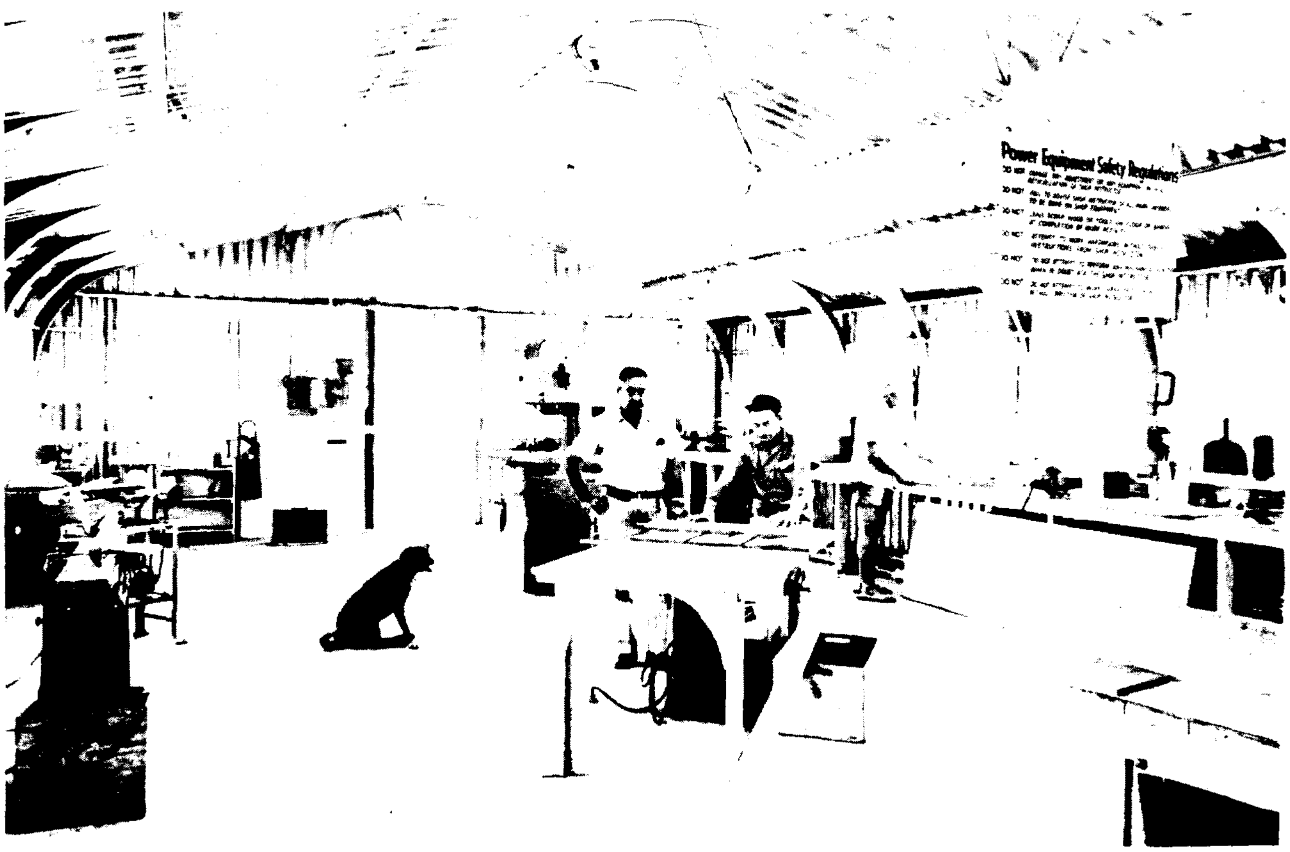
The Home Office Estimating Group collected construction progress data from Jobsite, applied weighted values to each item of construction, and computed progress for various PAC projects and expendable construction. These progress reports were in the form of bar charts and "S" curves and were distributed to AEC and H&N management for over-all job evaluation.

The following table reflects the number of estimates, by type, and their approximate total values:

TYPE OF ESTIMATE OR WORK ORDER	NUMBER	APPROXIMATE VALUE
Preliminary	210	$ 38,000,000
Original	915	21,000,000
Current	1,270	54,000,000
Working Estimate and Analysis	419	65,000,000
Special Reports	29	400,000

(Neg. No. W-V-291-1)

Figure No. 3-1. Swimming Area with Shark Net Installation — Nan.



(Neg. No. W-886-10)

Figure No. 3-2. Main Room of Hobby Shop — Elmer.

SECTION 4
PERSONNEL & SECURITY

GENERAL.

From experience gained through past Operations and in anticipation of broader requirements for Operation HARDTACK, the Industrial Relations Division at EPG and the Corporate Personnel & Security Department of the Home Office were enlarged to include collateral services. The H&N Corporate Personnel & Security Department provided all Home Office industrial relations and security support for the AEC Facilities Project Group. Close coordination between these two offices in matters pertaining to policies, personnel standards, and manpower requirements resulted in fulfilling satisfactorily all AEC Facilities Project Personnel & Security requirements. Although there was no direct organizational relationship between the Corporate Personnel & Security Department and the AEC Facilities Project, the former group furnished certain services, including personnel recruitment and processing, insurance activities, monitoring of AEC security policies, personnel relations, and travel arrangements. The Corporate Personnel & Security Department was directed by the Manager, Personnel & Security, with the aid of Assistant Managers and Section Supervisors. These sections included Employment, Personnel Relations, Security, and Clerical and Travel.

Activities of the EPG Industrial Relations Division were administered by a General Supervisor with the aid of assistants assigned to the functions of Personnel, Wage and Salary, Medical, Recreation, Rad-safety, Security, Guard, and Safety Departments.

A prevailing tight labor market during the latter half of 1956 required a program of limited recruitment for Engineers and other professional personnel. Authorization for a full recruiting program for off-continent personnel was received during March 1957; however, the construction deferment at EPG in August 1957 retarded employment efforts and delayed the recruiting program. After a brief interval, recruiting was resumed and by February 1958 hiring was on schedule. Approximately 4700 persons were employed for off-continent duty during Operation HARDTACK with the peak of manpower being reached on 9 April 1958, when 3158 H&N persons were at Jobsite.

August 1956	1290
September	1032
October	936
November	881
December	838
January 1957	813
February	845
March	891
April	949
May	1091
June	1267
July	1480
August	1600
September	1641
October	1807
November	2213
December	2435
January 1958	2623
February	2965
March	3214
April	3289
May	2981
June	2718
July	2392
August	1852

Includes personnel enroute to and from Jobsite.

Table No. 3-2. Average Jobsite Population.

EMPLOYMENT.

Restaffing of the H&N Home Office for preliminary work on Operation HARDTACK began in January 1957. With the exception of the Blast Study and Communications Engineering Groups, early manpower requirements were satisfied by the transfer of personnel from various Home Office divisions. The Blast Study and Communications Engineering Groups, however, called for highly specialized personnel who were not available within the H&N organization. Recruitment of qualified personnel for assignment to these groups was a difficult task due to the highly competitive engineering manpower market at the time.

Due to the lack of criteria with which to plan the initial off-continent employment program and the necessity to develop an adequate supply of cleared and qualified personnel well in advance of anticipated needs, former Operations were used as a recruitment guide. As soon as information became available, the recruitment strategy was refined. It became increasingly apparent during the initial planning stages that the magnitude of the HARDTACK operation would exceed that attained during REDWING and that the build-up would be far more accelerated. It was also apparent that Stateside recruitment efforts would be undertaken during a period of full employment, thereby encountering shortages of skilled personnel in the local labor market. For these reasons, a saturation type of advertising was conducted in Los Angeles, San Francisco, and adjacent localities.

The Honolulu Office Manager stated that a supply of skilled workmen was available in the Honolulu area. and that a substantial number could be removed from the Islands without damage to the progress of local construction activities. In view of this, it was decided that wider use would be made of the Honolulu office in the employment program. Accordingly, a recruiting quota, based upon Stateside and Honolulu employment trends, anticipated manpower needs, and an estimated rejection rate, was developed and assigned. As in past Operations, former employees who were eligible for rehire were given preference, thus delaying large scale of new hires until October 1957.

PERSONNEL RELATIONS.

After initial hiring, employees were guided by the Personnel Relations Section in all matters pertaining to their orientation, training, relationship to the total organization, general personal welfare, and their value to the work to be accomplished. Introduction to H&N practices and applicable policies were contained in an information booklet which was handed to each new employee. This, together with a booklet explaining the Group Insurance Plan to Home Office hires and an illustrated booklet entitled "Working at Eniwetok" for off-continent employees, provided all employees with answers to many pertinent questions regarding basic conditions of their employment.

The Jobsite Personnel Department was responsible for the requisitioning, reception, orientation, and assignment of all incoming personnel; maintenance of all personnel and transportation records for EPG; and delivery of all outgoing personnel to the MATS air facility at Site Fred for return to their points-of-hire.

A personnel representative met each incoming group of employees at Fred and conducted them to Elmer. Before being assigned to the division for which they were specifically recruited, all arriving employees, both new and rehire, were given a series of thorough indoctrination and orientation lectures by representatives of the Security, Safety, Camp, Timekeeping, Recreation, Guard, and Rad-safety offices. When an employee was assigned to work at another atoll, pertinent employment data were provided about that site. On Elmer the Department maintained a complete dossier on every H&N employee and on all terminees for a two-year period, and in addition a file of over 9000 Kardex records of former employees was kept.

An unexpected demand on H&N for manpower occurred in March 1958, when the request and authorization was received for the recruitment and assignment of 70 Camp Utility Workers to the Military Mess Hall on Site Fred. To facilitate recruitment and dispatch to Jobsite, Security approval was obtained to employ those individuals on Good Security Risk (GSR) clearance with "L" clearance to follow when they were authorized.

Upon the transfer of activities and facilities from Site How to Johnston Island, it was decided that personnel assigned there would be accorded the same personnel routine that prevailed at Sites Elmer and Nan. A Supervisor-Personnel was immediately assigned to Johnston Island, and an Assistant General Supervisor-Industrial Relations was assigned shortly thereafter to direct all divisional activities there. Additional personnel were recruited through the H&N Honolulu Office and transported directly to Johnston Island via MATS.

OTHER SERVICES.

Establishment of a Clerical & Travel Section in the Home Office permitted consolidation of all employee records, thereby eliminating duplications. A study was performed, equipment purchased, and a master card index file was compiled incorporating all pertinent security and personnel information for immediate reference for current and former employees. This file has proven invaluable for efficient departmental operation.

During the spring of 1957 in an effort to expedite the preparation and to improve the legibility of documents covering security clearance requests, a new system for preparing and processing Personnel Security Questionnaires was installed. Briefly, this system incorporates

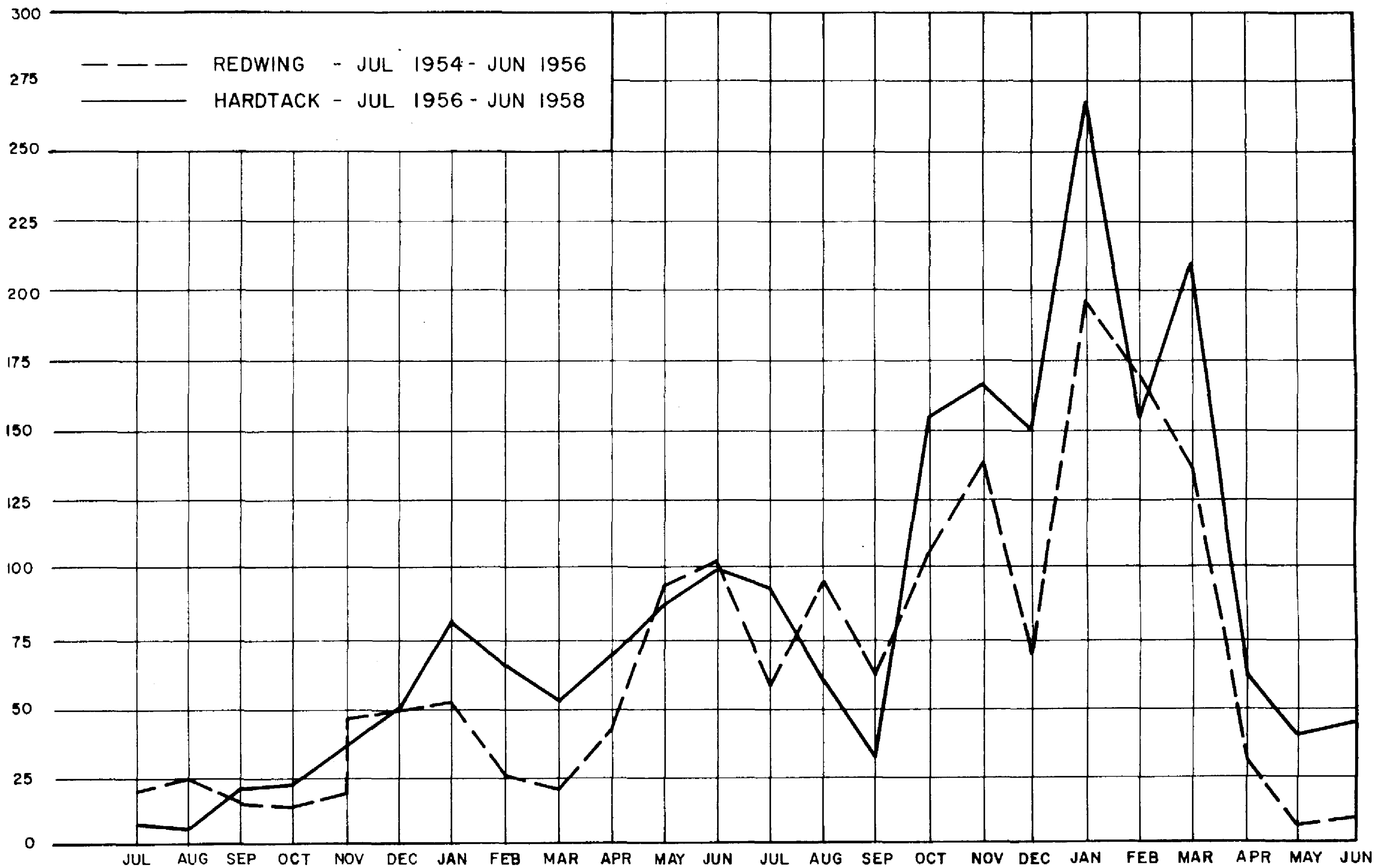


Chart No. 3-6. Honolulu Hires — HARDTACK vs. REDWING.

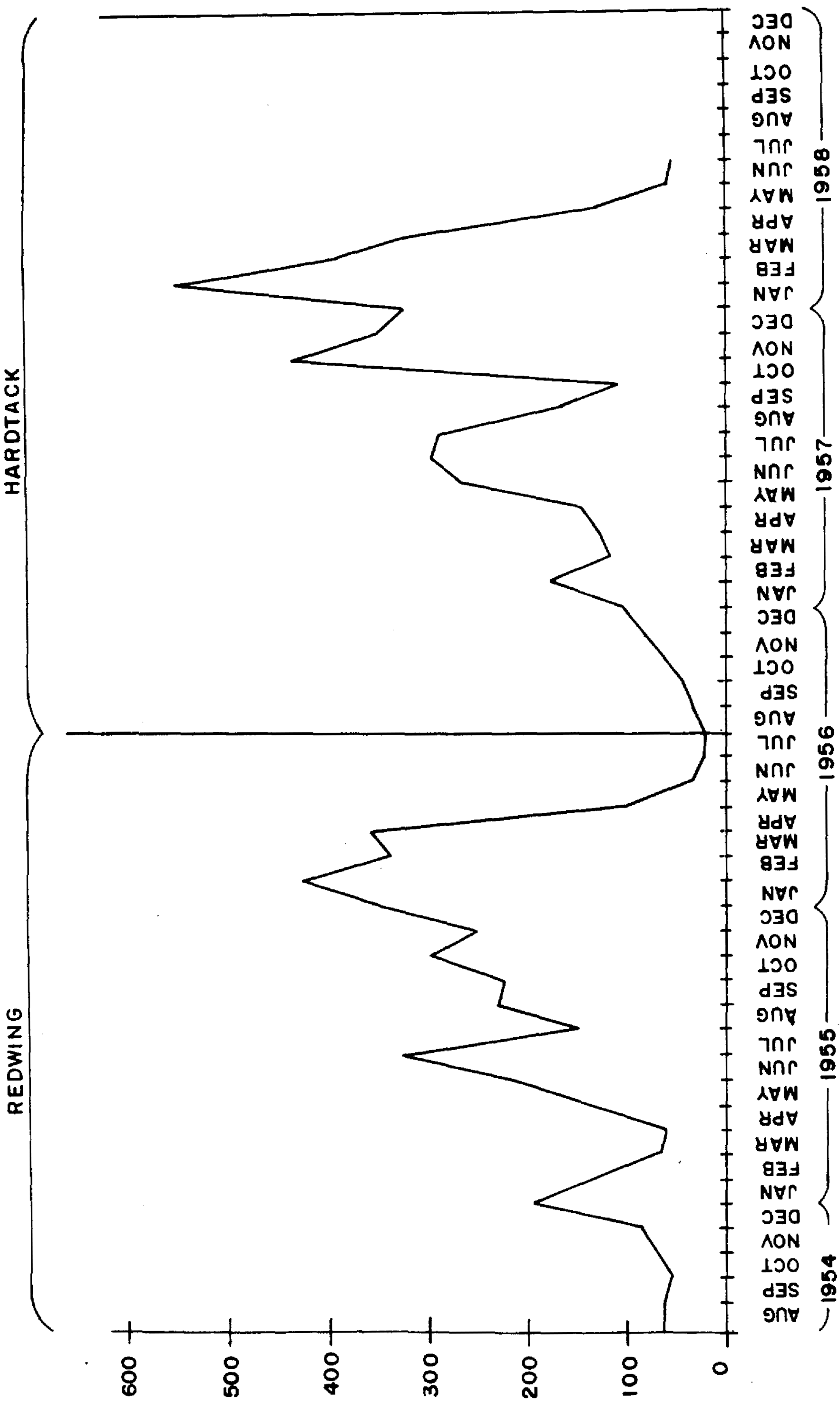


Chart No. 3-7. Total Hires — Off-Continent — HARDTACK vs. REDWING.

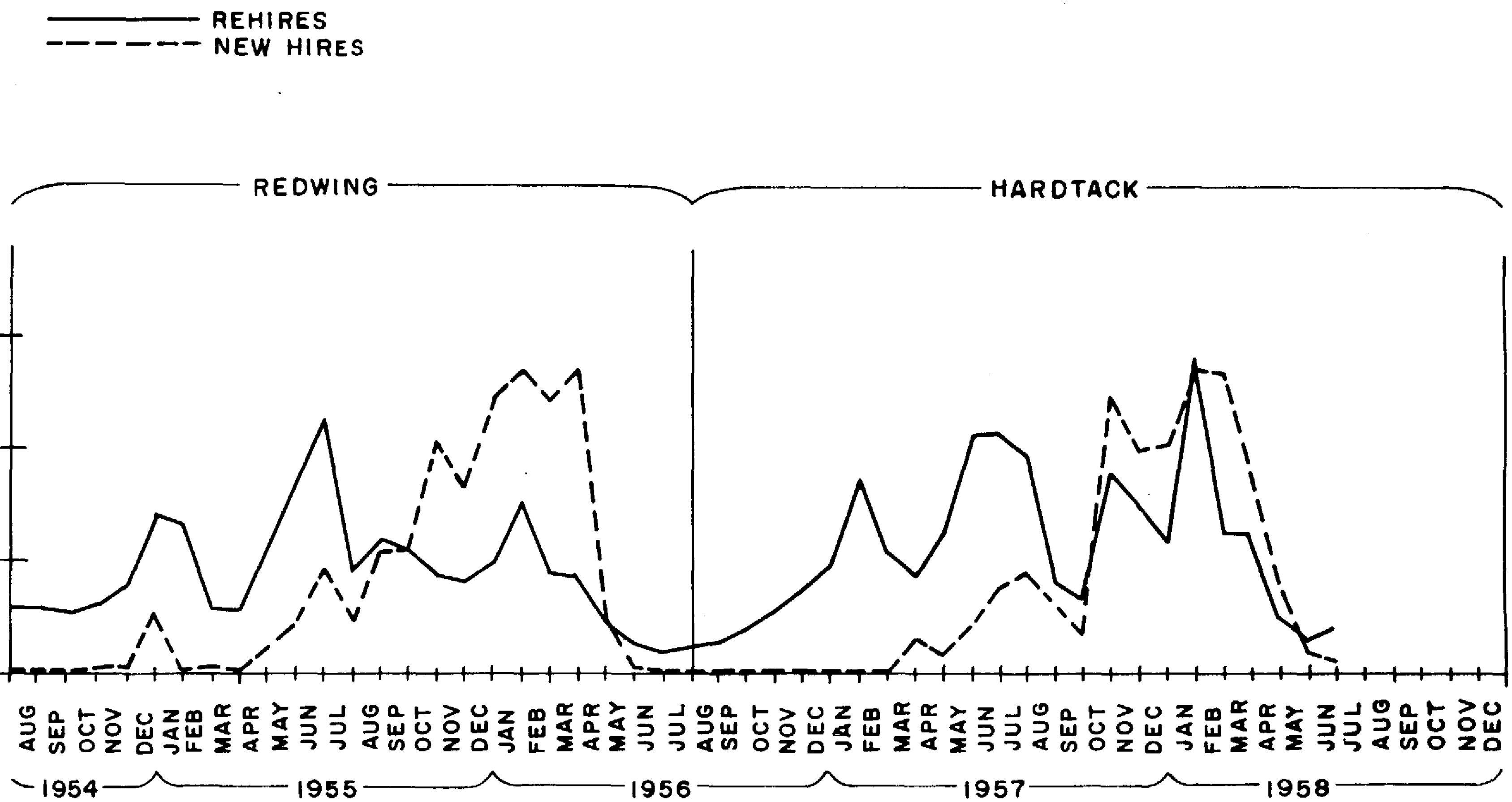


Chart No. 3-8. Rehires and New Hires — Off-Continent —
HARDTACK vs. REDWING.

	LA	SF	HONOLULU	SEATTLE	TOTAL	REHIRES	NEW HIRES
Aug. 1956	22	5	6		33	29	4
Sept.	21	5	16		42	42	0
Oct.	34	8	25		67	64	3
Nov.	38	13	28		79	76	3
Dec.	51	7	44		102	99	3
Jan. 1957	69	16	92		177	175	2
Feb.	43	17	56		116	115	1
March	44	26	54		124	109	15
April	74	15	54		143	125	18
May	118	56	89		263	215	48
June	122	55	118		295	217	78
July	126	74	86		286	195	91
Aug.	63	54	53		170	85	85
Sept.	66	14	25		105	70	35
Oct.	197	72	163		431	183	248
Nov.	160	56	137		354	155	199
Dec.	126	48	136	1	324	120	204
Jan. 1958	201	88	265	14	554	283	271
Feb.	154	67	175		396	126	270
March	77	37	197		311	126	185
April	36	14	94		144	59	85
May	15	6	33	1	55	31	24
June	20	7	25		52	42	10
July	27	10	104	1	142	81	61
Aug.	30	12	20		62	61	1

Table No. 3-3. Total Hires — Off-Continent.

MONTH	LA	SF	HONO	TOTAL	CC	VQ	SURP	PU	DISCH	DECEASED	INJ	TRF	OTHER
AUGUST 1956	242	77	241	560	162	4	391	1			2		
SEPTEMBER	75	8	26	109	69	3	34	3					
OCTOBER	74	19	73	166	112	7	46					1	
NOVEMBER	62	14	36	112	103	1	6	1			1		
DECEMBER	85	15	78	178	171	3	3			1			
JANUARY 1957	52	16	95	163	150	6	4	1	1	1			
FEBRUARY	32	13	32	77	72	3		1		1			
MARCH	27	10	34	71	68	3							
APRIL	23	9	20	52	46	5						1	
MAY	58	25	21	104	96	7		1					
JUNE	43	10	22	75	73	2							
JULY	53	20	33	106	102	4							
AUGUST	38	26	26	90	77	11		1	1				
SEPTEMBER	36	20	31	87	73	10		2	2				
OCTOBER	50	17	40	107	93	9	2	1		2			
NOVEMBER	50	19	47	116	87	21	1	5	2				
DECEMBER	75	14	82	171	153	11		5	1	1			
JANUARY 1958	72	32	112	216	169	28	3	5	5	1	5		
FEBRUARY	44	23	41	108	89	14	2	2			1		
MARCH	43	19	67	129	88	23	14	3	1				
APRIL	128	45	97	270	94	28	135	4	4		4	1	
MAY	156	68	110	334	81	21	216	2	6		4	3	
JUNE	104	66	115	285	124	55	98	9	7		2	1	
JULY	*	*	*	364	170	20	150	6	5		1		12
AUGUST 10	*	*	*	189	80	5	99	1	1				2

*Not Available.

Table No. 3-4. Total Terminations — Off-Continent.

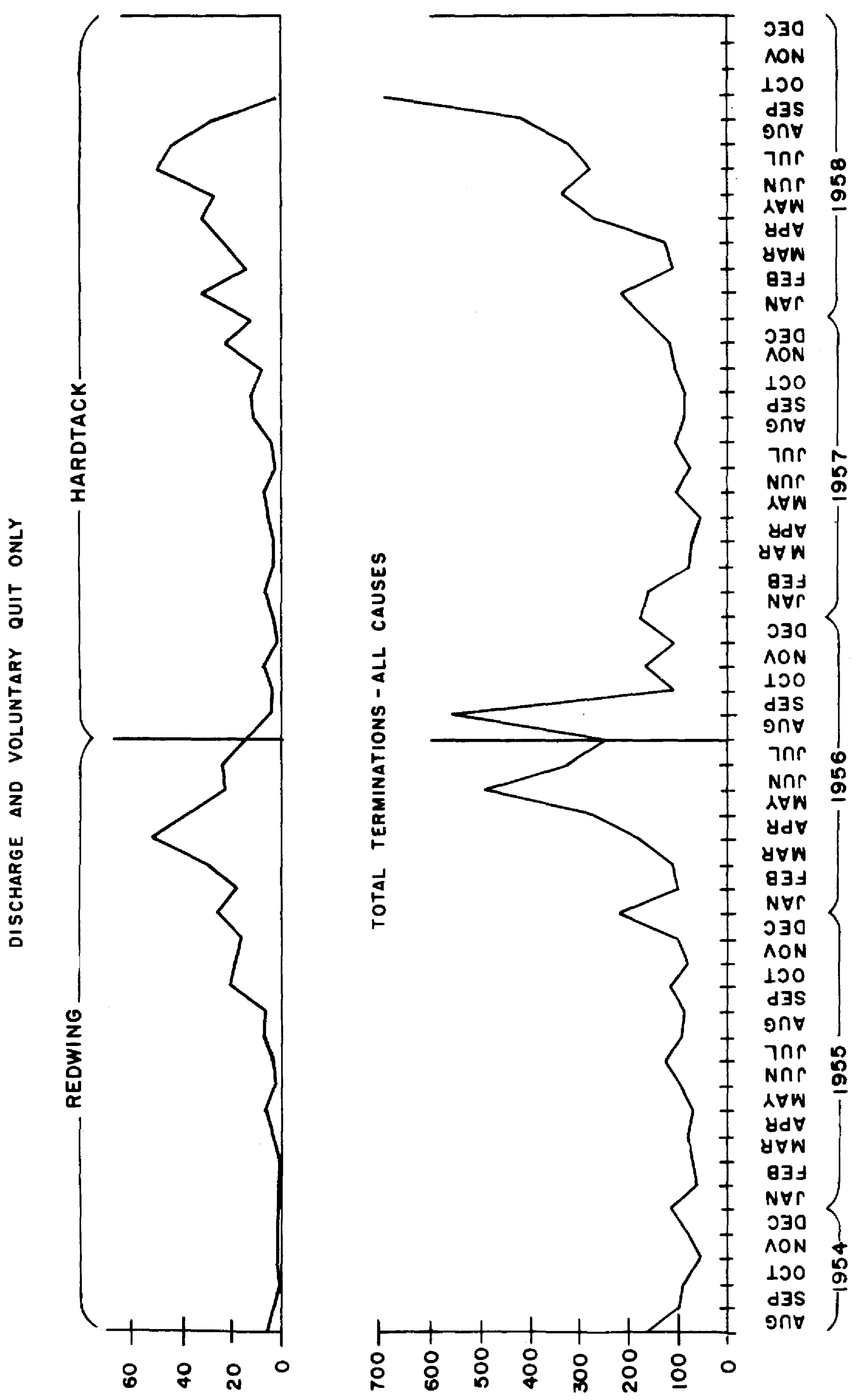


Chart No. 3-9. Personnel Turnover—Off-Continent—HARDTACK vs. REDWING.

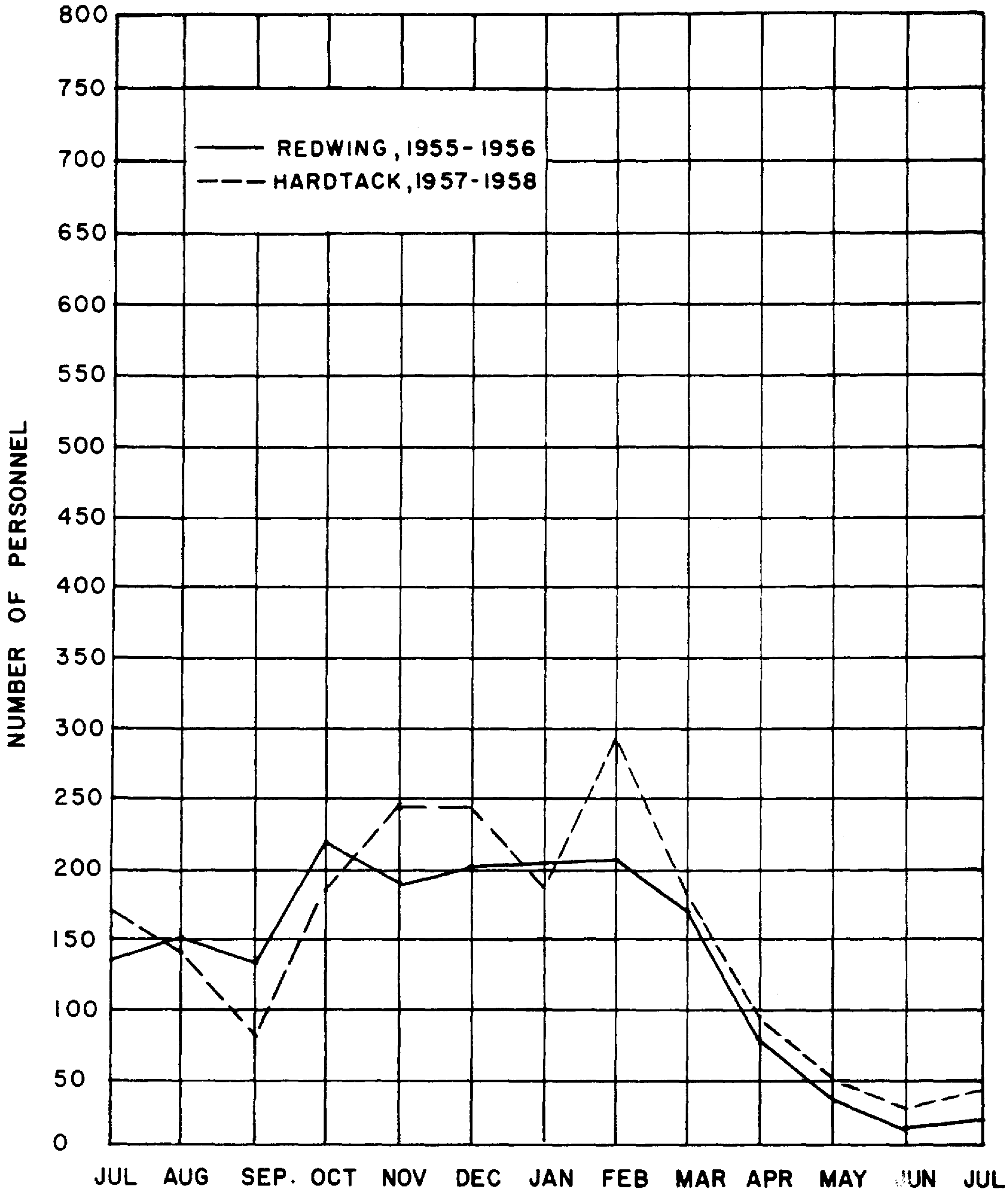


Chart No. 3-10. Personnel Transportation — Stateside to Honolulu via MATS and Commercial — HARDTACK vs. REDWING.

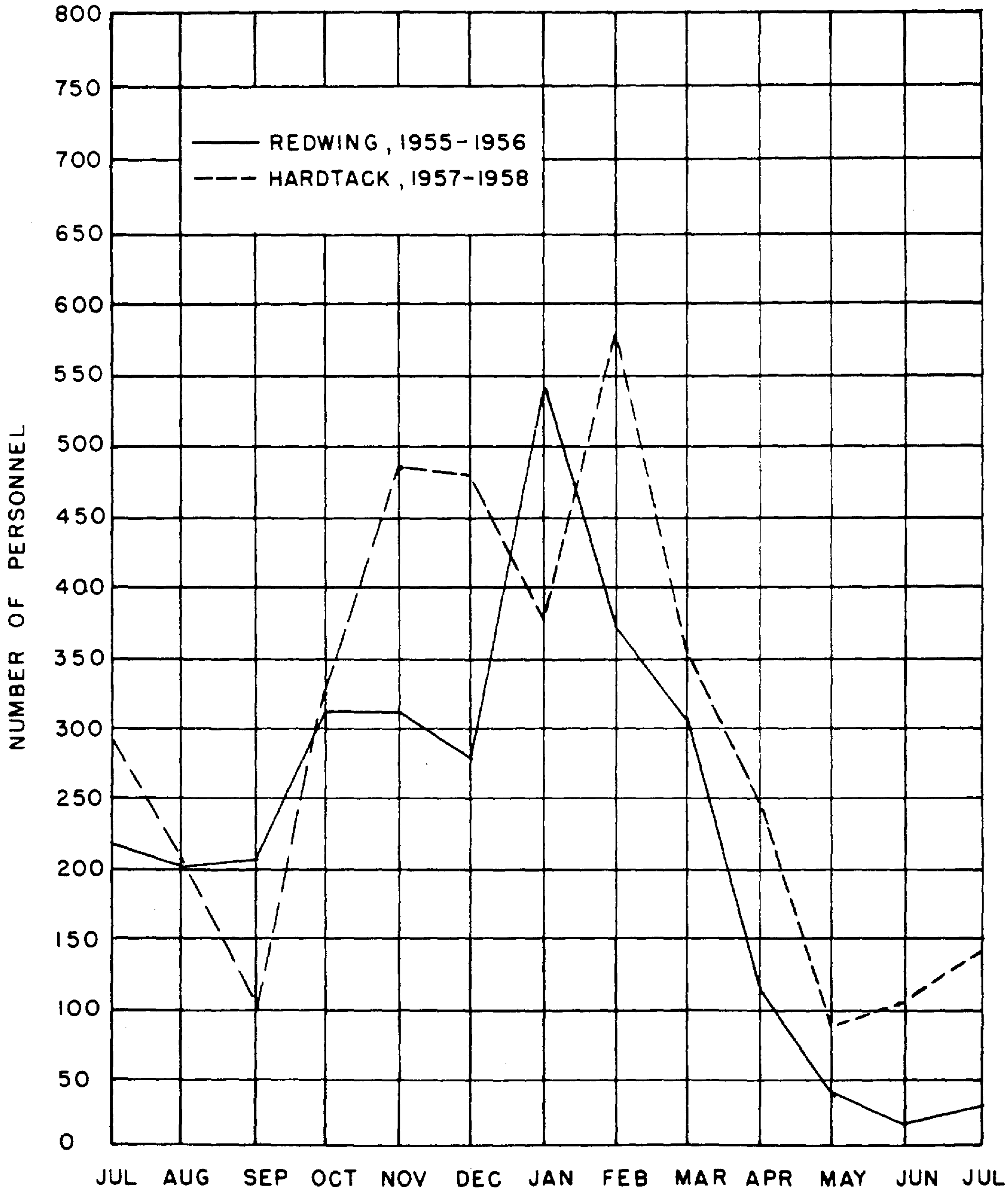


Chart No. 3-11. Personnel Transportation — Honolulu to Jobsite — HARDTACK vs. REDWING.

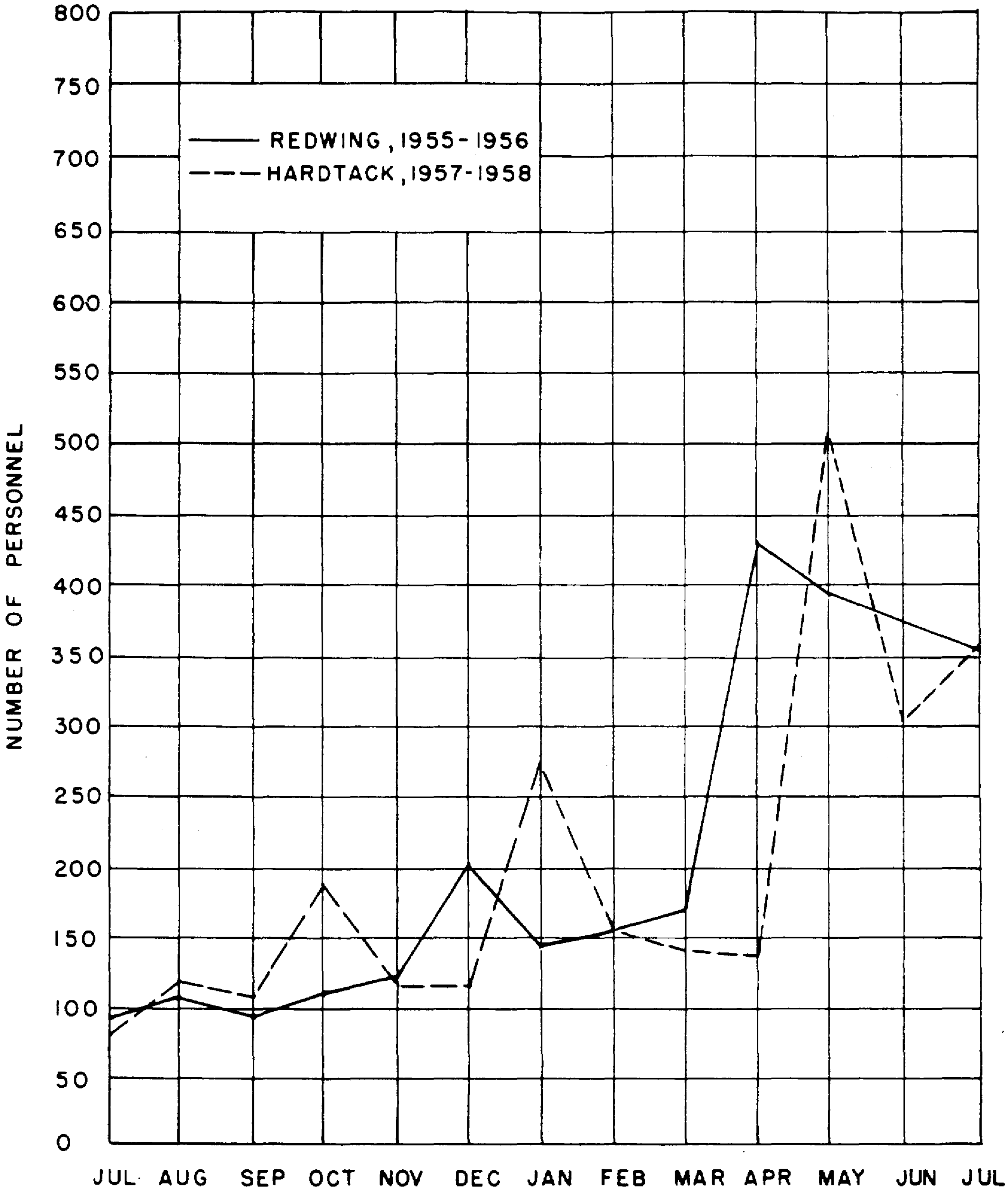


Chart No. 3-12. Personnel Transportation — Jobsite to Honolulu — HARDTACK vs. REDWING.

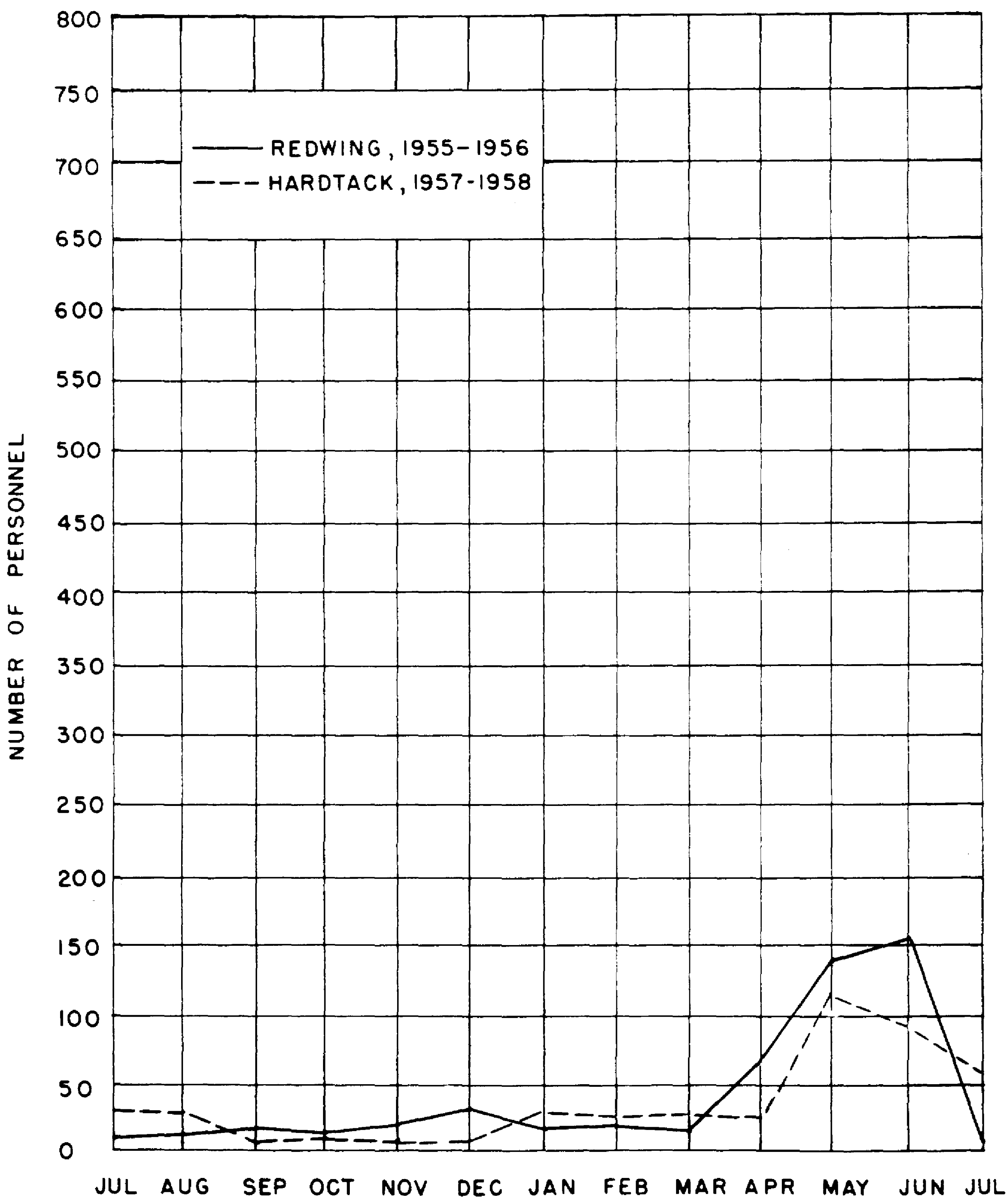


Chart No. 3-13. Personnel Transportation — Honolulu to Mainland (Commercial) — HARDTACK vs. REDWING.

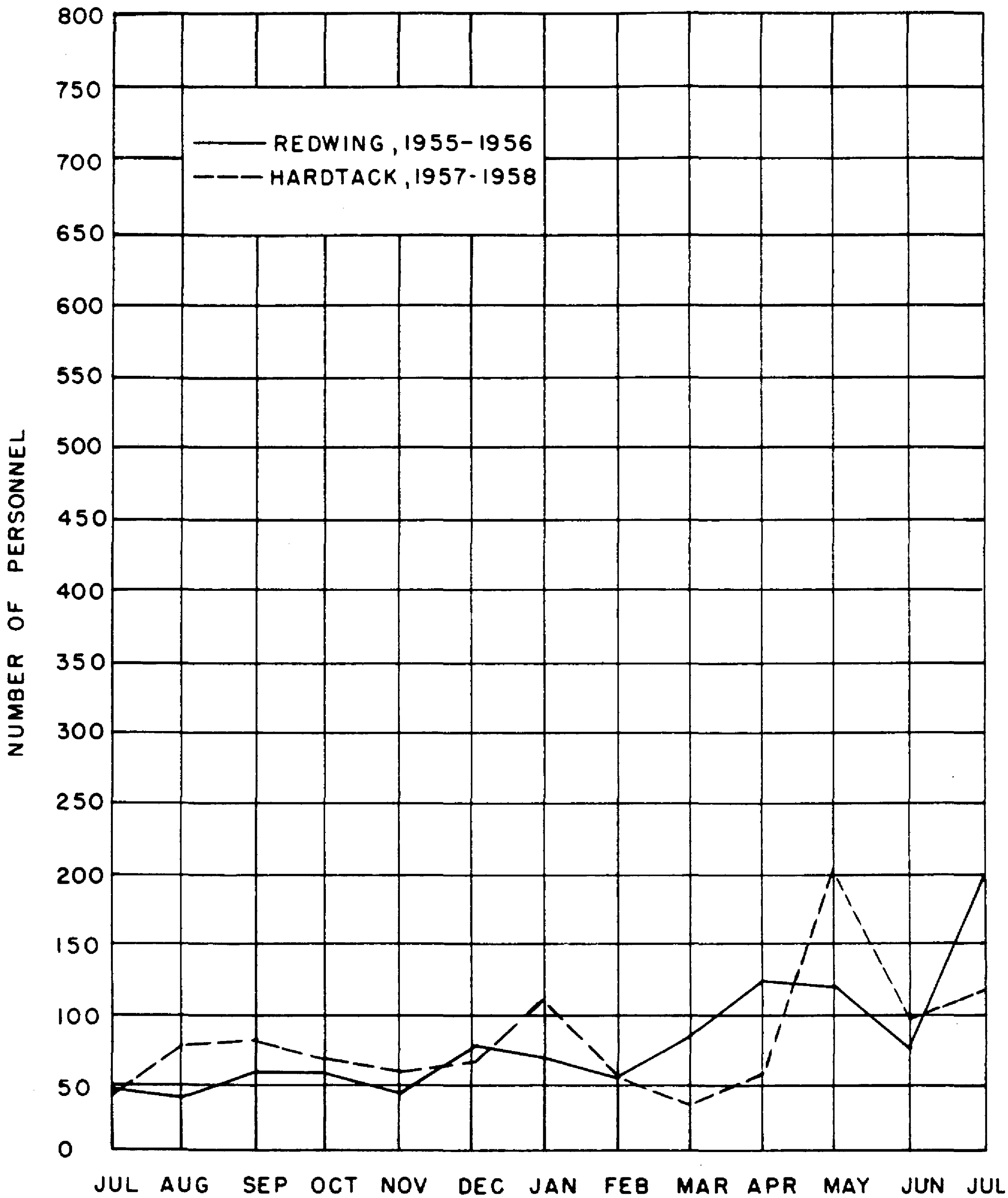


Chart No. 3-14. Personnel Transportation — Honolulu to Mainland (MATS) — HARDTACK vs. REDWING.

the use of a special ozalid typewriter ribbon which produces legible copies. A comparative study of the old and new methods of PSQ preparation indicated that 30 minutes of typing time was saved on each PSQ by the new system. In the process of re-instating security clearance, it is estimated that about one and one-half hours of typing time will be saved on each application.

The responsibility for processing and securing all travel requirements for off-continent and stateside personnel was a function of the Travel Section. In addition, all documents in connection with visitor clearance to AEC, DOD, and/or Contractor installations were prepared by Clerical & Travel Section.

During the peak of the Operation, Wage and Salary analysts were stationed at both atolls. Merit increases were checked out with appropriate Supervision and all reclassifications were investigated to ensure that individuals possessed the required qualifications for change of assignment or promotion. Temporary reclassifications met all special Jobsite needs, such as Foremen for special work of a temporary nature or the need for a replacement from assigned personnel at Jobsite. Only 13 wage claims were filed at EPG. These were due mainly to the individual's interpretation of his off-continent contract rather than to timekeeping or classification error.

SECURITY.

The Security Officer was responsible for the over-all security program, including physical security, information control, and classification at the Home Ofice, Honolulu Office, and at the EPG. The responsibility for the administration of the security program for H&N at the EPG was delegated to the Jobsite Security Officer. The Home Office Security Officer was responsible for selecting and properly indoctrinating Jobsite security personnel prior to their departure for overseas assignment. Assistant Security Officers were assigned to the EPG to assist the Jobsite Security Officer at Eniwetok and Bikini Atolls and at Johnston Island upon the activation of that site. Security activities for H&N in the Territory of Hawaii were handled by the Honolulu Office Manager, with technical guidance provided by the Home Office Security Officer.

Security forms, including identification cards and badges, were controlled by the Home Office Security Section. AEC identification cards were issued to all employees whose duties required travel to the EPG to serve both as a means of identification and to provide for the employee's re-entry into the United States. The Manager, Personnel & Security Department, the Home Office Security Officer, and the Honolulu Office Manager were designated as Adjutants General for TG 7.5 of JTF-7 and were empowered to sign and issue Government Travel Orders to the EPG. Assistant Security Officers at the Home Office and members of the staff of the Honolulu Office Manager also were so designated, as required.

Excellent liaison, nationally and locally, with governmental agencies, particularly with offices of the AEC, was enjoyed throughout the Operation and aided greatly in maintaining high standards of security. In furtherance of the goal of achieving a favorable security record, conferences were held at ALOO and in Los Angeles with representatives of the Test Division Security Office, the Office of Personnel Security, and the Classification Division of ALO. Administrative agreements relative to clearance processing with the Office of Personnel Security and the Test Division Security Office resulted in a reduction of the time required to obtain security clearance.

On 9 May 1957 the AEC granted the authority to H&N to determine an employee's suitability for employment in an uncleared status and to assign him to the EPG as a "Good Security Risk." It was required that any employee granted this approval be processed for at least an "L" clearance.

In addition to the Home Office location at 828 South Figueroa Street, facilities were maintained at 751 and 816 South Figueroa Street, and at 849 South Broadway, Los Angeles, California. The Records Center was located at 1335 South Figueroa Street, Los Angeles, California. Also, AEC "Q"-cleared subcontractor facilities were maintained at Hollywood Accessories Company, 1612 West Washington Boulevard, Los Angeles; B-P Blueprint Company, 747 South Figueroa Street, Los Angeles; and Allied Blueprint & Supply Company, 808 South Figueroa Street, Los Angeles, California. Periodic inspections of the various phases of the H&N security program at these facilities were conducted by Security Inspectors of the Atomic Energy Commission. Storage for all Restricted Data material in the Home Office was maintained in the Project Files at the 849 South Broadway location. Repositories containing classified information at all locations utilized by H&N were checked by members of the Guard Force at least hourly during non-working hours. Also, periodic inspections of repositories were made by a representative of the Security Officer to check classified inventories.

All Home Office employees received an initial security indoctrination lecture upon receipt of their clearance and participated in a semiannual re-indoctrination program. This educational effort was based upon a lecture series augmented by visual aids. At EPG all incoming and outgoing employees received security lec-

ITEM	8-10-56 THRU 12-31-56	1957 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1958 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
"QL" Requests	149	70	93	96	179	334	245	153	242	99	117	216	175	180	49	33	22	20	34	26	20	30			
"Q" Requests	28	1	4	5	19	14	1	16	17	5	30	36	45	11	52	43	5	3	6	12	0	2			
"QR" Requests	62	44	47	108	156	116	59	50	36	19	57	58	65	53	37	9	10	5	7	12	5	6			
ACCUMULATIVE TOTAL "Q" REQUESTS	239	354	498	707	1061	1525	1830	2049	2344	2467	2671	2981	3266	3510	3648	3733	3770	3798	3845	3895	3920	3958			
"QL" Requests	149	70	93	96	179	334	245	153	242	99	117	216	175	180	49	33	22	20	34	26	20	30			
"L" Requests	3	0	5	93	187	272	306	152	64	25	20	32	69	161	40	101	0	1	8	80	0	0			
"LR" Requests	3	6	12	60	120	53	11	12	13	6	5	4	7	9	3	1	0	0	8	1	0	3			
ACCUMULATIVE TOTAL "L" REQUESTS	155	231	341	590	1076	1735	2297	2614	2933	3063	3205	3457	3708	4058	4150	4285	4307	4328	4378	4485	4505	4538			
ACCUMULATIVE TOTAL ALL REQUESTS	394	585	839	1297	2137	3260	4127	4663	5277	5530	5876	6438	6974	7568	7798	8018	8077	8126	8223	8380	8425	8496			
Removed "Q" Processing-Derogatory Info.	3	4	4	5	3	16	15	4	14	27	21	15	19	19	24	12	14	16	5	3	2	0			
Removed "L" Processing -Derogatory Info.	2	4	3	3	2	15	11	1	13	19	9	12	17	14	22	9	10	3	4	4	1	0			
Removed "Q" Processing-Other Reasons	7	3	7	6	11	20	30	18	42	34	32	27	12	19	11	17	11	11	4	5	6	8			
Removed "L" Processing-Other Reasons	4	1	6	5	10	17	15	26	59	51	59	22	25	34	22	27	20	21	12	11	5	10			
Removed "QR" Processing- All Reasons	0	1	0	0	0	1	0	0	0	0	0	0	3	1	1	0	0	2	0	0	1	0			
ACCUMULATIVE TOTAL REQUESTS CANCELLED	16	29	49	68	94	163	234	283	411	542	664	740	816	904	985	1050	1105	1158	1183	1206	1221	1239			
"Q" Clearances Received	55	38	28	40	66	64	110	135	246	222	275	165	90	209	145	173	102	77	41	24	18	19			
"QR" Clearances Received	57	35	49	82	149	131	52	51	44	23	50	47	55	59	34	12	7	11	7	5	11	4			
"L" Clearances Received	83	18	49	67	152	230	506	399	453	286	145	96	190	253	177	115	108	24	28	39	67	15			
"LR" Clearances Received	2	7	11	38	108	82	7	21	13	7	5	4	5	9	5	1	0	0	7	2	0	2			
ACCUMULATIVE TOTAL CLEARANCES RECEIVED	197	295	432	659	1134	1641	2316	2922	3678	4216	4691	5013	5353	5883	6244	6545	6762	6874	6957	7027	7123	7163			
"Q" Clearances in Process	112	138	196	246	364	612	703	715	672	493	312	357	456	400	321	195	95	14	4	10	4	9			
"Q" Reinstatements in Process	5	12	11	37	44	28	35	34	26	22	28	29	36	28	29	26	29	21	21	28	21	23			
"L" Clearances in Process	63	110	150	264	466	810	829	708	489	257	181	299	311	351	219	202	86	59	57	109	56	61			
"L" Reinstatements in Process	1	0	1	23	35	6	10	1	1	0	0	0	2	2	0	0	0	0	1	0	0	1			
TOTAL IN PROCESS FOR MONTH	181	260	358	570	909	1456	1577	1458	1188	772	521	685	805	781	569	423	210	94	83	147	81	94			
"Q" Cleared at EPG	474	543	568	574	663	766	881	985	1048	1088	1290	1428	1457	1665	1957	2109	2055	1890	1718	1524	1161	917			
"L" Cleared at EPG	299	282	290	298	322	395	458	530	541	571	696	769	817	874	1025	1083	1031	929	804	731	541	321			
TOTAL CLEARED AT EPG FOR MONTH (INCLUDES "GSR")	773	825	858	872	985	1161	1339	1515	1589	1659	1986	2206	2306	2581	3012	3230	3100	2825	2528	2290	1703	1238			
"Q" Cleared at H/O and Honolulu	439	467	481	438	447	453	465	474	482	509	558	560	564	554	541	545	539	537	521	519	514	460			
"L" Cleared at H/O and Honolulu	35	22	41	52	44	40	52	59	58	54	47	36	46	40	44	45	45	43	42	44	42	33			
No Clearance	102	166	153	134	136	107	112	109	120	134	122	137	140	154	194	210	212	207	142	126	106	69			
TOTAL AT H/O AND HONOLULU FOR MONTH	576	655	675	624	627	600	629	642	660	697	724	733	750	748	779	800	796	787	705	689	662	562			
Average Time for "Q" Processing (Days)	84.85	85.11	89.12	81.12	71.36	75.68	75.33	82.12	82.41	90.04	81.08	81.59	85.55	77.91	82.22	78.83	81.72	72.95	94.68	81.79	63.11	77.73			
Average Time for "QR" Processing (Days)	18.58	14.45	13.14	11.31	8.61	11.53	14.36	14.00	12.18	13.13	11.29	11.09	14.58	14.88	9.14	11.91	12.00	13.63	11.14	19.60	12.54	9.03			
Average Time for "L" Processing (Days)	40.81	41.98	38.73	33.11	30.36	35.08	40.23	47.20	35.09	45.03	39.90	31.41	34.11	34.81	35.12	39.10	31.18	49.84	33.87	39.53	34.86	30.00			
Average Time for "LR" Processing (Days)	5.50	7.25	4.76	7.41	8.62	11.39	19.14	17.47	11.53	9.14	10.10	10.08	10.80	7.70	8.06	8.00	8.00	8.00	12.00	9.05	9.05	10.00			

Table No. 3-5. Personnel Security Processing — Contract AT(29-2)-20.

SITE	PERIOD	TASK GROUP	TOTAL HOSPITALIZED	TOTAL DAYS
ELMER	1 March 57 to 9 August 58	7.1	56	203
		7.2;7.3;7.4	133	626
		7.5	738	3,021
		Totals	927	3,850
NAN	18 May 57 to 9 August 58	7.1	14	47
		7.2;7.3;7.4	11	33
		7.5	99	312
		Totals	124	392
JOHNSTON ISLAND	20 April 57 to 9 August 58	7.1	1	1
		7.2;7.3;7.4	41	126
		7.5	48	179
		Totals	90	306

Table No. 3-6. Hospitalizations.

SITE	PERIOD	TOTAL FOR PERIOD BY TASK GROUP	
ELMER	1 March 57 to 9 August 58	7.1	2,390
		7.2;7.3;7.4	3,452
		7.5	26,258
		Total	32,100
NAN	18 May 57 to 9 August 58	7.1	681
		7.2;7.3;7.4	2,109
		7.5	7,934
		Total	10,724
JOHNSTON ISLAND	3 April to 9 August 58	7.1	189
		7.5	1,030
		7.2;7.3;7.4	1,340
		Total	2,559

Table No. 3-7. Out-Patient New Visits.

tures by the EPG Security Officer or his representative.

A contract guard force of 14 men was maintained at the Home Office. A Guard Sergeant under the supervision of the Home Office Security Officer was responsible for the administration and effectiveness of the guard force.

While the build-up for Operation HARDTACK commenced in March 1957, it was not until November that Jobsite requirements necessitated a limited number of "GSR" (Good Security Risk) clearance be authorized in order to expedite certain categories of workers to the EPG. It was mandatory that "GSR"-cleared employees be utilized in non-sensitive jobs not requiring access to classified material. From 15 October 1957 to 15 March 1958, it was necessary to dispatch 107 "GSR"-cleared H&N employees to Jobsite for employment in the Construction & Maintenance, Service Operations, and other divisions. The cut-off date for "GSR" employees — that is, the date by which "GSR"-cleared employees had to depart Jobsite—was 15 March, at which time it was determined that only 5 of the remaining 17 "GSR"-cleared employees would obtain "L" clearances. Special extensions of the cut-off date were granted individually to these 5 men, and they were "L" cleared by 27 April 1958.

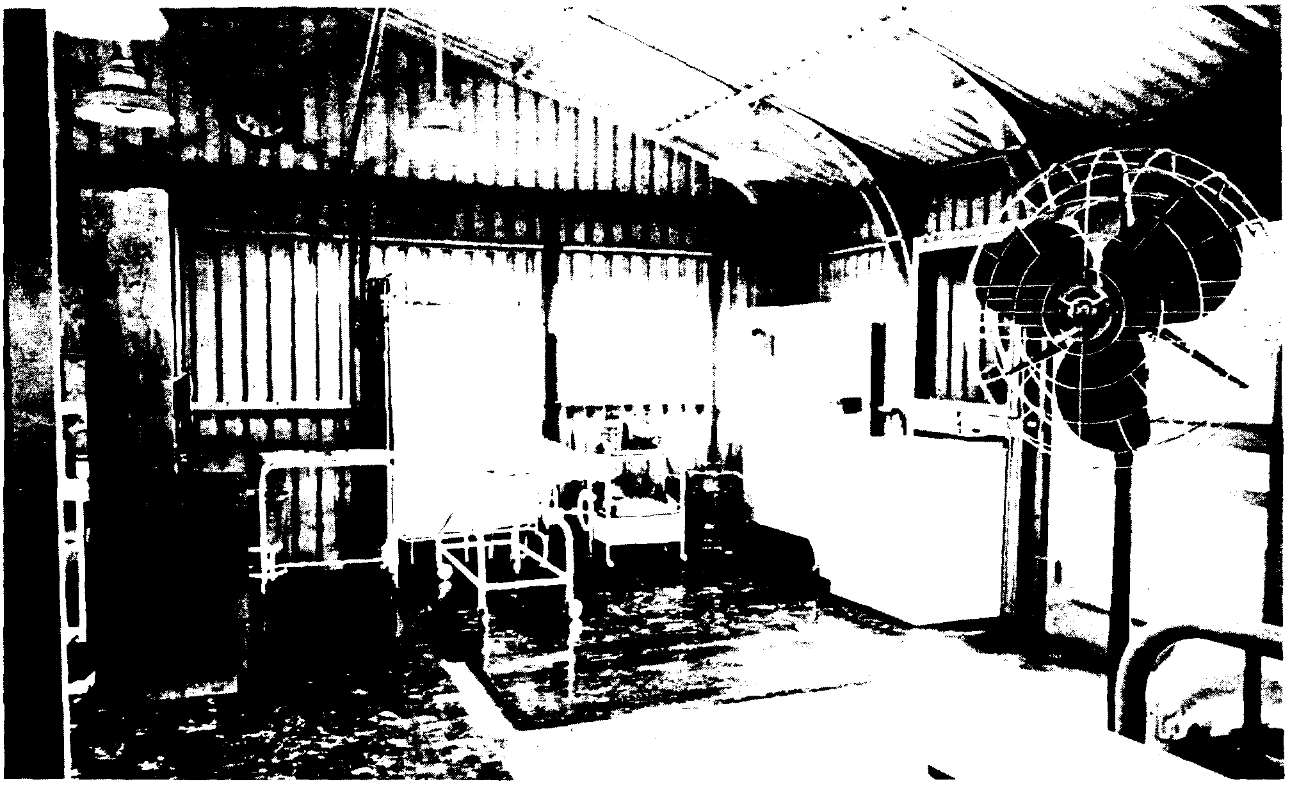
The greatest manpower urgency occurred in the Camp Utility Worker classification in the Camp Department, caused by the conclusion of an agreement with Military Task Groups whereby H&N would supply 70 such workers to provide general assistance in the preparation of food, its serving, mess hall cleaning and maintenance, and scullery work at the Fred Mess Hall. By agreement and authorization those workers were to be employed on a "GSR" clearance, and until such time as they received their "L" clearances they would not be permitted to leave Site Fred. By 1 June 1958 all but two of these employees had received an "L" clearance. The remaining two employees were transferred to Johnston Island where they soon received "L" clearances.

The Pass & Badge Office was a separate section under the direct supervision of the Jobsite Security Officer. The duties of the Pass & Badge Section was to prepare all identification badges for all Task Groups in the EPG; to maintain strict accountability of all identification media; to keep accurate files containing a record of all identification media issued and certificates signed by individuals visiting and assigned to controlled areas at EPG; to retain accurate files of active personnel clearances of all persons of all Task Groups authorized access to AEC-controlled areas at EPG; and to prepare a monthly list of persons traveling to EPG by order of TG 7.1 or TG 7.5 showing dates of arrival and departure.

MEDICAL AND DENTAL.

The Medical Department was under the administrative supervision of the General Supervisor-Industrial Relations, and was supervised by a Chief Medical Officer. The primary function of the Medical Department was to provide a medical and surgical program and emergency dental service to H&N employees and to personnel attached to other elements of JTF-7. Surgical and dental services were not elective by the patient. With the exception of emergency appendectomies and some emergency care of traumatic conditions, surgery was limited to injuries and infections which, by treatment at Jobsite, would restore the patient to active duty in a reasonable period of time. Major surgery cases were evacuated by air to general service hospitals, usually the Tripler Hospital or the Queens Hospital at Honolulu. All medical and dental services were under the direct supervision of a Chief Medical Officer at Site Elmer who was assisted by a Medical Doctor and a Dentist assigned to Nan and by a Medical Doctor and a Dentist assigned to Johnston Island. Under the respective Medical Doctors, a Chief Aid Man directed the activities of the First Aid Men.

During the interim and build-up periods, the Chief Medical Officer made several trips to Majuro, Kwajalein, and Guam to consult with U. S. Navy Health Officers and Trust Territory Public Health Officials on procedures and regulations on the prevention, treatment, and control of hepatitis and polio. The prevalence of these conditions among the natives on the various atolls on which H&N and other TG 7.5 personnel lived and worked while Weather Stations were being constructed or operated was a matter of prime concern to the AEC and H&N. Methods in preventing their contraction by Jobsite personnel were formulated and evaluated for effectiveness. In March 1957 a Navy Sanitation Officer with long experience in tropical sanitation was invited to visit Jobsit to inspect and offer advice and counsel on that subject, with particular attention being given to insect and rodent control. The possibility of an outbreak of polio was a matter of concern to the Chief Medical Officer. Early in 1957 he strongly recommended that immunization vaccine be administered at Jobsite on a compulsory basis. The presence of polio at Majuro Atoll caused the Army, Navy, and Air Force to adopt the Salk immunizations and a tri-services recommendation was made that the program be extended to all personnel in the EPG. In February 1958 H&N, with the concurrence of the AEC, started the first round of polio shots on a compulsory basis. An insignificant number of employees refused the shots and signed waivers absolving H&N of any re-



(Neg. No. W-729-11)

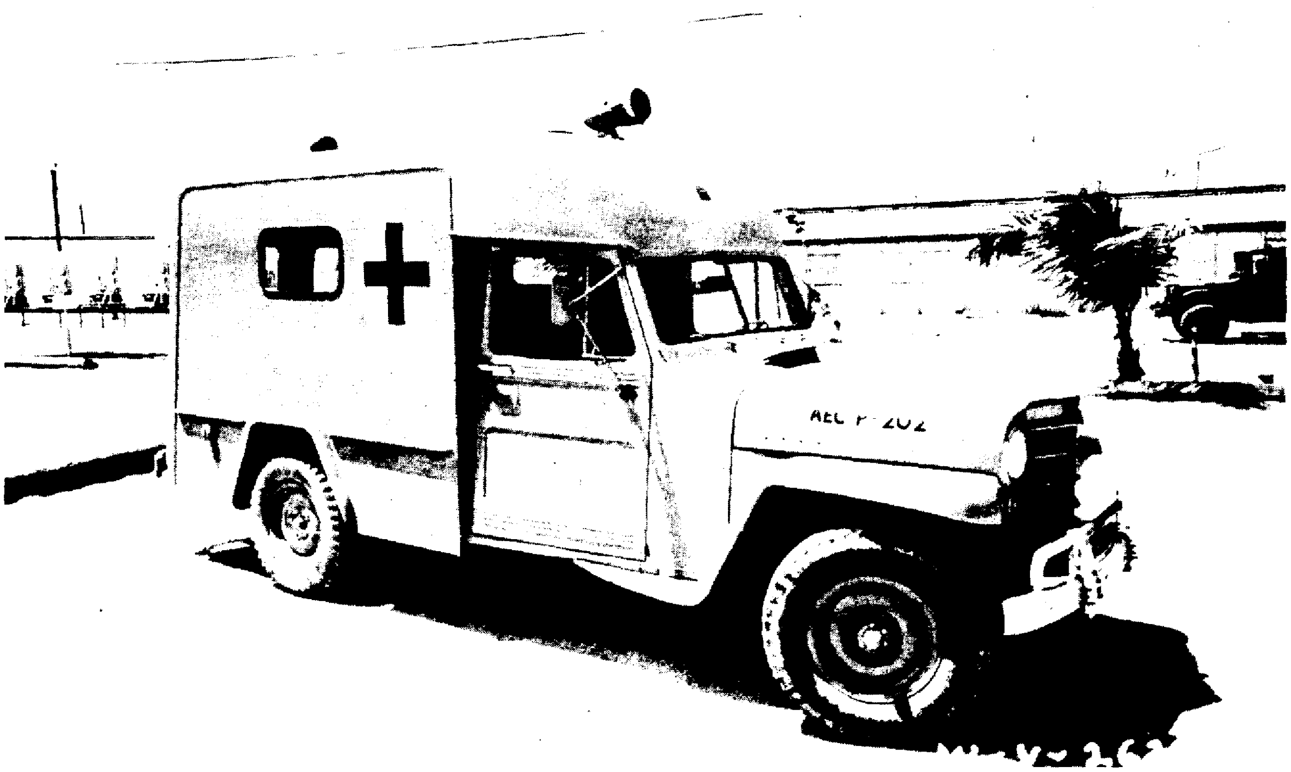
Figure No. 3-3. Hospital Emergency Treatment Room — Elmer.

(Neg. No. W-729-9)

Figure No. 3-4. Hospital Ward — Elmer.

SITE	PERIOD	TASK GROUP	NUMBER
ELMER	1 March 57 to 9 August 58	7.1	108
		7.2;7.3;7.4	160
		7.5	3,226
		Total	3,494
NAN	1 June 57 to 9 August 58	7.1	18
		7.2;7.3;7.4	233
		7.5	1,058
		Total	1,309
JOHNSTON ISLAND	3 April 58 to 9 August 58	7.1	13
		7.2;7.3;7.4	50
		7.5	225
		Total	288
	Grand Totals	7.1	139
		7.2;7.3;7.4	443
		7.5	4,509
		Grand Total	5,091

Table No. 3-8. Dental Treatments.



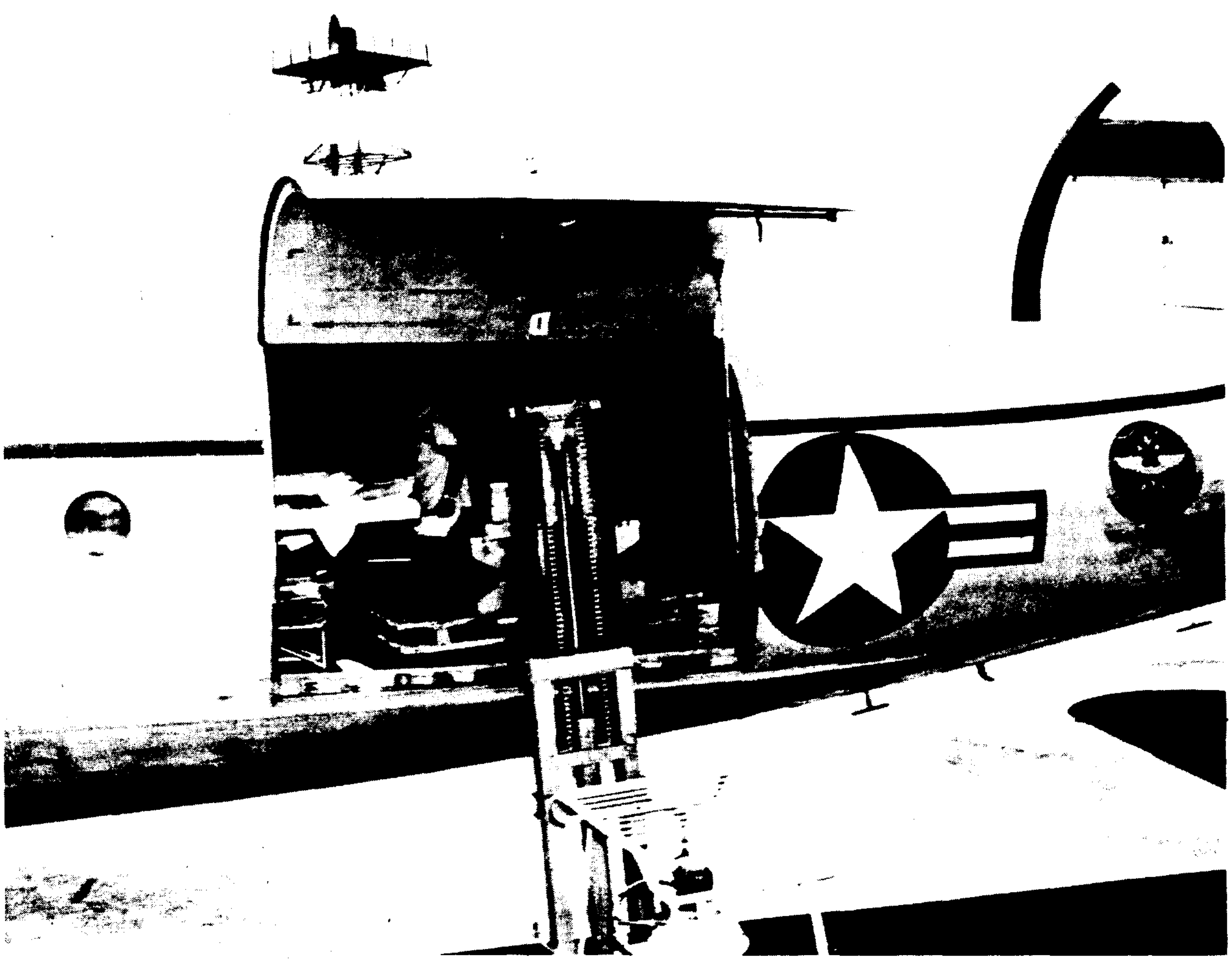
(Neg. No. W-V-262-9)

Figure No. 3-5. Jeep Ambulance.

sponsibility if they later developed polio. Not one case of polio developed among TG 7.1 or TG 7.5 personnel during Operation HARDTACK.

The Medical Department provided medical and dental services support for personnel of all Task Force Groups stationed ashore and for U.S. Navy and Merchant Marine persons who did not have medical facilities in port. In addition, complete diagnostic and therapeutic medical care on a general practice level was offered at all sites. First-Aid Men staffed the off-island Aid Stations and the Hospital-Dispensary facilities at all times to treat minor injuries and illnesses and to render first aid or nursing care. They were trained to recognize emergencies, illnesses, and injuries which required a Doctor's attention and accordingly refer patients to the regularly scheduled sick calls. Fully equipped emergency ambulances were maintained at Elmer, Nan, and Johnston Island Hospitals for litter case emergencies. Emergency first-aid equipment was available at each off-island site.

From 1 July 1956 to the end of Operation HARDTACK there were three deaths: two H&N personnel and one UCRL Scientist. One death occurred on 28 November 1957, while a H&N patient was enroute to Queen's Hospital, Honolulu, on a MATS medical air evacuation flight. An autopsy revealed that death was caused by a massive hemorrhage from the right middle cerebral artery. Another H&N man died on 3 January 1958, during an examination in the Elmer Dispensary. This patient had reported to the dispensary complaining of a pain in the chest, when he suddenly expired. The cause of death was undetermined, but it was believed to be due to massive myocardial infarction. An eminent UCRL scientist was drowned in the Eniwetok Atoll lagoon on 7 April 1958, as a result of a helicopter accident.



(Neg. No. W-736-10)

Figure No. 3-6. Air Evacuation of Patient.

RECREATION.

The Recreation Department was a function within the Industrial Relations Division and its responsibility was to conduct a sound recreational program of a sufficiently diversified nature to benefit all employees. During the interim, build-up, and operational periods the Department organized and rendered assistance in the formation of various types of participation and spectator-type games and sports at both Eniwetok and Bikini Atolls. The Recreation Department encouraged H&N and other personnel at Elmer to avail themselves of Amateur Radio Station KX6BQ and the service provided by Licensed Radio Operators to get messages through to Honolulu and Stateside in times of emergency. These operators donated a large amount of their off-duty time to provide this service.

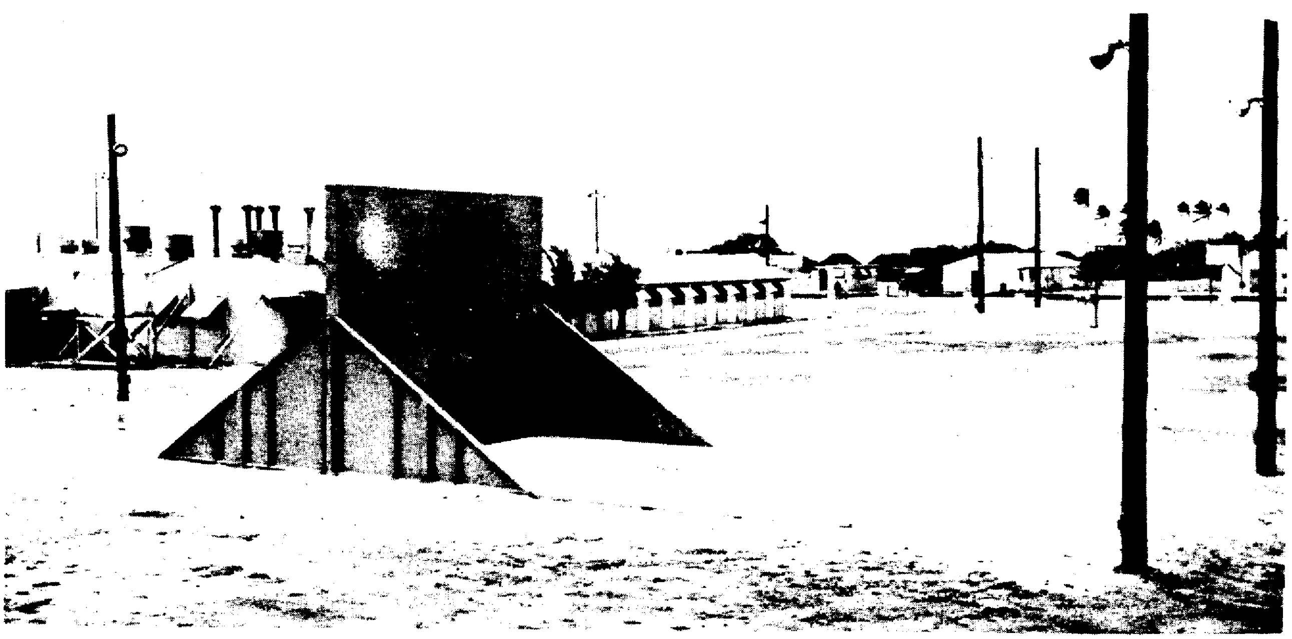
GUARD FORCES.

The Guard Department at Jobsite was under the supervision of the General Supervisor, Industrial Relations. Routine patrols were maintained to ensure that camp regulations were observed, especially in regard to personnel behavior, sanitation, and curfew time. Regular patrols were provided for the inspection of repositories to ensure that they were properly locked. Violations were reported to higher authority, and the repository was placed under guard until Supervision inspected the repository and proper disposition was made of any exposed classified documents. Fences were inspected for breaks; locks, gates, and facilities were checked to ensure that unauthorized personnel were not present and that acts of pilferage or sabotage were not committed.

Inspections were made to ascertain that required lighting of doorways, facilities, danger areas, and roadways was adequate and that all lighting was either on or off in compliance with rules and regulations. During routine patrols, watch was maintained for indications of fire in quarters and facilities, and an alarm was turned in when smoke or flame was detected. The baggage of all departing H&N personnel was inspected for contraband items, such as drugs, weapons, optical equipment, photographic equipment, inflammable items, and AEC property.

When test events were scheduled for early morning, the Guard Department cooperated with the fire fighting facility to see that all H&N employees were awakened at least 40 minutes before the scheduled shot time. Barracks and facilities were checked to ensure that laggards cleared these areas on schedule and that all personnel had reported to designated safety areas.

By arrangement with the High Commissioner, Trust Territory of the Pacific Islands, the H&N Resident Manager was authorized to prepare and issue warrants of arrest in the Eniwetok and Bikini Atolls. At least two Guards served as Deputy Sheriffs under his direction by the authority of the High Commissioner. Service of legal documents and the arrest and detention of felons constituted their functions. No occasion arose for the exercise of this authority during HARDTACK.



(Neg. No. W-V-290-11)

Figure No. 3-7. Handball Court and Basketball Court — Nan.

SECTION 5
SAFETY

INDUSTRIAL SAFETY.

Under the direction of the Safety Engineer stationed at Elmer, the Safety Department has as its main function and responsibility strict conformance to the high standards of safety and health control required on all AEC projects. In addition, the Department was responsible for the Fire Prevention and Protection Program at all sites.

The Safety Engineer and his staff also supported the representative of the American International Underwriters, Inc., who represented the insurance carrier on all matters pertaining to workmen's compensation.

An active and continuous safety program was maintained at all sites where H&N personnel were assigned. Although Fred is under control of the Military, safety activities continued to encompass all Contractor personnel and operations at that site. At Johnston Island a situation similar to that at Fred existed.

To assist new personnel in becoming acquainted with Jobsite safety requirements and some of the elements to be encountered, an indoctrination lecture was given upon their arrival. This type of programming invited safety consciousness and served as a medium for accident control. Charts pinpointing the causes of most accidents and showing which departments were experiencing the greatest number of accidents in any particular category were distributed to Supervision, creating a competitive spirit between departments and divisions which reduced the number of accidents and resulted in an improved safety record. To assist further in evaluating trends relative to accident frequency during the build-up and operational period, when increased hours of overtime were being worked, the accident frequency charts were designed to reflect hours of overtime worked by department and division so that comparisons could be made and necessary controls considered.

FIRE PROTECTION & PREVENTION.

The mobile fire protection equipment at Elmer consisted of two F.W.D. 500-gpm fire trucks, a Maxim 750-gpm fire truck used primarily for utility purposes, and a truck-mounted foam unit; a Ford 500-gpm fire truck was located at Nan. To meet the need for fire protection equipment at all other sites as they were being activated, seven Willys 500-gpm fire trucks were purchased which were more versatile and better adapted for small camp use than the larger trucks.

VEHICLE ACCIDENT DATA
(I July 1956 to 15 July 1958)

Average No. of Vehicles	388
Estimated Miles Driven	892,955
No. of Motor Vehicles Involved	11
*Frequency Rate	1.23
Total Cost of Vehicle Damages	$2,317

*Disabling injuries per million man-hours worked.

OCCUPATIONAL TIME LOST DATA
(1 July 1956 to 15 July 1958)

Average No. of Employees	2,492
Total Man Hours Worked	9,080,207
No. of Lost Time Injuries	76
No. of Days Lost	4,718
*Frequency Rate	8.37
**Severity Rate	520

*Disabling injuries per million man-hours worked.

**Days charged per million man-hours worked.

Table No. 3-9. Vehicle Accident Data.

The urgent need for additional salt water for the distillation plant and the potential need for additional fire protection at the POL area resulted in the installation of a draft hydrant close to the foam unit with the intake extending into the lagoon. This system was so installed that foam was available immediately should a fire occur in the POL area.

A new 10-inch salt water main for the fire protection system was completed on both Elmer and Fred. Additional fire hydrants were installed in the industrial section and at the Deep Water Pier. As recommended by the AEC Fire Prevention Engineer, 103 holes were cut through the deck of the Deep Water Pier and were recessed to allow metal covers to lay flush with the deck of the pier. These holes were spaced to allow maximum under-deck coverage by cellar-type fire hose nozzles in case of an under-deck fire.

SITE	DATE	AMOUNT OF DAMAGE	TYPE OF DAMAGE
Rex	3 October 1956	$ 8,636	Accident (Dynamite Magazine)
Fred	19 April 1957	130	Accident (Building)
Elmer	31 August 1957	75,000	Accident (Helicopter)
Elmer	15 October 1957	125	Accident (Equipment)
Elmer	21 October 1957	6,280	Accident (Pier)
Both Atolls	18-19 November 1957	181,870	Storm
Elmer	22 November 1957	167	Accident (Building)
Fred	22 November 1957	600	Accident (Equipment)
Nan	16 December 1957	1,800	Accident (Marine)
Elmer	18 January 1958	1,500	Accident (Pier)
Nan	18 February 1958	900	Accident (Equipment)
Elmer	17 April 1958	2,400	Accident (Pier)
Elmer	25 April 1958	1,600	Accident (Pier)
Tare	19 May 1958	4,000	Accident (Equipment)
Elmer	26 May 1958	2,420	Accident (Pier)
Elmer	12 June 1958	4,505	Accident (Pier)
Elmer	9 July 1958	125	Accident (Equipment)
Elmer	19 July 1958	1,000	Accident (Pier)
Utirik	8 August 1958	2,000	Accident (Equipment)
Elmer	19 August 1958	1,000	Accident (Pier)
Elmer	26 August 1958	200	Accident (Equipment)
Elmer	6 September 1958	1,437	Accident (Pier)

Table No. 3-10. Property Damages. (in excess of $50).

FREQUENCY AND SEVERITY OF
INDUSTRIAL ACCIDENT RATES AT EPG
AUGUST 1956 THROUGH SEPTEMBER 1958

	HOLMES & NARVER, INC.			ALL AEC CONSTRUCTION CONTRACTORS	
	FREQUENCY*	SEVERITY**	MAN-HOURS	FREQUENCY*	SEVERITY**
Aug. 1956	2.66	13	376.200	5.89	130
Sept.	0.00	0	340.680	5.62	823
Oct.	0.00	0	242,400	5.27	745
Nov.	10.34	59	290,150	5.28	690
Dec.	0.00	0	321,317	5.08	650
Jan. 1957	10.74	11	93,068	3.67	3,176
Feb.	7.91	32	253,000	3.09	1,563
March	5.09	20	196,640	2.99	2,012
April	4.85	126	206,080	3.30	1,506
May	13.23	199	226,700	3.38	1,205
June	5.61	1205	356,700	3.84	1,053
July	6.45	113	307,700	3.62	960
Aug.	4.57	34	435,390	3.43	855
Sept.	2.62	0	380,00	3.37	779
Oct.	10.13	139	391,962	3.45	726
Nov.	5.55	217	537,600	3.59	669
Dec.	1.99	169	754,750	3.64	633
Jan. 1958	15.01	34	263,900	6.68	41
Feb.	8.03	325	744,200	5.28	163
March	13.01	350	688.100	5.28	158
April	9.02	148	771,900	5.50	193
May	10.93	253	914,700	5.16	224
June	9.25	487	648,700	5.88	769
July	5.00	1,611	599,600	5.84	770
Aug.	3.03	908	659,400	5.69	722
Sept.	13.31	16,499	375,400	5.87	997

*Disabling injuries per million man-hours worked.
**Days charged per million man-hours worked.

Table No. 3-11. Frequency and Severity of Accidents.

Figure No. 3-8. Fire Station — Elmer. (Neg. No. W-682-1)

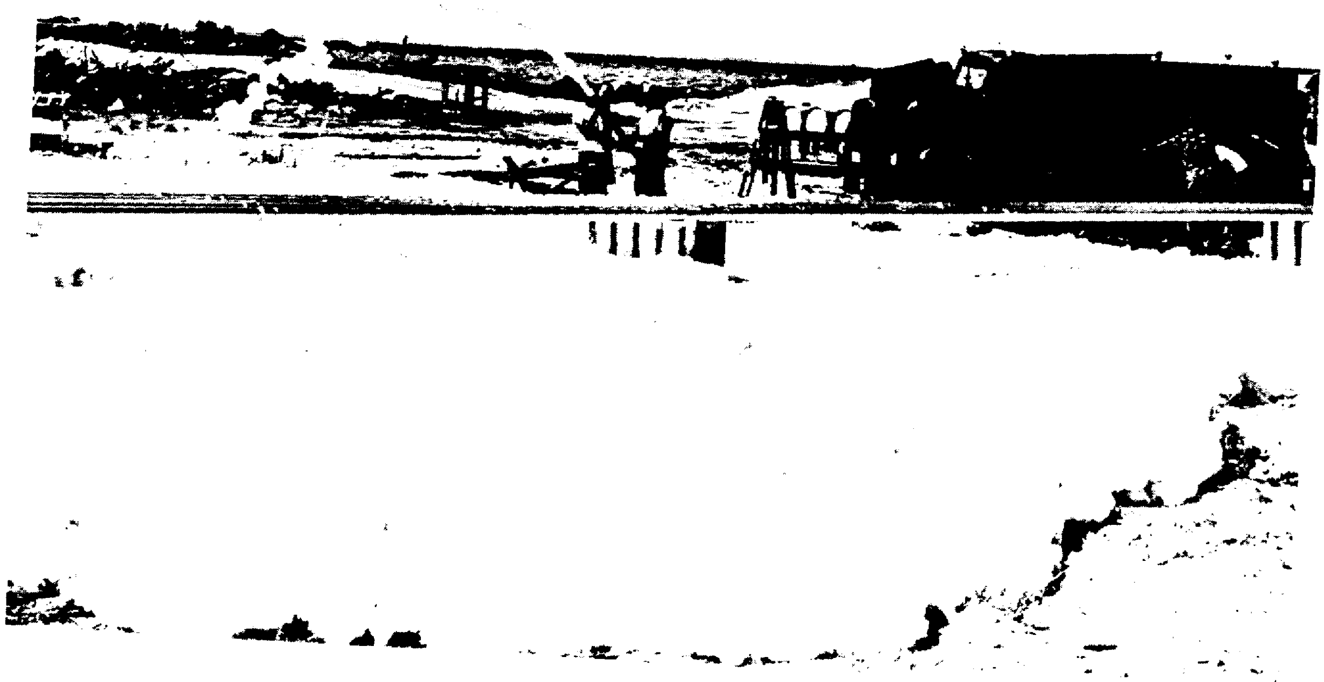


Figure No. 3-9. Spraying Foam in POL Area — Elmer. (Neg. No. W-828-9)

On 1 April 1957 the responsibility of fire protection on David was assigned to the H&N Safety Department. All fire equipment belonging to the Military was returned and replaced by equipment furnished by AEC. Military and H&N personnel stationed at this site were instructed in the use of fire protection equipment and fire-fighting techniques, and weekly inspections were made to check extinguishers, to make a general inspection of fire facilities, and to conduct routine training of personnel in fire protection methods.

With the closing of the Liquid Oxygen Plant at How, all fire prevention was transferred to Johnston Island. A Willys fire truck was later sent to Johnston Island to supplement existing fire protection.

The rehabilitation of Johnston Island to the extent required to support that portion of Operation HARDTACK activities presented many safety problems not normally encountered at other camp sites. The potential for structural fires at this site was extreme primarily due to the limited land area available for the number of facility installations. Normal winds sweep from one end of the island to the other and any fire, even moderately out of control, could readily devastate the entire area. Other factors contributing to the critical aspects of fire hazards at Johnston Island were the limited access roads for fire equipment, extremely narrow roadways requiring constant enforcement of the "no parking" restrictions, the inability to isolate storage areas for combustibles, inadequate fire hydrants, fire wells, etc., and the high potential hazard of operational facilities.

As a safeguard for personnel housed in the two-story wooden barracks, hourly fire patrols were scheduled during the hours of darkness, exterior fire escape stairways were installed at both ends of each building, emergency circuit fire phones were installed, and klaxon-type alarms were installed to effect quick evacuation of personnel.

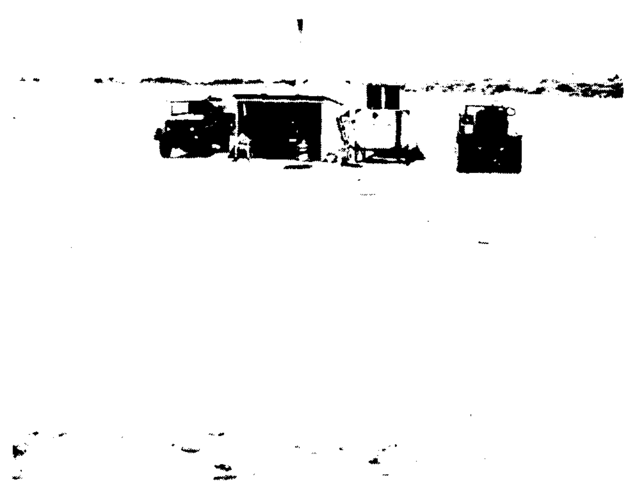
RADIOLOGICAL SAFETY.

The Rad-safety organization of TG 7.5, composed of AEC and H&N Rad-safety personnel, functioned separately from TU-6 of TG 7.1 and was designated TU-E.7. A close liaison was maintained on mutual rad-safety matters during the operational period betwen TU-6 of TG 7.1 and the H&N Rad-safety Department. Work on common problems such as dosimetry, decontamination, and instrument repair was accomplished as a joint function. On 1 April 1958 the operational control of the Rad-safety facilities, operated during non-test periods by H&N, was relinquished to CTU-6, TG 7.1.

Prior to the operational period of HARDTACK, a Rad-safety Monitors' Training School was conducted by the AEC Rad-safety Assistant and the H&N Rad-safety Officer to train personnel from the various divisions of H&N as Rad-safety Monitors for H&N work parties entering "Radex" areas. During training, emphasis was placed on recovery party operations, protective clothing and its use, medical aspects of radiation, decontamination, and radiation detection instruments. At the completion of the training course, 53 H&N personnel were available for duty as qualified Monitors.

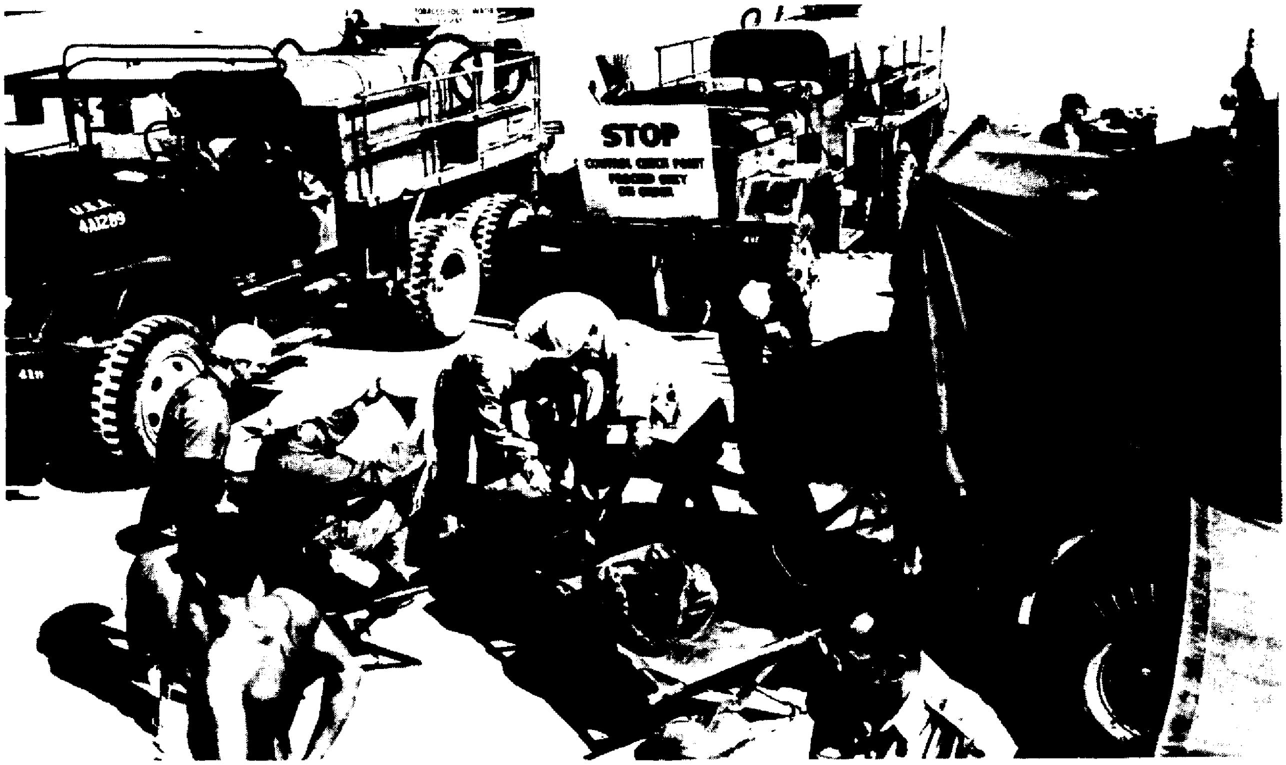
As of mid-July 1958, H&N Rad-safety Monitors at Eniwetok Atoll had accompanied 1463 persons on 209 missions into "Full Radex" areas, and at Bikini Atoll they had accompanied 1965 persons on 427 missions. The main functions of the Monitors were to advise the party leaders of radiation intensities in the areas, the accumulated dosages of the party members, and the safe "time of stay" in the areas. In addition, the Monitors relayed radiation intensity information to the Rad-safety Operations Section, which was then plotted on the daily rad-safety situation maps. In addition to monitoring for H&N work parties, the Monitors were also called upon to accompany personnel of other Task Groups into "Full Radex" areas.

An innovation in the field of rad-safety monitoring was the use of underwater Monitors. Four Rad-safety personnel, checked for physical fitness and swimming ability, were instructed in the use of the Aqua-Lung. These Monitors made underwater radiation surveys whenever H&N divers were required to do underwater work



(Neg. No. W-V-290-9)

Figure No. 3-10. Vehicle Decontamination Pad — Nan.



(Neg. No. W-W-401-1)

Figure No. 3-11. Donning Protective Clothing at Rad-safety Check Point — Yvonne.

in Radex areas. It was found that in some underwater areas the radiation intensities were in excess of 50 roentgens per hour. Rad-safety divers were instrumental in detecting and recovering a radioactive source which had been dropped from a barge into 85 feet of water.

H&N Rad-safety personnel assisted TU-6, TG 7.1, in the issuance, collection, and processing of film badges. Daily rosters were compiled of all H&N personnel who had accumulated dosages in excess of 2000 mr. After the first 13-week period of the operation, a daily roster was issued covering all personnel whose accumulated dosages were in excess of 4000 mr.

Contributing significantly to the dosage of all personnel at Eniwetok Atoll was the fall-out that resulted from the KOA event in early May 1958. This fall-out contributed up to 1500 mr to those persons who remained at Eniwetok Atoll for the duration of the Operation. It became necessary, therefore, to request that the limitation of 3750 mr dose per 13-week period be increased and the 5000-mr dose for the Operation be increased to 10,000 mr for 35 H&N employees. These were personnel whose work was of such a nature that their absence would have seriously handicapped the accomplishment of the Operation. As of 20 July 1958, only 4 of the 35 employees had exceeded the 3750 mr guide, and none had exceeded the 5000 mr limit.

Following is a summary of the dosages received by TG 7.5 personnel as of 20 July 1958:

DOSE IN MR	NUMBER OF PERSONS	PERCENT
0	674	19.5
1 to 500	521	15.1
500 to 999	362	10.5
1000 to 1999	1352	39.3
2000 to 2999	432	12.6
3000 to 3750	81	2.4
3751 to 5000	19	0.6
Over 5000	0	0.0
Total	3441	100.0

The Fs-3 Film Evaluation System, built by Eberline Instrument Company, was used for processing the film and interpreting the optical density to mr dosage. Film used was a 2-film packet containing Dupont Type 502 and Dupont Type 834 films. Film packets were dipped in ceresin wax prior to sealing in vinyl plastic cases.

On 1 April 1958 all TG 7.5 personnel were issued operational film badges. All initial issue badges were collected on 23 May 1958, and new badges were issued. Each time a badge wearer entered a "Full Radex" area his badge was exchanged for a new one upon his return from the area. Each evening all the badges which had been turned in during the day were processed, and a roster of the dosages was compiled by the IBM Group of the Dosimetry and Records Section. Bi-weekly total dosage roster and quarterly dosage rosters were also compiled.

The environmental testing and sample counting program was a joint function of the H&N Rad-safety Department and TU-6. A Rad-Chem trailer at Elmer and one at Nan provided the facilities for sample preparation and counting. The majority of samples processed were counted for gross beta activity and a small number were counted for alpha.

The following is a summary of the samples which were processed and counted during HARDTACK through 20 July 1958:

Water Samples	336
Rain Water	22
Alpha Swipes	91
Fall-outs Trays	21
Air Samples	9
Food	14
Urine (Tritium)	20
Soil	14
Marine Specimens	6
Plant Specimens	3

The decontamination activities of the Rad-safety Department were divided into two Sections: the Personnel Decon Section, and the Vehicle and Equipment Decon Section. All personnel returning from "Radex" areas were monitored at the check points and, if contaminated, they were processed through the Personnel Decon Center. After showering, they were monitored again, and, if found uncontaminated, proceeded to the "clean" side of the Decon Center, where they had left their clothes prior to departing for the "Radex" area.

The Vehicle and Equipment Decon Section was responsible for the decontamination of all contaminated vehicles and equipment to safe tolerance levels. In a few cases where steam and chemical cleaning failed, sandblasting was used. Following is a summary of the major equipment which was processed through the decon lot as of 20 July 1958:

Trucks	21	Helicopters	10
Jeeps	11	Tractors (Cat)	10
DUKW's	34	Barge	1
LCM's	2	Airplane	1

In addition, a great many miscellaneous articles and materials were decontaminated and returned to service. Materials which could not be decontaminated were placed in barrels, filled with concrete, and disposed of at sea.

The Instrument Repair Section of Rad-safety was a joint function of the H&N Rad-safety Department and TU-6. There was one H&N Rad-safety Electronics Technician assigned at Elmer, and one assigned at Nan. Their function was to repair, maintain, and calibrate all Rad-safety instruments and equipment. Due to the corrosive climatic conditions at EPG, a constant vigilance over these instruments had to be maintained. The instruments which were most troublesome and required the most repair and maintenance were the CD-V 700 beta-gamma survey meters.

Figure No. 3-12. Equipment and Materials Awaiting Shipment to Off-Atoll Site. (Neg. No. 658-2)

Figure No. 3-13. Electrical Warehouse — Elmer. (Neg. No. W-732-5)

SECTION 6
SUPPLY AND PROCUREMENT

PROCUREMENT.

The activities of the Home Office Project Purchasing Department were directed by the Chief Purchasing Agent, with the assistance of a Purchasing Agent, Chief Expediter, and Shipping Agent in the performance of all project procurement functions.

As all procurement functions were contingent upon receipt of material requisitions, coordination of activities of these groups was predicated on the required delivery date of the material or equipment. To ensure arrival of material and equipment at Jobsite within the specified delivery date, various aspects were taken into consideration: procurement lead-time, type of material or equipment, and method of shipment.

Initial procurement action was started during the late months of 1956, and the tempo increased throughout 1957 with an extended work week becoming necessary during the latter months of 1957 and extending through 15 February 1958.

During the build-up for construction and scientific program, considerable emphasis was placed on the "lead-time" allowed for arrival of material or equipment at Jobsite. Because of the heavy volume of procurement and the short delivery lead-time during this period, it was necessary to solicit bids on very short notice by telephone, telegraph, and letter request for quotations. Although the element of time placed undue pressure upon vendors, in most instances all requests for quotations were processed in the allowed period of time.

The early receipt of requisitions for items of long lead-time and special fabrications such as steel towers, guys, bridge cranes, submarine and telephone cables, steel piling, winches, distillation units, walk-in refrigerators, steel and aluminum buildings, dehumidification and air conditioning units, generators, and other miscellaneous items, assisted greatly in allowing additional procurement time.

During May 1957 the Purchasing Department was required to make the necessary arrangements for dismantling, packing, crating, and hauling of two Tropospheric Scatter Systems which were transferred to the AEC from the U.S. Air Force on an M/R basis. One unit was located at North Truro, Massachusetts, and the other at Stewart AFB, Newburgh, New York. A representative was sent to the Eastern seaboard to secure the necessary bids for this service. Bids were solicited from nine companies specializing in this type of service, and on the basis of low bid an award was made to Jerome F. Gould, Inc., Brooklyn, New York. Partial dismantling of the complex equipment was accomplished by several H&N Communications Engineers. Upon final dismantling, packing, and crating operations, all items were placed in storage at Stewart AFB, pending arrangements for special MATS airlift to EPG. Actual loading of the first of six C-124 aircraft commenced on 5 August 1957; the final aircraft was loaded on 9 August 1957.

Due to the long-lead time requirement for distillation units, early procurement action was initiated to assure the best possible delivery. At the time of Purchase Order award there appeared to be no difficulty in obtaining all required basic materials and components. However, during the process of manufacture, the sub-vendor furnishing the compressors was absorbed by another firm. This change caused numerous production delays, and it became necessary to assign a representative at the factory to expedite production to conform to required delivery schedules. During this delay period, other component parts were delivered and with the cooperation of the prime vendor, fabrication and assembly proceeded and a minimum of time was lost. In spite of the unforseeable delay, this order was completed in a satisfactory manner.

Due to a change in Users' requirements, the delivery schedule of the mobile launching tower for Station 6001 was accelerated by 30 days. In order to accomplish this requirement, necessary details involving production, delivery of component parts, and overtime required were coordinated with the fabricator. thus enabling a premium proposal to be submitted and accepted. The final result was delivery of all components two days earlier than required by the revised delivery date.

During the early part of 1957, a Purchase Order was placed for a dial telephone system for inter-atoll communications. The original delivery was scheduled for the latter part of 1957, but increased User requirements and necessary design changes created a delayed delivery schedule. However, delivery of certain basic portions of the system was expedited for earlier shipment, enabling Jobsite to proceed with the installation.

The late 1957 and early 1958 requirements covering pipe assemblies, caissons, and related connecting items for Pinex Barges were placed, and extensive engineering, production planning, and shop drawing submittals were necessary to meet the exacting requirements of the program.

On 20 April 1958 representatives of the Purchasing and Construction and Planning Departments departed for the Honolulu Office to make arrangements for procurement of equipment and materials in connection with the Johnston Island activities. A pre-investigation by the Honolulu Office had revealed that all available rental equipment was in use on numerous local building programs. This situation necessitated a check of all possible sources of Government equipment available in the Territory, and through the cooperation of various branches of the Military, sufficient equipment was obtained on an M/R basis.

MONTH	YEAR	REQN'S. REC'D.	LINE ITEMS	P. O. ISSUED	MONTHLY VALUE	ACCUMULATIVE TOTAL
July	1956	671	3518	593	$ 333,964.79	$ 333,964.79
Aug.	1956	443	2059	471	999,650.82	1,333,615.61
Sept.	1956	447	2610	478	252,687.55	1,586,303.16
Oct.	1956	434	2512	451	201,269.78	1,787,572.94
Nov.	1956	346	2229	392	175,739.50	1,963,312.44
Dec.	1956	558	3147	585	550,785.70	2,514.098.14
Jan.	1957	354	1780	472	860,287.56	3,374,385.70
Feb.	1957	453	2564	381	330,201.52	3,704,587.22
Mar.	1957	628	3262	667	684,599.52	4,389,186.74
April	1957	468	2474	557	844,136.71	5,233,323.45
May	1957	598	620	607	532,420.20	5,765,743.65
June	1957	519	2240	833	3,014,550.97	8,780,294.62
TOTALS	FY 1957	5919	29,015	6487	$ 8,780,294.62	
July	1957	865	4635	751	$ 1,092,968.36	$ 9,873,262.98
Aug.	1957	620	3244	818	1,308,062.18	11,181,325.16
Sept.	1957	1071	4490	803	1,249,480.93	12,430,806.09
Oct.	1957	895	4025	944	3,212,331.65	15,653,137.74
Nov.	1957	962	4007	1109	1,989,242.10	17,632,379.84
Dec.	1957	1342	5222	1155	1,575,050.47	19,207,430.31
Jan.	1958	1132	5477	1328	1,823,338.23	21,030,768.54
Feb.	1958	935	5030	1342	1,240,536.67	22,271,305.21
Mar.	1958	794	4108	1147	1,346,342.55	23,617,647.76
April	1958	609	3492	687	477,596.49	24,095,244.25
May	1958	756	4709	884	913,628.13	25,008,872.38
June	1958	750	3734	1172	815,471.05	25,824,343.43
TOTALS	FY 1958	10,731	52,173	12,140	$17,044,048.81	
July	1958	649	3340	887	686,128.79	$26,510,472.22
Aug.	1958	688	2625	753	1,047,611.15	27,558,083.37
Sept.	1958	385	2467	480	273,483.00	27,831,566.37
GRAND	TOTALS	18,372	89,620	20,747	$27,831,566.37	

Table No. 3-12. Procurement Statistics.

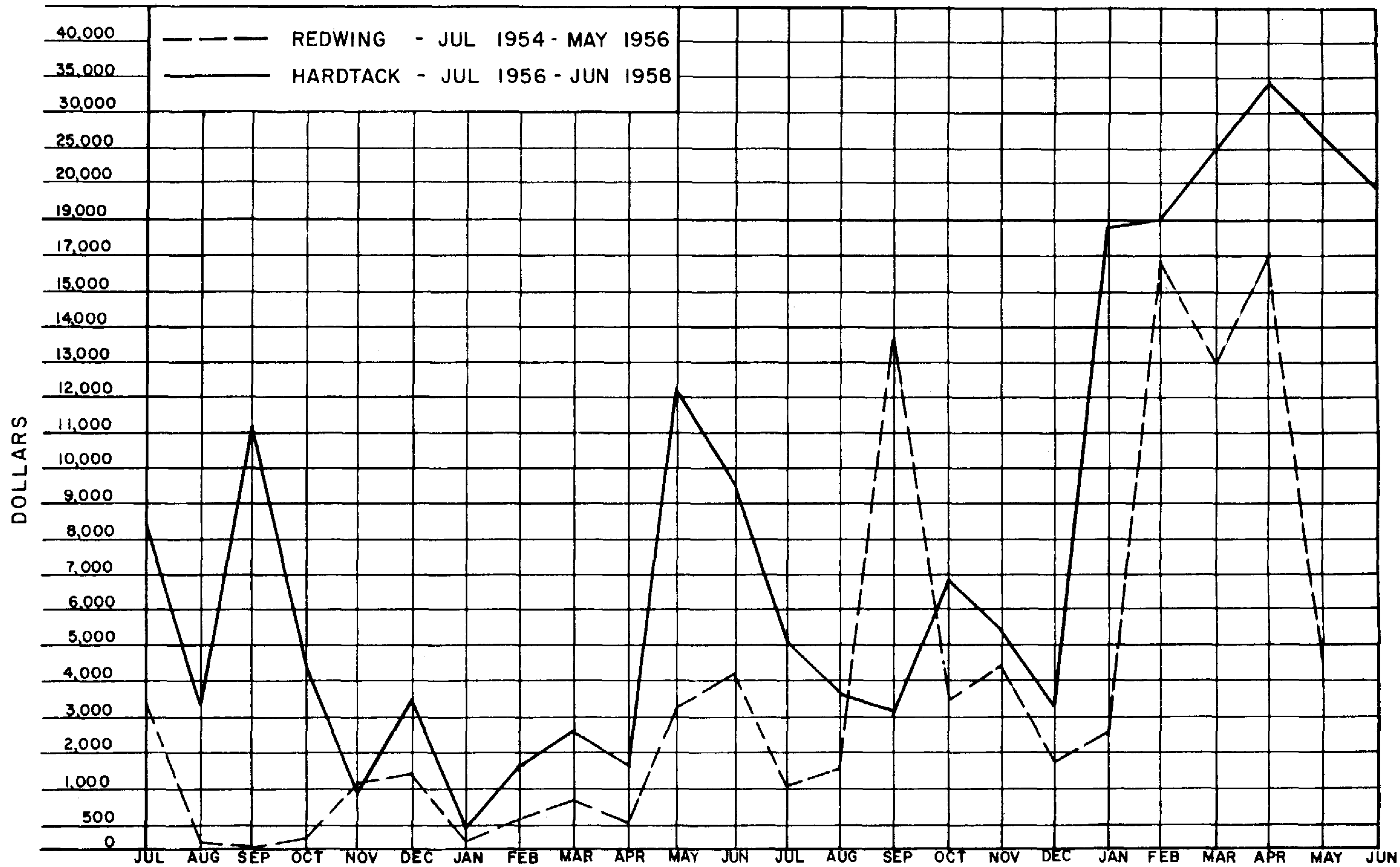


Chart No. 3-15. Honolulu Purchases — HARDTACK vs. REDWING.

SHIPPING AND TRAFFIC.

The coordination and scheduling of all shipments destined for transshipment to EPG by surface or air was the responsibility of the Shipping Section. The functions of this section were administered by a Shipping Agent with the assistance of two Assistant Shipping Agents, one stationed at the Naval Supply Center, Oakland, California, and one at Travis Air Force Base, Suisun, California. An Expediter was assigned to the export packing facility to ensure that the Packing Contractor met export packing requirements and H&N schedules for shipment.

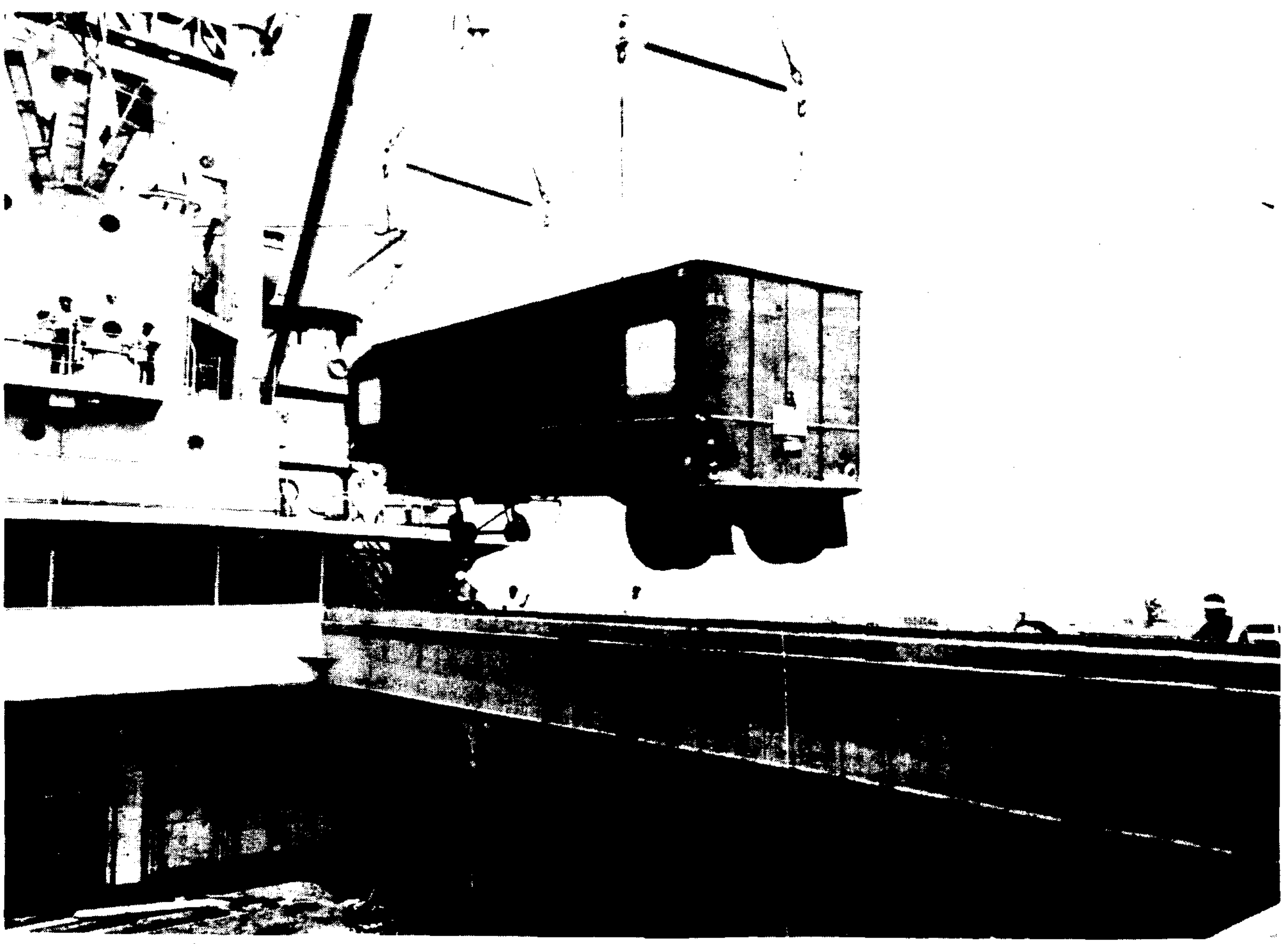
The means of shipping used were predicated on (1) the method requested on the material requisition, (2) the date required at Jobsite, (3) the supplier's promised delivery date, and (4) the ability of surface carriers to deliver materials to Jobsite in time to meet construction schedules.

Shipping allotments were made on the basis of the Monthly Transportation Report. A monthly tonnage forecast was initiated by the Shipping Section and coordinated with and approved by the Chief Purchasing Agent and the Chief, Construction & Planning.

Refrigerated Cargo

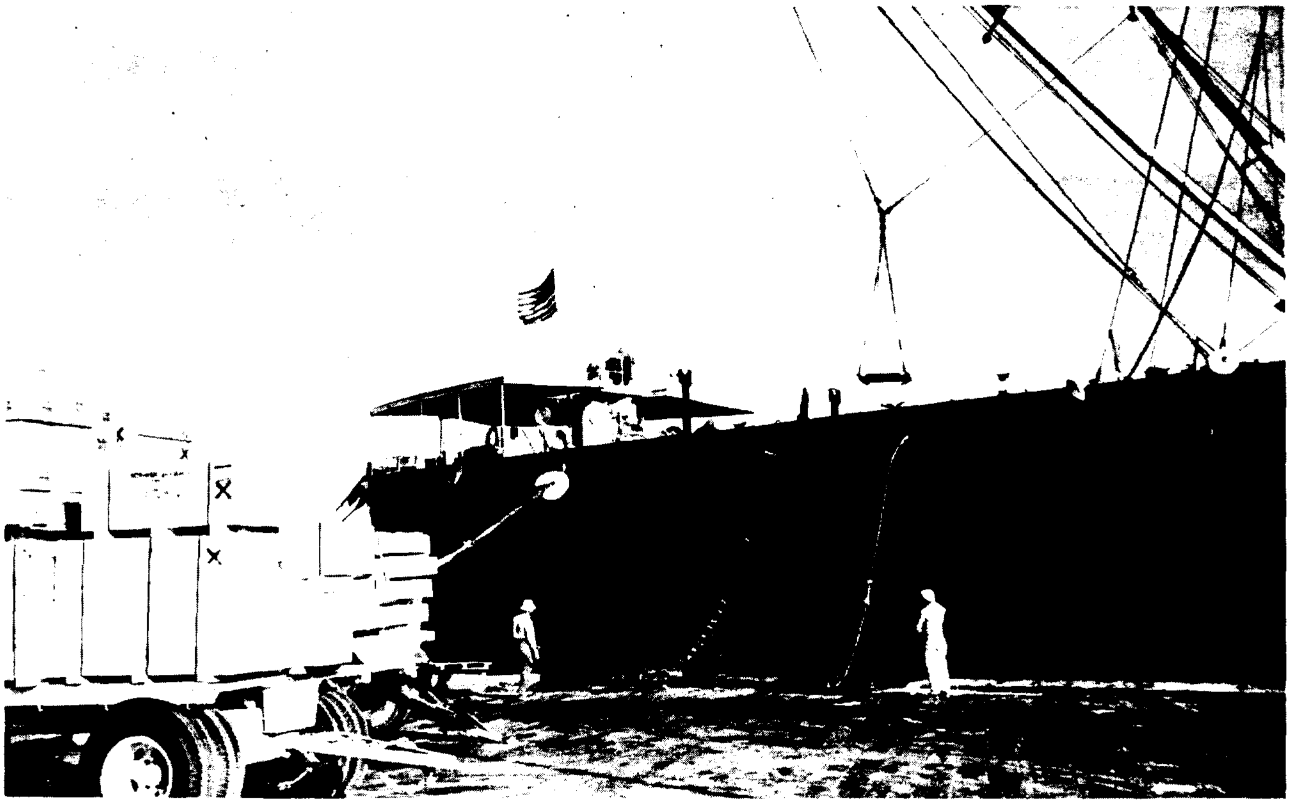
The scheduled departure dates of commercial reefer ships from NSC, Oakland, were coordinated to ensure arrival at Pearl Harbor to connect with scheduled U.S. Navy reefer ships departing for EPG.

Scheduling of refrigerated cargo began with the receipt of requisitions which indicated the requirements by a specified delivery date. The subsistence items were accumulated at the Cold Storage Contractor's plant in Oakland until such time as a reefer ship was ready for loading. The scheduling of reefer cargo to meet the shipping dates was accomplished by the combined efforts and coordination of the Assistant Shipping Agent at the Naval Supply Center and the Resident Inspector in the Bay area. When the firm date of a specific reefer was established, the Assistant Shipping Agent was notified by the Navy Office and arrangements were made for reefer cargo which had been accumulated at the cold storage plant to be loaded in refrigerated



(Neg. No. W-V-250-6)

Figure No. 3-14. Off-Loading 30-Foot Trailer — Elmer.



(Neg. No. W-753-12)

Figure No. 3-15. Off-Loading Cargo at Deep Water Pier — Elmer.

rail cars or trucks and delivered to dockside for transshipment. Reefer cargo shipments to Jobsite during the period from July 1956 through September 1958 amounted to 6,844,540 pounds, equivalent to 3056 long tons or 5309 measurement tons. Shipments of dry store provisions totaled 7,496,938 pounds, amounting to 3347 long tons or 5126 measurement tons.

General Cargo

Scheduling of all general cargo water shipments was determined by the date required at Jobsite. The Purchase Order was then written to coincide with this determination. In some cases, due to unanticipated vendor changes or changes in the construction schedules, material originally scheduled for water was diverted to air. Material scheduled for shipment through NSC was delivered direct from the vendor or the Packing Contractor for accumulation at the NSC warehouses. The amount of general cargo shipped by water from July 1956 through September 1958 totaled 120,248,473 pounds, or 79,483 measurement tons. In addition, a total of 2,059,802 pounds was shipped by water from Honolulu to EPG.

Representative quantities of miscellaneous materials and equipment shipped by water during Operation HARDTACK are as follows:

Cement	22,270,661 pounds
Cable	5,889,004 pounds, or 1,025 reels
Acid	2,184,444 pounds
Petroleum	2,184,320 pounds
Vehicles	2,870,000 pounds, or 309 units

On 19 July 1957 the Holmes & Narver Shipping Agent was appointed to act as agent for the U.S. Atomic Energy Commission to issue Government Bills of Lading. From July 1957 through September 1958, the Shipping Section issued 63 Government Bills of Lading involving 66 rail cars for a total of 4,064,606 pounds; this resulted in a saving in transportation costs of approximately $90,000.

During the last half of 1957, arrangements were made for materials purchased from the Navy to be picked up by Navy ships at Port Hueneme, California. This cargo consisted of anchoring items, portable generator sets, wire rope, vehicles, pontoons, and other miscellaneous items for a total of 1,644,600 pounds and 71,066 cubic feet. Elimination of overland hauling from Port Hueneme to the Naval Supply Center, Oakland, resulted in a savings of approximately $13,156 in freight charges.

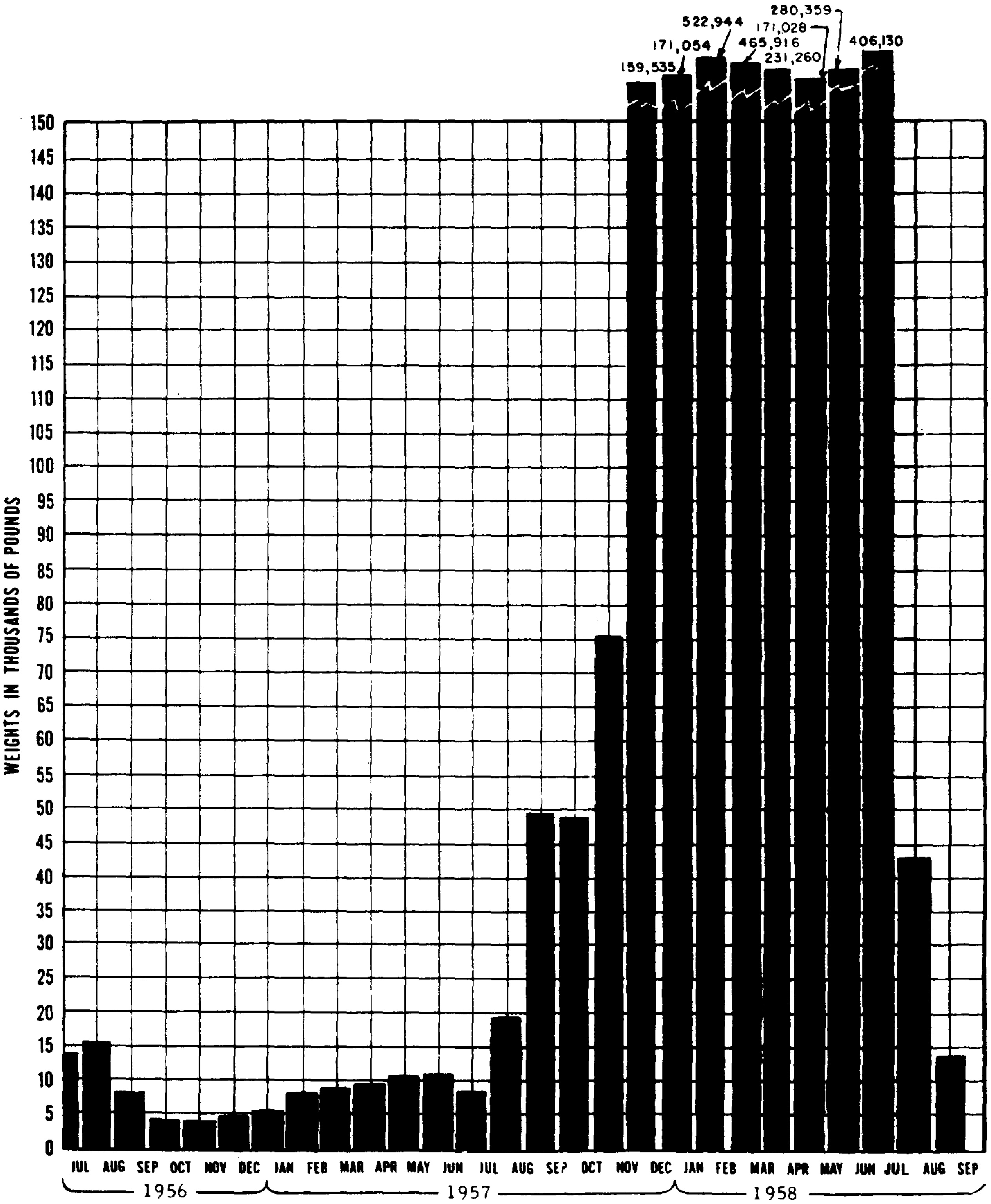


Chart No. 3-16. Airlift Shipments.

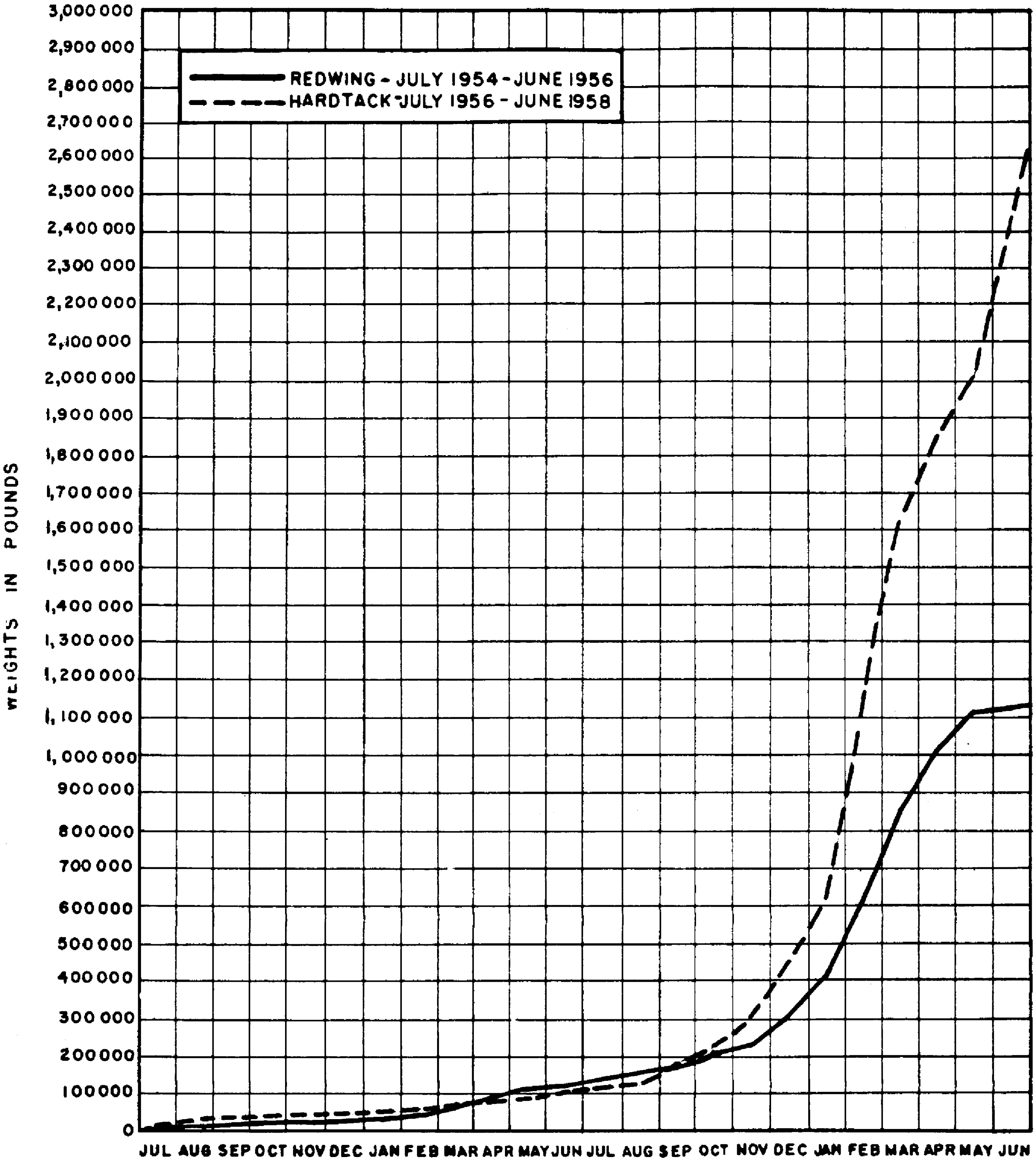


Chart No. 3-17. Airlift Shipments — Accumulative Totals — HARDTACK vs. REDWING.

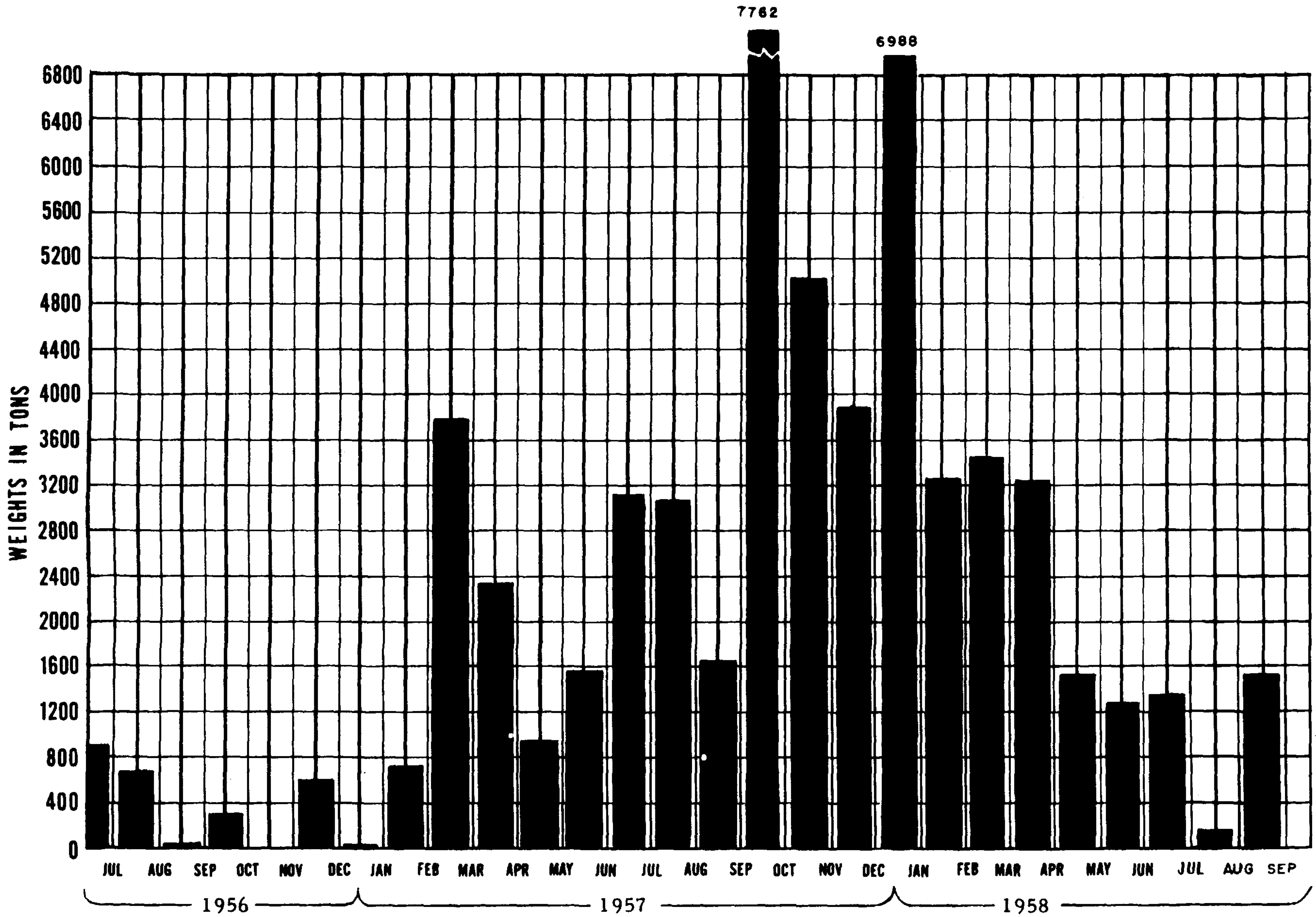


Chart No. 3-18. Water Shipments.

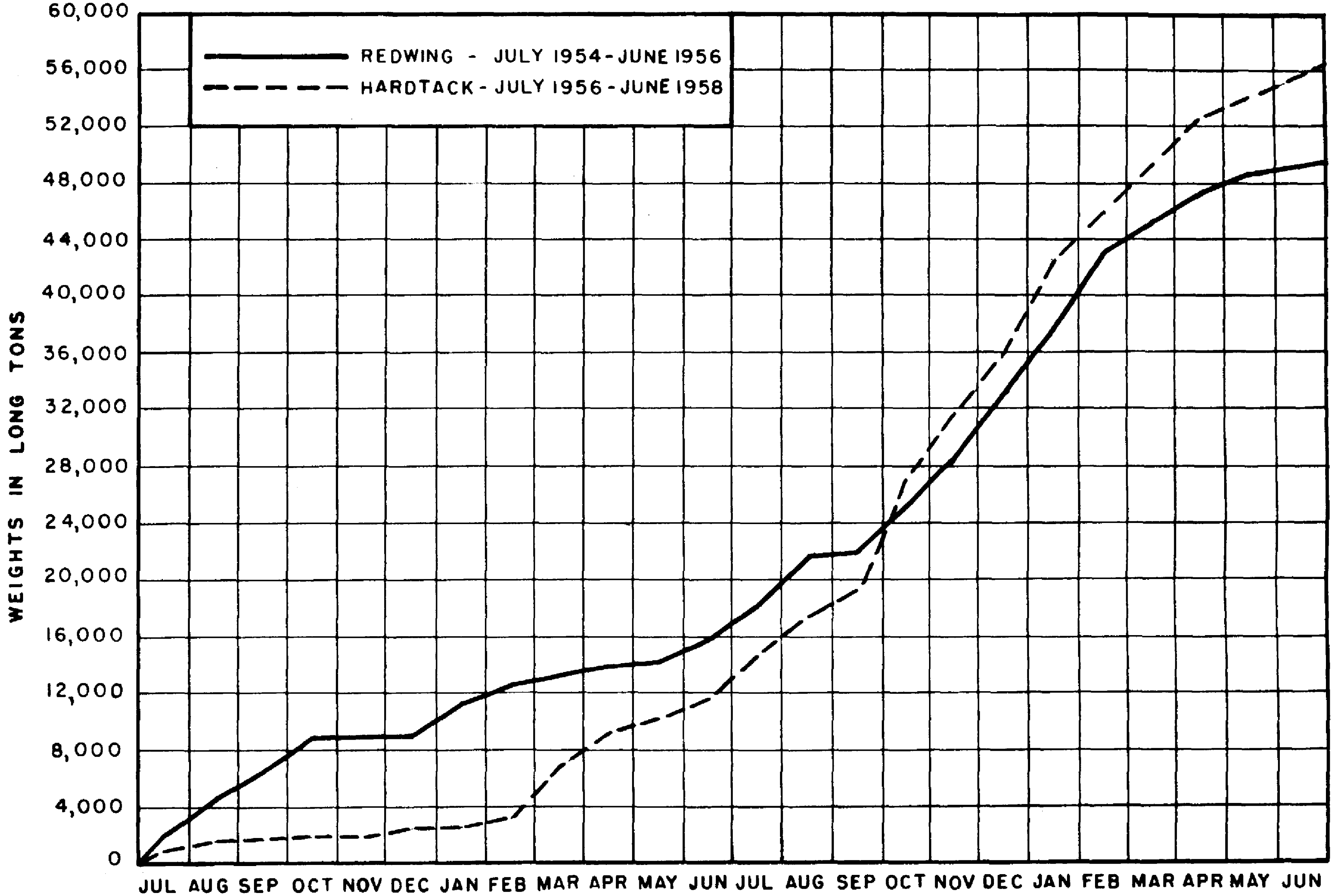


Chart No. 3-19. Water Shipments — Accumulative Totals — HARDTACK vs. REDWING.

Air Cargo

At various times during the Operation, difficulties were encountered involving the movement of critical air cargo, which resulted in a backlog of cargo at Travis Air Force Base. It became necessary on occasion to divert critical items to commercial air freight to Honolulu for transshipment from Hickam Air Force Base to EPG and Johnston Island. Due to changes in criteria and rescheduling of occupancy dates, it was mandatory from time to time to deliver to Travis Air Force Base virtually a month's air cargo allotment within a few days. When this occurred, it was necessary to request assistance through the JTF-7 Liaison Officer at Travis Air Force Base for additional cargo flights.

Total weight of air shipments from the mainland to EPG for the period July 1956 through September 1958 was 2,686,393 pounds. In addition, 717,361 pounds were airlifted to EPG from Honolulu.

SUPPLY (Jobsite).

The Supply Division General Supervisor was assisted by two Assistant General Supervisors at Elmer who administered the supply functions at all sites, including Bikini Atoll and Johnston Island. One was responsible for the Material Coordinating and Material Take-off Departments, and the other the Material Control, Warehousing, and Property Departments. A Supervisor was responsible for the Stevedoring Department and reported directly to the General Supervisor.

For Operation HARDTACK a new method of operation was introduced to increase the efficiency and effectiveness of the supply functions in the field. This involved the assignment of Supply Coordinators at the various temporary campsites who were responsibble for coordinating and delivering on schedule all materials and supplies required at their respective sites. To further the over-all effectivness of the Supply Division, the Material Take-off and Property Departments were organized.

MATERIAL COORDINATING.

The Material Coordinating Department was responsible for coordinating and expediting material and equipment requisitions and purchasing action. In addition, it was responsible for maintaining adequate and complete records necessary for furnishing delivery information to interested agencies in the field.

A total of 6888 requisitions were processed from 15 March 1957 to 15 June 1958, an average of 466.6 requisitions per month. The processing of Field Requisitions consisted of reviewing Purchase Requests submitted by the various departments at Jobsite and checking them for accuracy, complete nomenclature, and pertinent information as to model, serial number, and manufacturer. A total of 18,799 Receiving Reports and 302 Over, Short, and/or Damaged Reports were processed from 15 March 1957 to 15 June 1958. The processing of Receiving Reports involved reconciling the Warehouse "Tally-in" with the Advance Packing Lists forwarded by the Home Office. During this same period 4040 off-island warehouse requests and shipping documents were processed. Also during this period the Expediting Section processed a total of 660 Advance Material Estimates, 3631 Construction Bills of Material, and 987 Bills of Material.

As of 1 July 1958, H&N assumed the responsibility of all documentation pertaining to cargo vessels. This function formerly was accomplished by the TG 7.2 Transportation Officer. Administration of this function is assigned to the Material Coordinating Department, which utilizes information furnished to it by the Stevedoring Department.

MATERIAL TAKE-OFF.

The Jobsite Material Take-off Department was integrated into the Supply Division in September 1957. This Department was the counterpart of the Home Office Material Take-off Section and had the responsibility of determining items and quantities of material and equipment required to complete field-initiated construction programs. Due to the shift of engineering emphasis to the field during the latter part of the Operation, the Jobsite Material Take-off staff was augmented by personnel from the Home Office Material Take-off Section.

Construction Bill of Material requirements initiated by the Department included temporary camps and construction or rehabilitation of Scientific, Weather and Rad-Safety stations and PAC program features. In addition, all Jobsite revisions to Home Office-initiated CBM's were made by this Department.

MATERIAL CONTROL.

The Material Control Department was responsible for maintaining records and inventories of all materials and returnable containers at Jobsite except property items. A significant innovation was the standard package program, which consisted of converting small inventory items (nuts, screws, fuses, etc.) in several warehouses into package units. This resulted in achieving uniformity in packaging and re-ordering, and facilitated handling. A monthly report on unallocated or uncommitted major and uncommon items in the construction inventory was introduced during this Operation. This report was forwarded to the Chief, Construction and

Planning, and other interested parties where it was utilized for future construction planning.

PROPERTY.

The Property Department was responsible for storing, issuing, and accounting for all AEC-owned property and equipment and for operating the office machine repair service.

WAREHOUSING.

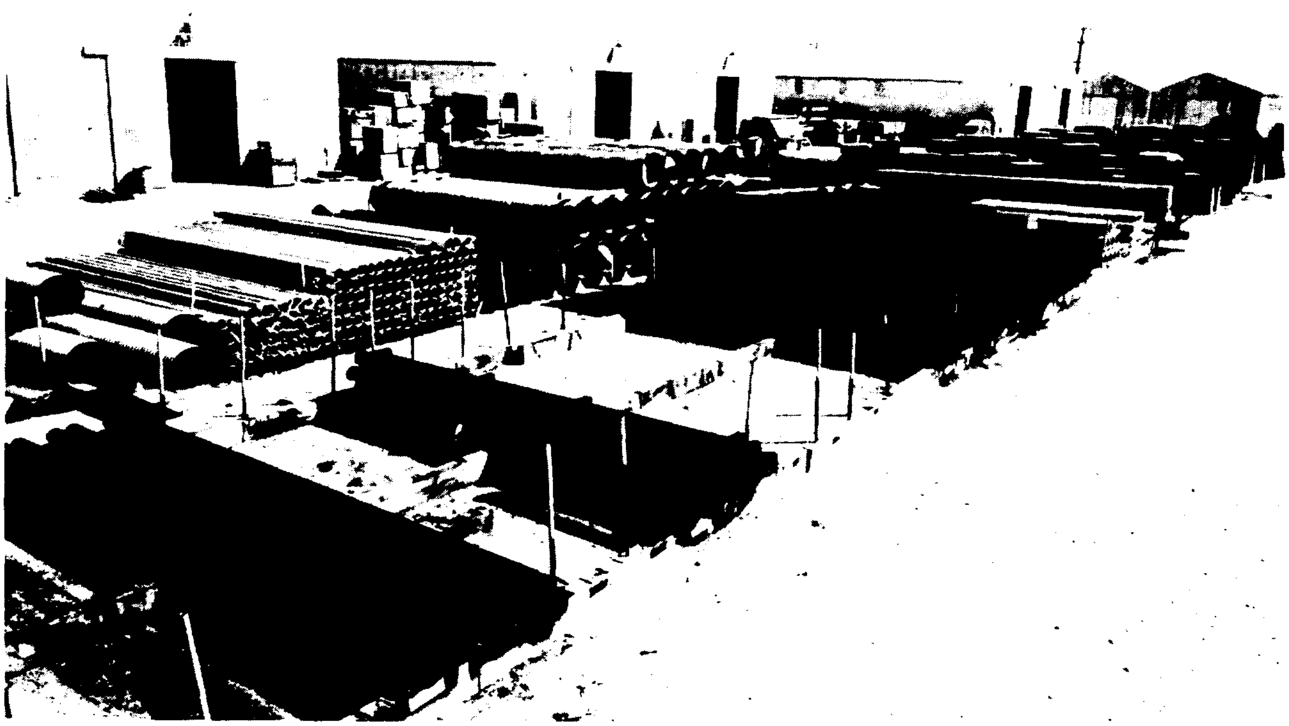
The Warehousing Department was responsible for receiving, storing, and issuing all materials at Jobsite, and for the operation of the POL Farm and the Fork Lift Pool. This Department's responsibility started at shipside or at the MATS terminal on Site Fred during off-loading and continued until the material or equipment involved reached its final destination. A total of 4600 new bin shelves were added in the Automotive Parts and Mechanical Warehouses on Elmer, increasing the spare parts storage capacity by 50%. During the Operation a total of 49,524 cubic feet of refrigerated storage and 547,750 square feet of outside storage areas were required.

Facilities at the POL Farm consisted of drum stock and packaged grease storage, three 420,000-gallon diesel fuel tanks, two 210,000-gallon automotive gasoline tanks, and a 24x32-foot Pump House.

STEVEDORING.

The Stevedoring Department was responsible for loading and off-loading all cargo entering or leaving EPG via water. Before the arrival of a vessel carrying cargo to EPG, the off-loading was pre-planned by utilizing advance shipping documents for the purpose of estimating hours needed to discharge cargo, determining stevedore personnel assignment to hatches, and coordinating the various stevedoring support elements.

Ship's gear was rigged to facilitate rapid discharge either to the dock or barge, and, if circumstances permitted, to both simultaneously. Insofar as possible, all components of the ship's gear were checked for any unsafe condition by both the Gang Foreman and the Stevedore Supervisor. Defective or unsafe gear was reported to the ship's officers and was corrected before use. Special attention was given to trailer



(Neg. No. W-581-5)

Figure No. 3-16. Outside Storage Area — Elmer.

vans and other heavy lifts and to the safe handling of the ship's "jumbo" gear. Individual lifts of up to 30 tons were common, and lifts to 50 tons were handled with no difficulty. Cargo was transported from the dock by fork lift, flatbed trailer, or lowboy to the classification yard or receiving areas. Special safety precautions were observed in the handling of inflammable, toxic, or explosive commodities.

Freeze cargo was discharged in sling boxes to eliminate multiple handling during transfer from ship to reefer bank. These boxes, open on top and with a removable panel in one end, were taken into the hatch by ship's gear. After being loaded they were hoisted to the dock, placed on waiting flatbed trucks by fork lift, and transported to a designated area for sorting before final storage in the reefer bank. Reefer cargo consigned to TG 7.2 was handled in the same manner, except that it was loaded at the pier into trucks provided by the Army and ferried to Site Fred by the H&N Marine Department.

Vessels containing POL products were connected by means of a flexible hose to pipelines running from the pier to the tank farm. Lines were checked for leakage, and thorough precautions were taken to minimize danger from fire or explosion.

The Stevedore Department maintained an active safety program within its own organization. Safety lectures with blackboard illustrations were given from time to time; also, on-the-job demonstrations and safety pointers were presented whenever the situation warranted.

All equipment necessary to work a ship was fabricated in the Stevedoring Department gear loft. After use, each piece of equipment was inspected, cleaned, and stored, and any gear showing signs of wear or undue strain was repaired or replaced from stock on hand. In no instance was gear failure experienced using gear fabricated by the Stevedore Department.

The work schedule for off-loading and back-loading cargo vessels during the interim and operational period commenced at 0730 hours and ended at 2200 hours. This work period proved highly satisfactory in keeping step with the demands for discharging and loading ocean carriers and for the supply of construction material to all sites. A few exceptions to this work period were necessary to meet the demands of the tight shipping schedule set up by JTF-7.

A Foreman and five specially trained and "Q"-cleared Stevedores, working under the Assistant General Supervisor, Supply, handled special security cargo and devices entering, leaving, and between the various sites at EPG.

During the operational period, a crew of Stevedores was maintained at Bikini Atoll to off-load and load LST's carrying inter-atoll cargo. A crew of from 6 to 20 men, depending on the requirements, were transported to Johnston Island to handle the stevedoring operations.

The operation at Johnston Island presented unusual challenges to the Department because (1) it was necessary for all ships other than LST's to be off-loaded appproximately three miles from the dock in the open sea and (2) many of the trailer vans needed for the Operation were too high to be loaded into the tank deck of an LST, requiring some other means of transportation. The possibility of shipping these vans as deck cargo on the larger ships was excluded because of the obvious dangers involved in off-loading in the open sea with the ship's "jumbo" gear.

The first problem was approached by marshaling all available marine craft, including a small barge, to ferry cargo from shipside to the dock. In spite of heavy swells, averaging six feet, several heavy lifts were handled successfully. The second problem was solved by a loading and off-loading operation not heretofore used by this Department. Trailer vans were taken two at a time in LCU's to an LSD in the lagoon, which took on sufficient ballast to permit the loaded LCU to enter the stern gate. After this procedure, the ballast was pumped out leaving the LCU riding dry in the well deck. The trailer vans were then pulled onto the well deck of the LSD, the LCU was refloated, and the process repeated until the loading was completed.

In the space normally occupied by two LCU's carrying a maximum of eight trailer vans, a total of 18 trailer vans, a truck, a flatbed trailer, two jeeps, and sufficient general cargo for five additional flatbed trailers were loaded. It is estimated that one trip by an LSD loaded in this manner was the equivalent to three trips loaded by previous methods. It is also estimated that at least 30 trailer vans could have been handled at one time by this method of loading.

Off-loading was accomplished by reversing the procedure and pulling the trailer vans from the well deck of the LSD to an LCU, thence to the seaplane ramp on shore. Off-loading of general cargo from the LSD was handled by floating an empty barge into the well deck, pumping the well dry, and using two forklifts. One forklift operated on the mezzanine deck, bringing general cargo to the deck's edge, and the other operated on the barge, carrying cargo from the edge of the mezzanine deck to the barge itself. By using this method, off-loading time for general cargo carried on the mezzanine deck was cut in half. Cargo from the helicopter deck was haudled by ship's crane to the barge inside the well, thus decreasing the distance traversed by the ship's crane and speeding up production.

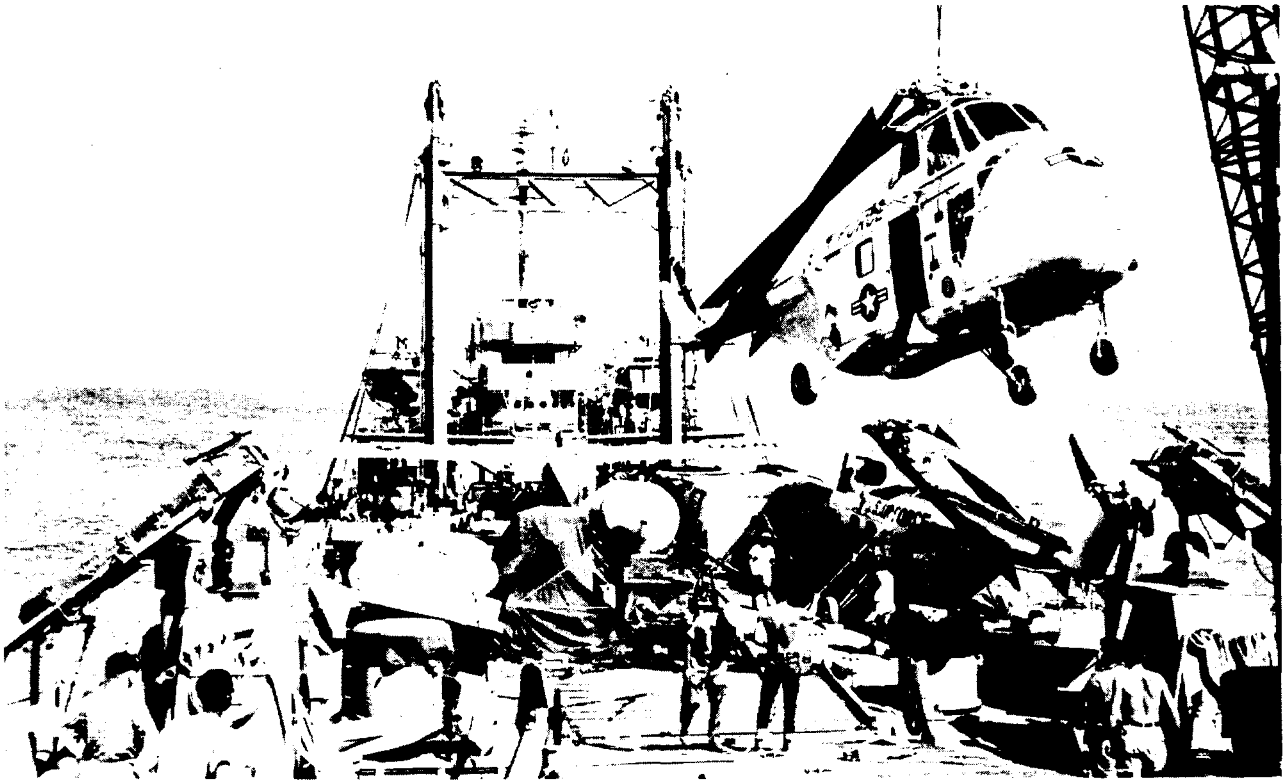


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Figure No. 3-17. Loading Helicopters on LST.

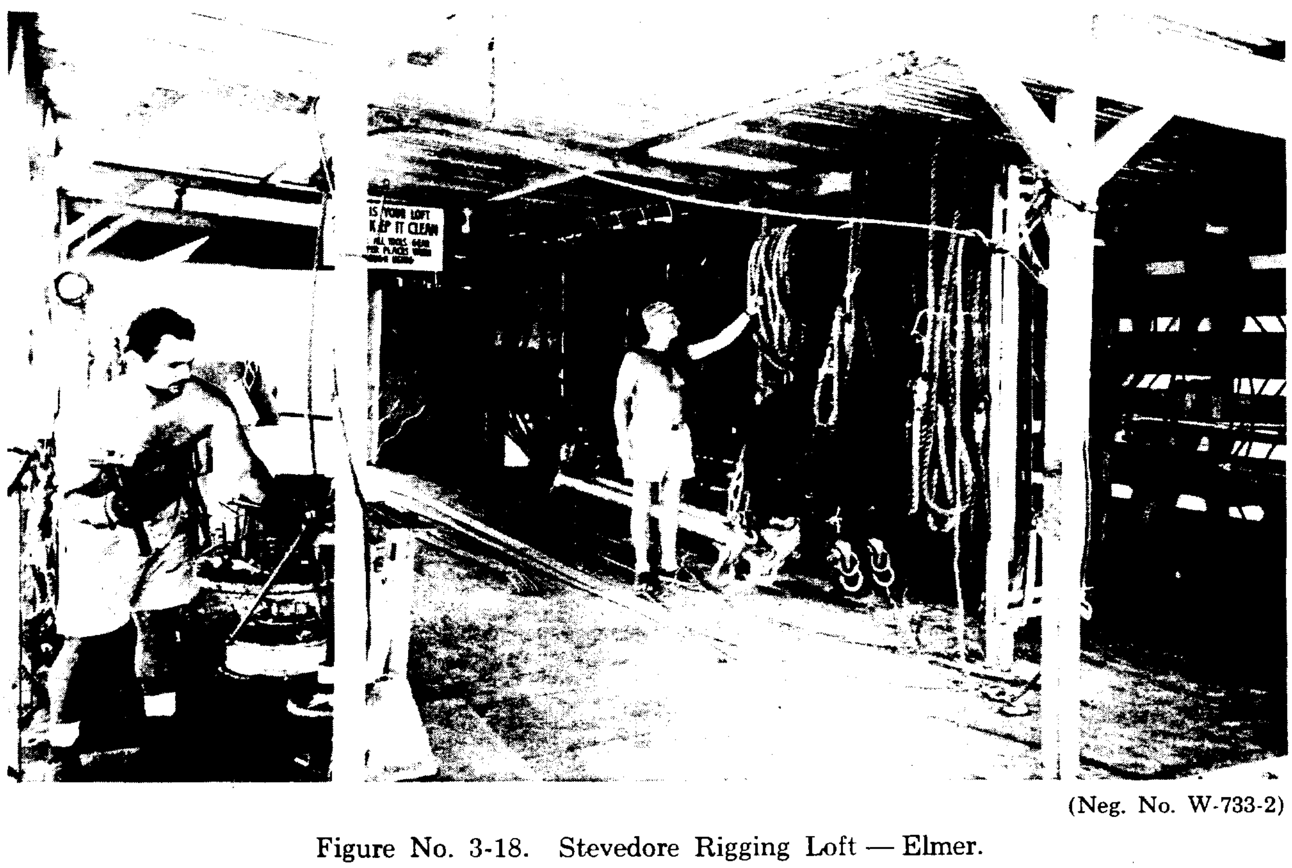

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Figure No. 3-18. Stevedore Rigging Loft — Elmer.

Month	OFFLOADED L/T's	OFFLOADED M/T's	BACKLOADED L/T's	BACKLOADED M/T's
1956				
July	2,038.0	3,416.0	899.1	11,420.0
August	1,254.0	2,194.0	2,183.5	11,593.0
September	39.2	76.2	1,770.0	13,873.0
October	633.0	1,346.0	1,285.0	5,742.0
November	116.0	197.0	19.0	69.5
December	736.4	1,030.4	———	———
1956 Totals	6,232.6	11,204,6	6,475.6	44,245.5
1957				
January	170.3	292.7	42.6	204.4
February	891.2	1,750.8	272.4	714.8
March	1,275.9	1,992.8	57.7	143.5
April	682.6	1,594.5	32.4	46.4
May	2,224.38	4,658.9	98.0	356.0
June	2,543.6	4,207.2	138.7	364.6
July	2,731.59	5,147.0	281.6	992.6
August	4,661.1	9,367.0	127.5	273.2
September	1,980,1	5,790.7	44.5	113.1
October	4,587.1	9,041.7	47.1	130.3
November	7,266.2	11,352.2	166.3	258.6
December	5,063.1	10,748.2	39.1	95.3
1957 Totals	34,077.17	65,943.7	1,347.9	3,692.8
1958				
January	10,281.5	23,723.5	92.1	183.5
February	2,795.6	7,887.7	199.3	394.8
March	8,416.6	21,383.3	73.3	109.3
April	4,087.4	13,890.8	127.0	444.5
May	2,560.6	4,482.4	51.9	243.7
June	1,191.5	2,581.3	901.8	4,477.9
July	2,474.9	4,376.7	970.4	5,151.2
August	504.0	1,030.5	1,878.3	10,366.7
September	951.5	2,926.9	707.6	4,048.8
1958 Totals	3,326.6	82,283.1	5,001.7	25,420.4
Grand Totals	73,573.6	159,431.4	12,825.2	62,353.8

Table No. 3-13. Summary of Cargo Off-Loaded and Back-Loaded.

MONTH	VESSEL	MOGAS (GALS.)	DIESEL (GALS.)
1956			
July	USS AGAWAM	55,073	454,692
July	USS AGAWAM	146,202	463,764
August	USS NEMASKET	92,853	399,298
October	USS KISHWAUKEE	76,682	432,090
1956 Totals		370,810	1,749,844
1957			
January	USS NATCHAUG	70,238	387,391
March	USS TOMBIGBEE	——	479,556
April	USS TOMBIGBEE	53,866	454,619
June	USS NEMASKET	61,882	410,846
August	USS KISHWAUKEE	114,770	197,460
October	USS GENESEE	——	497,196
October	USS ELKHORN	——	416,136
December	USS GENESEE	——	278,469
1957 Totals		300,756	3,121,673
1958			
January	USS NATCHAUG	50,088	332,728
February	USNS VALENTINE	——	41,118
March	USS GENESEE	——	314,244
March	USS KARIN	——	112,804
March	USS NATCHAUG	——	27,500
March	USS ELKHORN	134,536	181,102
April	USS MERAPI	——	141,876
April	USS TOMBIGBEE	——	89,000
May	USS ELKHORN	46,143	354,126
May	USS TOMBIGBEE	——	254,940
May	USS ELKHORN	133,412	241,367
May	USS MERAPI	——	23,478
June	USS ELKHORN	——	302,947
July	USS ELKHORN	——	65,495
July	USS NEMASKET	——	238,819
August	USS NATCHAUG	61,733	422,557
September		——	——
1958 Totals		425,912	3,144,101
Grand Totals		1,097,478	8,015,618

Table No. 3-14. Summary of POL Products Off-Loaded.

INTRA-ATOLL AIRLIFT
FROM MARCH 1958 THROUGH AUGUST 1958

	ENIWETOK ATOLL						BIKINI ATOLL			
Month	L-20 Flts	L-20 PAX	H-19 Flts	H-19 PAX	H-21 Flts	H-21 PAX	H-19 Flts	H-19 PAX	L-20 Flts	L-20 PAX
March	248	887	184	678	282	1,923	2,660	5,949	518	1,138
April	155	404	193	656	376	3,283	3,027	6,063	746	1,509
May	266	826	180	585	685	5,117	1,780	3,482	826	1,837
June	180	442	189	671	545	3,686	1,890	3,826	1,041	2,236
July	88	248	102	340	293	2,100	603	1,263	722	1,519
August	58	136	25	83	602	4,424				

INTER-ATOLL FLIGHTS TO BIKINI
FROM MARCH 1958 THROUGH AUGUST 1958

	NO OF	PASSENGERS		CARGO (pounds)	
MONTH	FLIGHTS	OUT	IN	OUT	IN
March	62	1,132	592	332,574	88,375
April	77	1,012	1,206	249,180	103,953
May	61	707	830	130,173	95,211
June	64	722	814	161,522	87,028
July	53	577	1,095	90,138	143,342
August	20	73	318	6,975	31,122

OFF-ATOLL FLIGHTS
FROM MARCH 1958 THROUGH AUGUST 1958

	NO OF	PASSENGERS		CARGO (pounds)	
TO	FLIGHTS	OUT	IN	OUT	IN
Wotho	22	80	86	21,563	896
Kapingamarangi/ Ponape	26	101	112	14,913	300
Utirik	23	71	80	25,939	0
Kusaie	41	148	164	19,574	2,210
Rongelap	33	111	113	27,046	3,005
Ujelang	20	73	80	14,160	3,049
Nauru	12	64	110	14,211	2,972
Tarawa	18	145	135	12,631	2,816
Johnston Island	28	404	19	35,872	5,676

Table No. 3-15. Jobsite Airlift Statistics.

SECTION 7
LAND AND AIR TRANSPORTATION

AIR.

Air transportation of cargo and personnel was performed by C-54's for flights between Eniwetok and Bikini Atolls and to other atolls in the Trust Territory where landing runways were available. SA-16's were used for special and routine scheduled flights to atolls in the Trust Territory where runways were not available.

The intra-atoll passenger and cargo airlift for Eniwetok Atoll utilized L-20 type aircraft for service at Sites Fred, Elmer, Yvonne, Tilda, and Janet where runways existed. H-19 and H-21 type helicopters were used for all sites including helicopter barges which were placed adjacent to certain of the shot barges.

Air Dispatch Facilities were activated at Janet and Yvonne on 8 October 1957 and 16 December 1957 respectively. These sites were rolled up prior to test events CACTUS and KOA, and all future air dispatching was controlled by the Air Dispatch Office at Site Elmer. Due to the intermittent use of the Tilda airstrip, no Air Dispatch Facility was activated at that site.

The Air Dispatch Facility at Site Nan was activated on 1 June 1957, followed by installations at Oboe, How, and George, as required. Aircraft utilized at Bikini Atoll for intra-atoll airlift were L-20's and H-19's. L-20's shuttled between Nan and Oboe, where the only airstrips existed. H-19's were utilized for traffic to all other points, including sandspits, shot barges, and marine craft equipped for them, including the aircraft carrier USS BOXER.

The H-19 type helicopter proved to be the most versitile and adaptable aircraft for Jobsite needs. Its maneuverability and ability to land on any sand-spit, bunker top, and surface vessel satisfied all requirements for photography, rescue, nose cone recovery, post shot damage surveys, and Rad-safety survey missions. During the operational period of HARDTACK, User personnel were the principal users of the airlift, and the air dispatch facility became the operational responsibility of E-3, TG 7.5.

In June 1958 a control tower was erected on Elmer and put in operation by the Air Force which provided a more efficient and effective control of the heavy traffic using this facility. At times there were as many as 236 landings and take-offs in a single day.

(Neg. No. W-869-7)

Figure No. 3-19. Helicopters Used at Bikini Atoll.

The principal function of the E-3 Section of TG 7.5 in regard to off-atoll operations was the administration of TG 7.5 interests in scheduling air transportation. This function was accomplished through various conferences with Headquarters, JTF-7 and TG 7.4. One of the basic problems encountered in establishing a smooth and efficient schedule was the limitations established on the amount of cargo and number of passenger allowable on the SA-16 type aircraft. The following schedule, once established, remained in effect throughout the balance of the operational period:

DAY	ATOLL
*Monday	Wotho
*Tuesday	Kapingamarangi
Tuesday	Nauru
*Wednesday	Utirik
*Thursday	Kusaie
*Friday	Rongelap
Friday	Tarawa
*Saturday	Ujelang
Daily	Bikini (Number of flights based on load requirements.

*Flights requiring SA-16 type aircraft.

Flights to Johnston Island were initiated in April 1958.

(Neg. No. W-860-2)

Figure No. 3-20. H-21 and C-54 Aircraft.

At Bikini Atoll, H-19 flights were terminated on 29 July 1958, and L-20 flights were terminated on 9 August 1958.

The Air Dispatch Facility at Elmer discontinued operations on 13 September 1958.

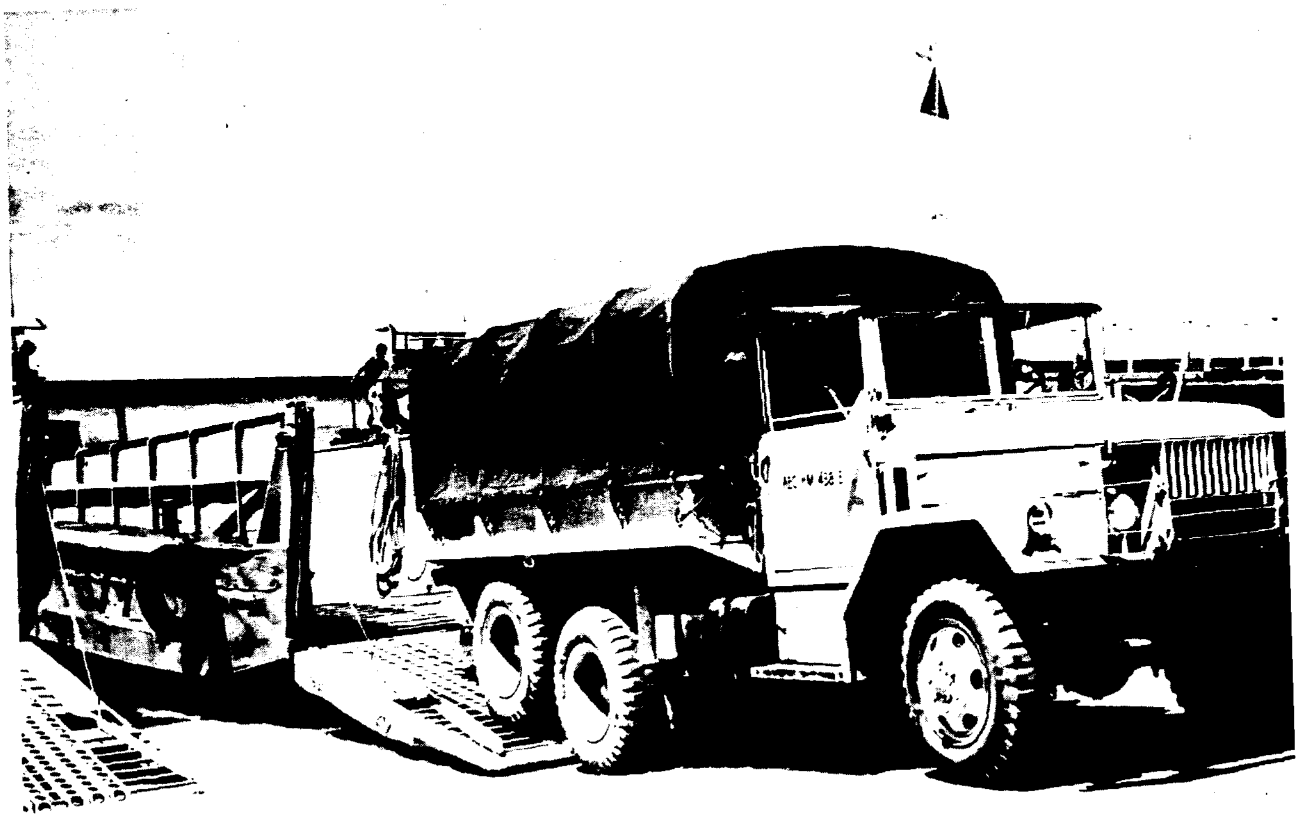
LAND.

Vehicles available for land transportation were assigned to individuals, as required, on the basis of a letter of justification by a Division Head, and the over-all distribution of vehicles was correlated with the total number of vehicles available for assignment.

A scheduled bus passenger service was established at Eniwetok and Bikini Atolls. At both sites buses were used for the transportation of personnel to and from work sites at starting time, lunch time, and quitting time. At Nan the bus met all in-coming aircraft and provided passenger transportation as requested, and non-scheduled runs were made around the island as required. The bus at Elmer operated on a regular 30-minute schedule during the week and on a 45-minute schedule on Sunday. Bus service at both sites was augmented by jeep-towed trailer taxis, which provided shuttle service to areas not included in the bus schedule. This shuttle service was intended for and used principally by TG 7.1. A similar shuttle service, employing 2 personnel trailers, was established at Johnston Island.

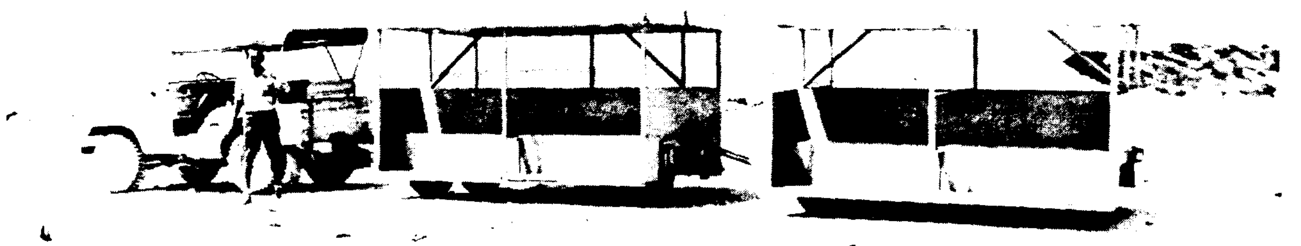
Transportation of arriving and departing personnel was accomplished by assigning 5 trucks, accommodating 17 passengers each, to the Personnel Department at Elmer. When necessary, this service was supplemented by bus service.

On 30 June 1958 the Motor Pool at Johnston Island, staffed by a Dispatcher and 6 drivers, inaugurated a chauffeur-driven taxi service using ½-ton pick-ups, which operated during normal working hours and at such other times as service was required. In addition, 2 jeep-drawn personnel trailers, operating on a ½-hour schedule, covered a circuitous route on the island affording service to every facility. These two services proved suitable to this site and materially reduced the need for department-assigned vehicles.



(Neg. No. W-622-7)

Figure No. 3-21. Personnel Transportation Vehicle.



(Neg. No. W-V-270-12)

Figure No. 3-22. Jeep Shuttle-Taxi.

AEC VEHICLE DISTRIBUTION — ALL SITES
Typical week during build-up period.

	ENIWETOK ATOLL					BIKINI ATOLL					
TYPE	ELMER	FRED	YVONNE	JANET	TOTAL	NAN	HOW	OBOE	GEORGE	TOTAL	GRAND TOTAL
Jeeps, ¼-Ton Willys	62	11	4	7	84	17	5	4	1	27	111
Pickups, ¼-Ton Chevrolet	5	1	0	0	6	0	0	0	0	0	6
Power Wagon 1-Ton Dodge	20	10	4	1	35	3	1	0	0	4	39
Pers. Carrier 1½-Ton Dodge	7	4	1	2	14	3	1	0	0	4	18
Weapon Carrier ¾-Ton Dodge	11	4	2	2	19	6	3	2	0	11	30
2½-Ton Trucks Reo, GMC International	34	6	2	3	45	11	6	2	1	20	65
Scooters, Cushman	4	0	0	1	5	0	0	0	0	0	5
Cab-over 1-Ton Ford	1	0	1	0	2	1	0	0	0	1	3
Bus, 37 Passenger	1	0	0	0	1	1	0	0	0	1	2
Ambulance, Dodge and Willys	2	0	0	0	2	2	0	0	0	2	4
Totals	147	36	14	16	213	44	16	8	2	70	283

NOTE: The preceding table does not reflect vehicles used by TG 7.1 which were furnished by TG 7.2 and maintained and serviced by TG 7.5

Table No. 3-16. AEC Vehicle Distribution.

CHAPTER IV
SERVICE OPERATIONS
SECTION I
CAMP OPERATIONS

GENERAL.

The Service Operations Division was supervised by a General Supervisor, wmo was assisted by two Assistant General Supervisors in administering the responsibilities of the Division. The Division was composed of three departments: Camp Operations, Marine Operations, and Power and Distillation Operations. The number of personnel in the Division varied from 287 on 31 December 1956 to a peak of 1035 on 21 April 1958.

CAMP OPERATIONS.

The Camp Operations Department was responsible for operating and maintaining a system of facilities and service adequate to provide an acknowledged standard of living at EPG. The Department was directly supervised by a Camp Supervisor aided by various assistants responsible for functions within the Department. All personnel of JTF-7 were housed, fed, and furnished with other community services at Contractor-operated facilities, except those quartered on naval vessels, those on Fred and David, and those at Weather Stations operated by military personnel. The community services included Company Stores, Beach Clubs, Refreshment and Snack Bars, and postal and laundry services. The Contractor-supported personnel peak of 5280 was reached on 22 April 1958.

After the completion of Operation REDWING, only the main camp at Elmer remained activated; all other camps were rolled up and abandoned. In May 1957 the camp at Nan was re-activated. Operating from Elmer in Eniwetok and Nan in Bikini Atoll, the off-island camps were established. Rad-safety Stations were established from the main base camp on Elmer. Limited camp facilities were also provided afloat by outfitting 5 LCU's as houseboats, which were primarily used for the support of the Scientific project personnel during instrumentation and recovery periods at sites where camp facilities were not available.

Requisitioning of equipment and supplies to support the large influx of personnel for the operational phase was initiated in the latter months of 1957. By mid-January, however,

SITE	DESIGNED CAPACITY	PEAK POPULATION	PEAK DATE	DATE ACTIVATED	DATE DE-ACTIVATED
ELMER	2,707*	3,195	4-30-58	Continuing	Continuing
JANET	352	213	4-11-58	10-2-57	5-7-58
YVONNE	280	276	4-2-58	12-16-57	4-28-58
FRED**	—	448	4-28-58	—	—
NAN	1,248	1,308	4-25-58	5-27-57	8-19-58
HOW	312	317	4-7-58	11-4-57	4-27-58
GEORGE	64	65	4-10-58	3-9-58	4-23-58
OBOE	312	213	4-15-58	11-18-57	7-16-58
RONGELAP	16			3-12-58	8-15-58
UJELANG	16			3-22-58	8-7-58
UTIRIK	30			3-21-58	8-9-58
WOTHO	24			3-17-58	8-15-58

*Single Deck Bunks.

**TG 7.5 and 7.1 only.

Table No. 4-1. Camps Operated by H&N.

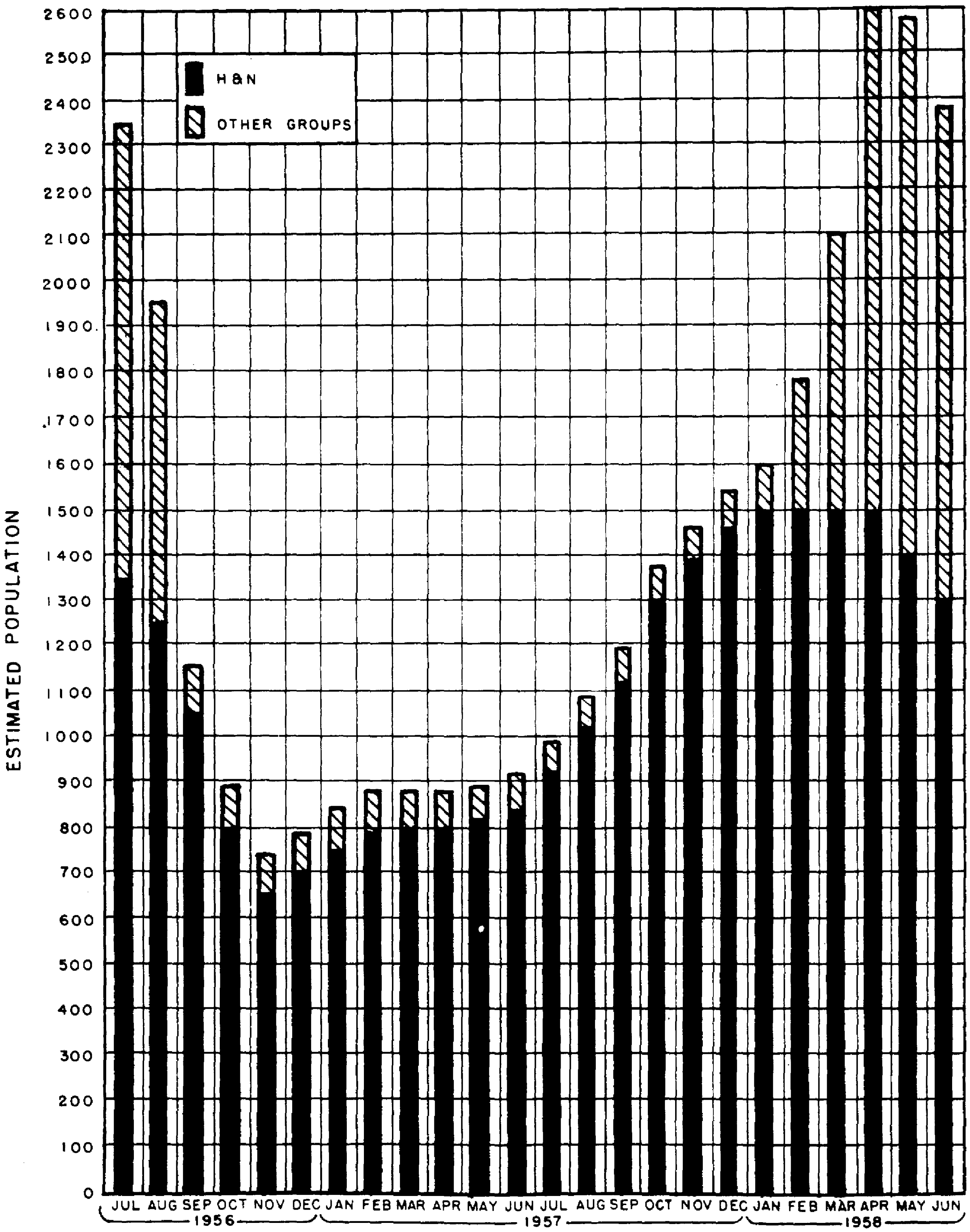


Chart No. 4-1. Estimated Population — Elmer.

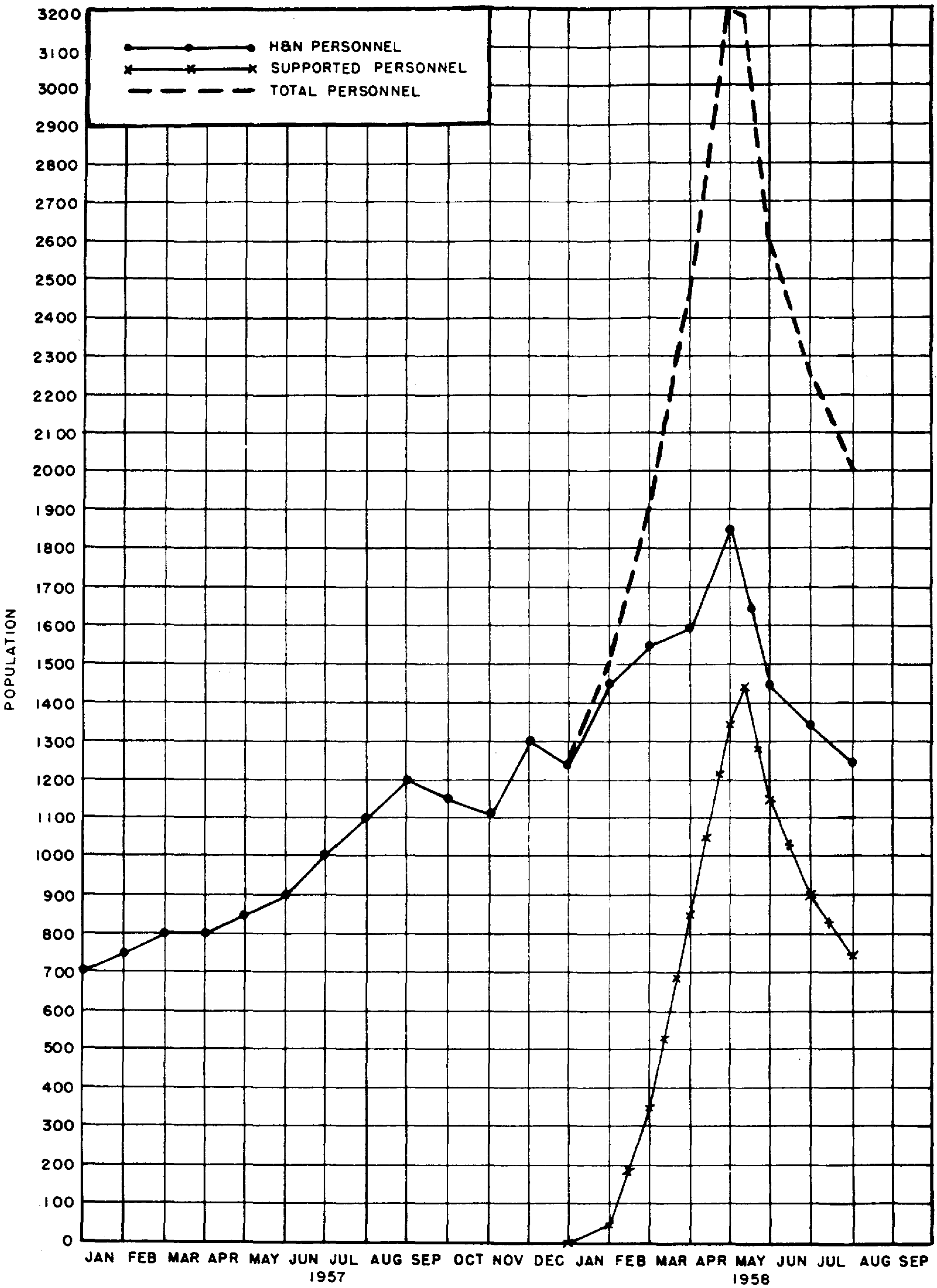


Chart No. 4-2. Actual Population — Elmer.

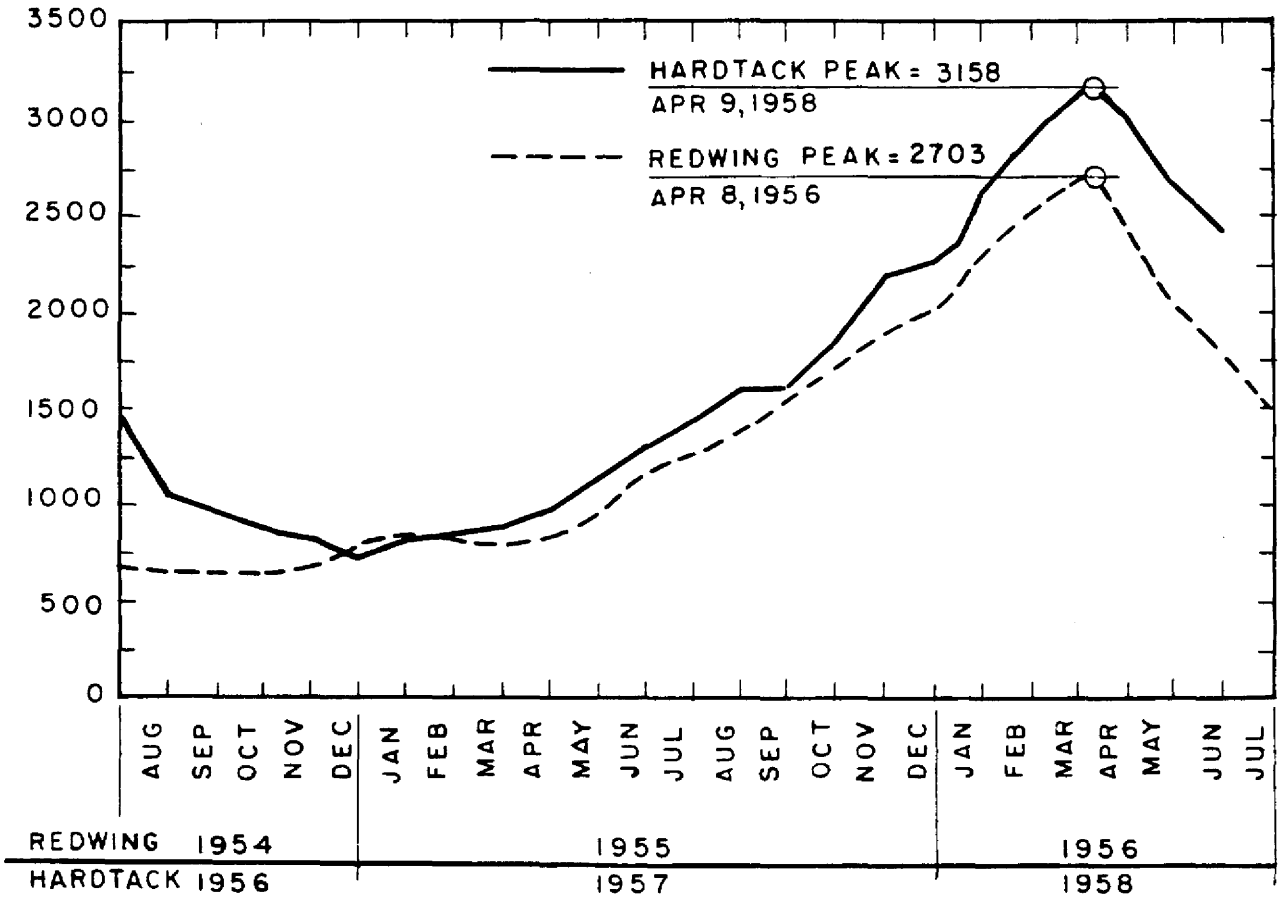


Chart No. 4-3. H&N Jobsite Population — HARDTACK vs. REDWING.

when strength reports of the various Task Groups were received, a realistic forecast indicated that support would have to be furnished for a much larger population than had been previously estimated. Because of such factors as long procurement lead times, tight shipping space and schedules, and an earlier than planned influx of personnel, some shortages of supplies existed for a short period during the operational phase.

On 10 April 1958, the Contractor was alerted to the probable move to Johnston Island; a general over-all plan was formulated directing that all camp functions at the new site be assumed by H&N on 8 May 1958. However, because of the accelerated build-up in Contractor personnel at this site more quickly than had been anticipated, H&N relieved the Air Force Base Command of all camp responsibilities on 1 May. Planning this move to Johnston Island indicated that it could be better supported logistically from Honolulu and Oakland. However, because of the procurement and shipping time involved, provisions and camp supplies could not be started for Johnston from outside sources until 1 June. Therefore, for the initial phase, this camp was supported from Site Elmer. Requisitions were placed for provisions and supplies on the basis that two orders would provide for the entire Operation. This was done because at the time the requisitions were placed, the criteria for camp operations were not fully developed; it was anticipated that as camp needs would be more firmly fixed, any necessary adjustments could be made to the second order. This actually did develop, and it was necessary to divert one half of the orders for provisions to Eniwetok.

In late April personnel planning for Johnston Island revealed that the necessary personnel could be furnished from excesses created by test program completions at Eniwetok and Bikini. However, just the reverse happened, and the

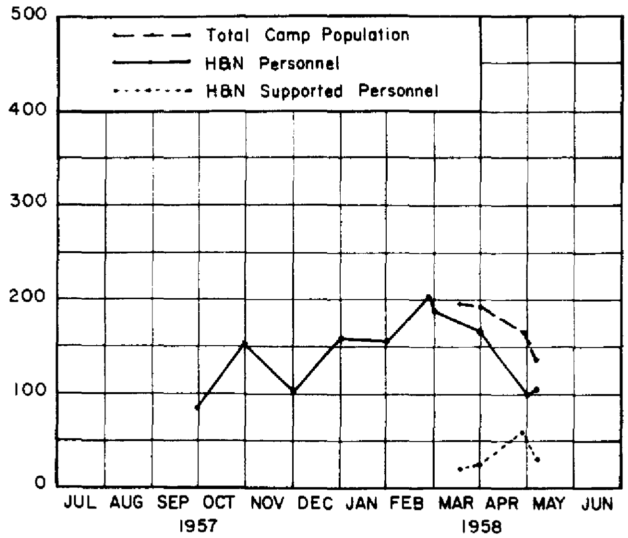


Chart No. 4-4. Camp Population — Janet.

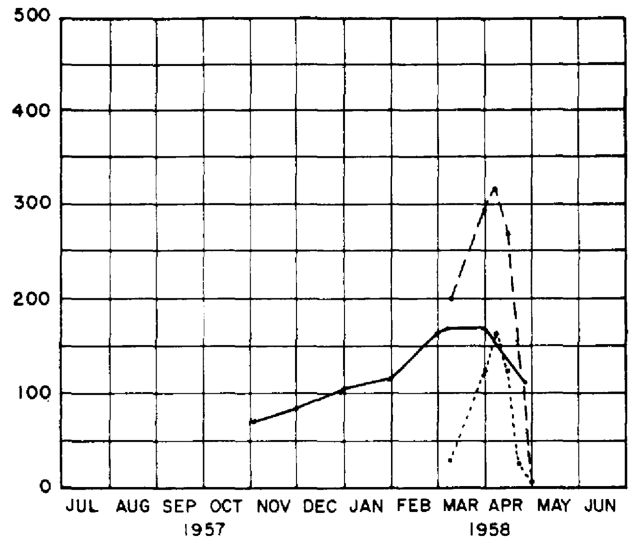


Chart No. 4-5. Camp Population — How.

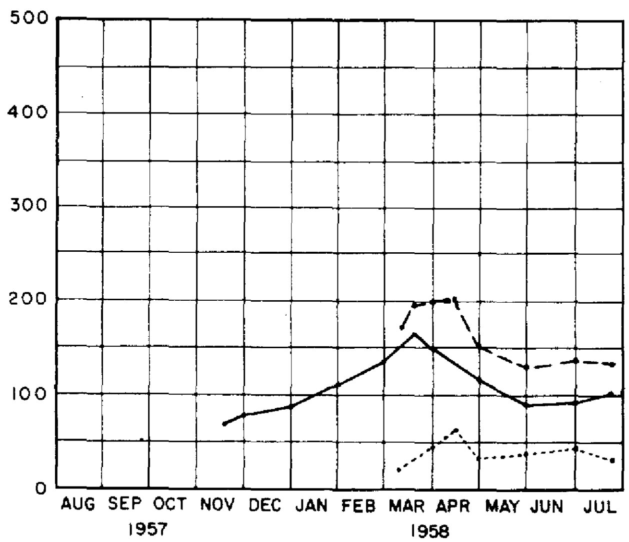


Chart No. 4-6. Camp Population — Oboe.

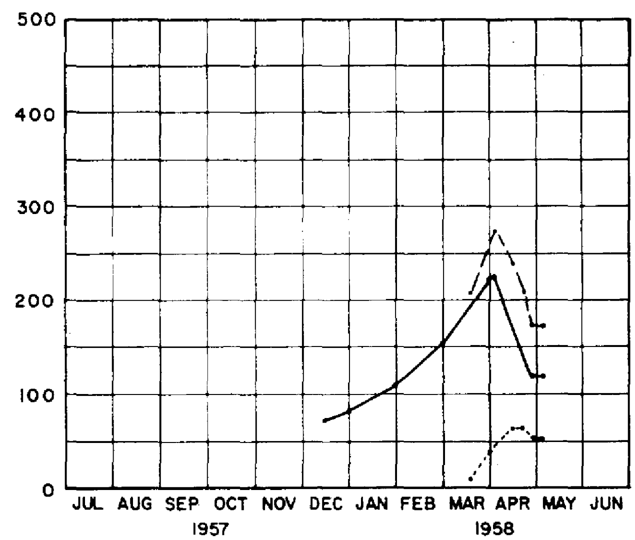


Chart No. 4-7. Camp Population — Yvonne.

ESTIMATED PEAK BILLETING REQUIREMENTS AS OF 25 JAN 1958			ACTUAL PEAK POPULATION	PEAK DATES
ELMER	7.1	875	873	5-8-58
	7.2	104	84	4-29-58
	7.3	153	161	5-2-58
	7.4	12	119	5-14-58
	7.5	1841	1894	4-30-58
	JFT-7	120	179	5-18-58
NAN	7.1	473	354	4-29-58
	7.2	61	67	5-7-58
	7.3	266	250	4-24-58
	7.4	34	41	4-29-58
	7.5	540	643	4-25-58
	JTF-7	0	5	4-1-58
JANET	7.1	84	52	4-27-58
	7.2	10	11	4-26-58
	7.5	109	183	4-10-58
YVONNE	7.1	80	56	4-21-58
	7.2	10	11	4-11-58
	7.5	195	238	4-2-58
HOW	7.1	169	139	4-7-58
	7.2	7	17	4-1-58
	7.5	250	210	3-7-58
OBOE	7.1	55	57	4-13-58
	7.2	0	9	4-9-58
	7.5	260	163	3-18-58
GEORGE	7.1 and 7.5	35	65	4-10-58

Table No. 4-2. Task Group Population Peaks — Estimated vs. Actual.

HOUSING ALLOCATION AND OCCUPANCY — ELMER

ORG.	TYPE QUARTERS	NO. OF BLDGS.	BILLET'S NORMAL OCCUPANCY	PEAK POPULATION NUMBER	PEAK POPULATION DATE	%—NORMAL OCCUPANCY REQUIRED
JTF-7	Building 120	1	9			
	18-Man Barracks	2	36			
	36-Man Barracks	1	36			
	4-Man Tent	12	48			
	8-Man Tent	11½	92			
	Totals	27½	221	179	5-19-58	81
TG 7.1	18-Man Barracks	11	198			
	36-Man Barracks	1	36			
	128-Man Barracks	4	512			
	4-Man Tent	13	52			
	8-Man Tent	16	128			
	Totals	45	926	873	5-8-58	94
TG 7.2	36-Man Barracks		4			
	8-Man Tent	6½	52			
	Totals		56	84	4-29-58	150
TG 7.3	36-Man Barracks		8			
	18-Man Barracks	1	18			
	8-Man Tent	15	120			
	Totals	16	146	201	[illegible]-20-58	138
TG 7.4	36-Man Barracks		24			
	8-Man Tent	11	88			
	Totals		112	119	5-14-58	106
TG 7.5	18-Man Barracks	4	72			
	36-Man Barracks	13	468			
	48-Man Barracks	2	96			
	8-Man Tent	72	576			
	Totals	91	1212	1861	4-30-58	154
AEC	16-Man Barracks	1	16			
	18-Man Barracks	1	18			
	Totals	2	34	33	4-12-58	99

Table No. 4-3. Housing Allocation and Occupancy — Elmer.

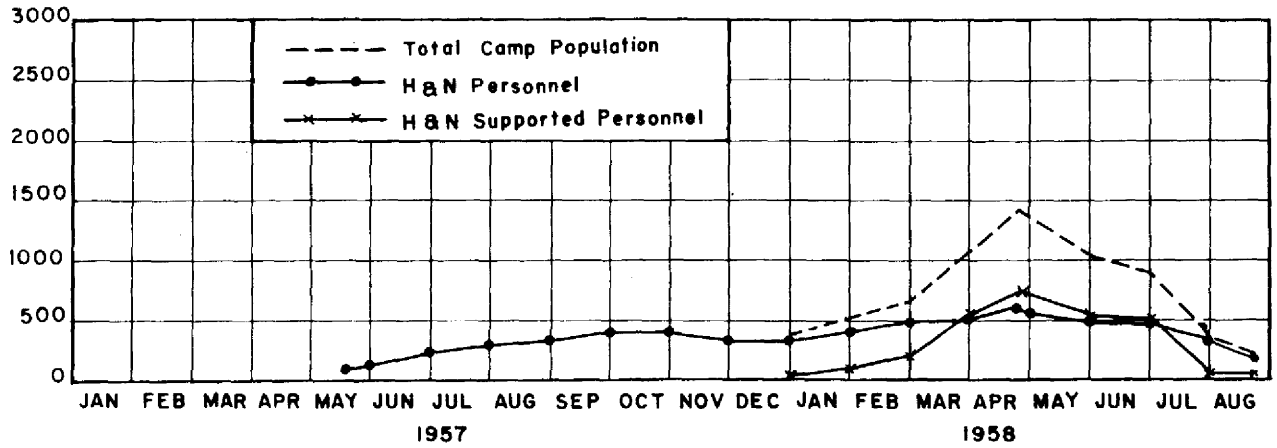


Chart No. 4-8. Camp Population — Nan.

HOUSING — NAN

8 MAY 1958

TASK GROUP	NO. TENTS OCCUPIED	DESIGNED CAPACITY	NO. BUNKS IN TENTS	BUNKS OCCUPIED	BUNKS VACANT	% VACANT BUNKS INSTALLED	AVERAGE OCCUPANCY	% OF DESIGNED CAPACITY USED
7.1	54	432	383	264	119	31.0	4.90	61
7.2	7	56	65	65	0	0.0	9.30	116
7.3	26	208	231	222	9	4.0	8.60	107
7.4	5	40	43	38	5	11.0	7.60	95
7.5*	60	480	549	545	4	0.7	9.08	114
TOTALS	152	1216	1271	1134	137			

NOTE: The following tents are not included in this Table:

7.2 Army Chaplain's tent behind H&N Store
7.3 Three tents occupied at Camp Blandy
7.5 AEC tents 158, 167, and 295
JTF-7 Tents 299 and 300

* H&N

Table No. 4-4. Housing — Nan.

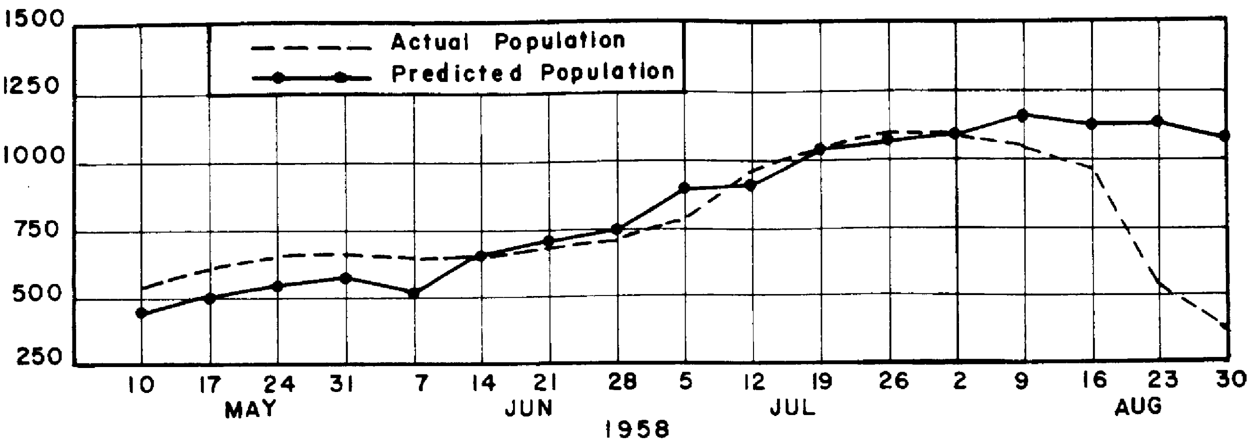


Chart No, 4-9. Total Population — Johnston Island.

EPG operations thereafter expanded in scope and in time; simultaneously the timetable for the Johnston Island operation was firmed up, and an emergency recruitment of approximately 50 camp workers became necessary. Permission was obtained to employ personnel with Good Security Risk classification, and the required personnel were phased into Johnston coincidental with the actual influx of the User Groups.

The unexpected change in plans for the TEAK and ORANGE events and the very short period scheduled for implementing and manning the Johnston Island camp presented a challenge. The effectiveness of the organizational set-up, existing techniques for procurement of supplies, and mobilization of manpower were indicated by the rapid solution of the problems that arose. It proved that the existing organization was functional and flexible enough not only to accommodate an orderly progression in camp operations but also to adjust and respond to sudden and radical changes.

For the first time in the history of the EPG, Contractor personnel were used to augment military personnel in the Army Mess Hall on Fred. In early March 1958 H&N was requested to furnish men for kitchen police duties. These included table waiters, cook's helpers, and general helpers for maintenance of sanitary standards. Because of the cut-off date for security clearance, permission was granted for the use of men classified as Good Security Risks. The first contingent of men was furnished on 27 March 1958; by mid-April the number had increased to 70.

MESSING.

Planning for mess operations was based on the use of the existing mess facilities at Elmer and Nan, use of the standard allowances for equipment and utensils (based on 200-man camp increments), and the staffing of all facilities to provide mess service with a minimum of overtime. The size, layout, and equipment installations at each of the temporary camps were satisfactory as designed in almost every detail. Early in the planning it was evident that to serve properly the large populations anticipated at Elmer, additional equipment would be required. However, the lack of dining room space required a schedule of multiple seatings which was not entirely satisfactory.

The Elmer Mess Hall went on a three-seating schedule on 11 March 1958 and continued this arrangement until 14 July 1958, when a return to two seatings was effected. During the period of three seatings, there were several occasions when it was necessary to provide a fourth seating for the overflow.

A standard menu was established so that all camps would serve like fare. In general, family-style service was provided at the base camps and cafeteria-style service was furnished at the off-island and Weather Station camps. An outstanding feature of Camp Operations was the high standard of food service, which was evidenced by the favorable comments received from many of the Users.

Field forces working in areas other than those with established camps were generally so widely scattered on the various islands that it was not always practicable to furnish the regular lunches. In such cases, box lunches were prepared of sandwiches, for which meats were specially cooked, in addition to cold cuts, cookies or cake, fresh or canned fruit, and cold drinks. At locations where it was practicable, hot lunches were delivered to work sites by mess hall personnel, who set up tables and served the established menu for the day.

Mess service was provided in houseboats at both atolls to support personnel whose services were required around the clock at off-island sites. Wider latitude in menus was permitted on houseboats because of the limited kitchen facilities with which these boats could be equipped.

MEAL COSTS — ENIWETOK ATOLL*

MONTH ENDING	NO. OF MEALS	DIRECT FOOD COSTS	DIRECT LABOR COSTS	COST PER MEAL
9-16-56	81,356	$ 49,569.77	$ 58,587.50	$1.3294
10-21	93,434	57,892.36	65,959.50	1.3256
11-18	68,053	41,260.27	45,310.00	1.2721
12-16	64,621	37,782.34	44,265.00	1.2697
1-20-57	73,702	46,377.18	54,147.50	1.3639
2-17	63,529	38,456.14	41,468.50	1.2581
3-17	64,393	39,601.79	40,745.00	1.2478
4-21	84,575	50,571.23	55,930.00	1.2593
5-19	73,033	43,461.28	51,147.50	1.2954
6-30	114,576	67,992.45	80,866.25	1.2992
7-21	64,435	42,936.99	44,177.17	1.3520
8-18	92,847	53,668.58	60,045.82	1.2248
9-15	96,249	56,896.82	62,953.98	1.2452
10-20	113,688	81,075.95	73,611.47	1.3606
11-17	100,092	79,416.52	66,686.56	1.4597
12-15	139,607	72,865.99	65,440.72	0.9907**
1-19-58	165,034	104,945.97	90,294.74	1.1830
2-16	176,295	85,880.73	79,037.00	0.9355**
3-16	200,160	115,309.78	98,976.32	1.0706
4-20	343,943	207,618.81	138,045.25	1.0050
5-18	321,160	167,269.62	118,348.46	0.8893**
6-30	502,565	308,864.92	181,745.91	0.9762**
7-20	197,088	128,070.42	100,478.30	1.1596
8-17	272,395	179,494.77	132,363.40	1.1449
9-21	209,938	103,172.46	100,457.50	0.9700**
Totals	3,776,768	$2,260,453.14	$1,951,089.35	Average $1.1151

*Includes Johnston Island, ship and Military messes.

**Due to more meals consumed on board ships and at Military messes than normal, these meals are billed at established rates which are lower than the per meal cost incurred by the Contractor.

Table No. 4-5. Meal Costs — Eniwetok Atoll.

MEAL COSTS — BIKINI ATOLL

MONTH ENDING	NO. OF MEALS	DIRECT FOOD COSTS	DIRECT LABOR COSTS	COST PER MEAL
6-30-57	23,823	$ 14,004.41	$ 14,297.50	$1.1880
7-21	18,582	11,171.07	10,740.80	1.1792
8-18	28,956	19,348.31	19,098.98	1.3278
9-15	32,982	14,042.67	20,730.68	1.2059
10-20	45,528	31,230.18	29,118.25	1.3255
11-17	39,216	23,983.39	28,032.90	1.3264
12-15	45,360	30,374.57	33,403.30	1.4060
1-19-58	61,593	38,921.56	42,988.93	1.3299
2-16	66,053	45,223.36	40,565.88	1.2988
3-16	92,964	56,761.60	49,821.97	1.1465
4-20	169,290	107,537.34	79,627.45	1.1056
5-18	112,785	69,696.71	52,957.97	1.0875
6-30	135,981	77,903.91	65,500.74	1.0546
7-20	72,351	42,010.82	32,938.10	1.0359
8-17	31,974	37,601.91	23,762.70	1.9192*
9-21		No Activity		
Totals	977,438	$624,811.81	$543,586.15	Average $1.1954

*Due to close-out of camps..

Table No. 4-6. Meal Costs — Bikini Atoll.

(Neg. No. W-V-280-5)

Figure No. 4-1. Messing Facilities — Houseboat 453.

In the mess halls at Elmer and Nan special tables were designated at breakfast as "Coffee and . . ." for those desiring only coffee and rolls or doughnuts. At Elmer during the interim period several tables at lunch were designated as "Soup and . . ." for those desiring a light lunch; soup, salad, and sandwich materials were available at these tables. On mornings when shots were scheduled before breakfast, coffee and rolls were served in personnel assembly areas. This was not only a convenience to the general population, but it also reduced the load on the mess hall when breakfast doors were opened after the shot.

Economy in food was stressed at all times. A Food Control Section was assigned the responsibility of establishing the master menu, determining the type and quantity of food to be procured, prorating available food stocks to various mess facilities, maintaining a running cost account of food used, and supervising the operations of each mess.

HOUSING.

Housing of the Task Force was in general satisfactory, though congestion existed at both Elmer and Nan during the peak of operations. Expansion of the housing facilities at Elmer after the REDWING Operation increased the number of designated billet spaces from 2200 to 2707, or approximately 23%. Allocation of tents at all other camps was made in accordance with requests of TG 7.1 as contained in its letter of 9 December 1957 and to all other elements of the Task Force on an "as needed" basis. Assignments to TG 7.1 were based on its requirement of housing not more than six men to each 8-man tent.

Unrealistic billeting requirements by Scientific and Military Users as reflected in their strength reports resulted in shortages of certain housing equipment, such as bunks and mattresses. This situation was resolved by frequently moving this equipment from housing unit to housing unit and from camp to camp. Reliable strength reports on the part of Task Force groups would have prevented this constant shuffling of housing equipment to meet the requirements of each camp.

BARS AND CLUBS.

During the interim and build-up periods a Refreshment Bar, an Officers' Club, and one Beach Club were operated at Elmer and a Refreshment Bar at each camp upon its activation. On 15 March 1958 the Officers' Club at Elmer was placed under the operation and control of JTF-7. On Nan a new club was constructed and operated by H&N for the use of TG 7.1. A good selection of mixed drinks, beer, and soft drinks

(Neg. No. W-733-9)

Figure No. 4-2. Refreshment Bar — Elmer.

were served at these facilities at moderate prices. There were some shortages for short periods of specific brands of the various liquors, primarily because it is difficult to predict accurately the tastes and drinking habits of approximately 4000 new men coming to Jobsite. There were no gross shortages, and bar operations throughout were handled satisfactorily.

As in the previous Operations, package sales were permitted. Sale to Contractor personnel was strictly controlled under a ration system, and the sale of bottled liquors to other elements of the Task Force was approached with the understanding that it was the responsibility of each individual Task Group to control the sales to its personnel and that H&N would perform no policing of this control. There were excessive issues of bottled liquors, far in excess of experience factors, which created a few problems in the maintenance of adequate stocks of certain brands.

CAMP STORES.

At the request of the Military authorities on Fred, the designation of PX was changed to "Camp Store" on 30 April 1958. Camp Stores were operated at each camp site for the sale of articles for ordinary use and for recreational purposes. Retail prices were established by the Resident Controller.

Due to the priority of other construction, the authorized remodeling and expansion of the Elmer Camp Store had to be postponed, and because of the large population served, inadequacy of the existing store facilities imposed a heavy burden on store personnel.

All Camp Store supplies were first received at Elmer and then distributed to other sites.

(Neg. No. W-601-10)

Figure No. 4-3. Tables Set for Christmas Dinner — Elmer.

(Neg. No. W-V-126-9)

Figure No. 4-4. Kitchen and Bakery — Oboe.

SITE	DESIGNATION	OPERATED BY	SERVICES AVAILABLE
ELMER	Enlisted Men's Club	CJTF-7	Mixed drinks, beer, and soft drinks
	Officers' Club	CJTF-7	Same as EM Club, with bar snacks
	Beer Hall	H&N	Mixed drinks, beer, and soft drinks
	Riviera Beach Club	H&N	Beer and sandwiches (Sunday only)
	Snack Bar	H&N	Soup, sandwiches, hamburgers, Sunday breakfast, limited fountain service
NAN	JTF-7 Club	H&N	Mixed drinks, beer, and soft drinks
	Beer Hall	H&N	Mixed drinks, beer, and soft drinks
	Camp Blandy	TG 7.3	Mixed drinks, beer, and soft drinks
OFF-ISLAND CAMPS	Beer Hall	H&N	Mixed drinks, beer, and soft drinks
JOHNSTON ISLAND	Officers' Club	H&N	Mixed drinks, beer, and soft drinks
	NCO Club	H&N	Mixed drinks, beer, and soft drinks
	Beach Club	H&N	Mixed drinks, beer, and soft drinks
DAVID	Camp Parsons	TG 7.3	Mixed drinks, beer, and soft drinks

Table No. 4-7. Refreshment Bars — Operational Period.

(Neg. No. W-718-11)

Figure No. 4-5. Snack Bar — Elmer.

REFRESHMENT BARS — MONTHLY PROFIT STATEMENT
1 JULY 1957 THROUGH 20 JULY 1958

DATE	REVENUE	COST OF SALES	GROSS PROFIT	DIRECT LABOR	DIRECT SUPPLIES	NET PROFIT
7-21-57	$ 23,226.44	$ 10,902.04	$ 12,324.40	$ 5,406.30	$ 410.39	$ 6,507.71
8-18-57	33,625.04	16,243.48	17,381.56	8,308.18	283.23	8,790.15
9-15-57	35,252.56	16,887.08	18,365.48	8,759.90	444.70	9,160.88
10-20-57	45,252.39	21,295.30	23,957.09	10,416.33	353.83	13,186.93
11-17-57	38,815.72	18,792.43	20,023.29	9,059.25	317.41	10,646.63
12-15-57	46,099.61	25,371.11	20,728.50	9,637.70	530.33	10,560.47
1-19-58	60,431.92	25,988.11	34,443.81	12,839.73	637.43	20,966.65
2-16-58	54,550.61	25,443.90	29,106.71	10,930.50	531.29	17,644.92
3-16-58	65,748.62	33,525.71	32,222.91	11,659.53	245.79	20,317.59
4-20-58	120,879.23	69,119.26	51,759.97	16,212.75	1,287.93	34,259.29
5-18-58	94,962.03	56,119.75	38,842.28	12,663.80	982.89	25,195.59
6-29-58	140,755.93	86,201.83	54,554.10	20,285.25	989.11	33,279.74
7-20-58	64,634.39	38,611.26	26,023.13	10,245.30	233.06	15,544.77
STMT ADJ.	62.00	8.43	53.57			53.57
Totals	$824,296.49	$444,509.69	$379,786.80	$146,424.52	$7,247.39	$226,114.89

Table No. 4-8. Refreshment Bars — Monthly Operating Statement.

CAMP STORE MONTHLY PROFIT STATEMENT
1 JULY 1957 THROUGH 20 JULY 1958

DATE	REVENUE	COST OF SALES	GROSS PROFIT	DIRECT LABOR	DIRECT SUPPLIES	NET PROFIT
7-21-57	$ 17,128.14	$ 13,808.69	$ 3,319.45	$ 2,587.50	$ 16.25	$ 715.70
8-18-57	25,091.42	17,564.19	7,527.23	3,355.00	19.76	4,152.47
9-15-57	24,498.55	23,230.46	1,268.09	4,085.00	19.76	<2,836.67>
10-20-57	31,485.99	26,042.59	5,443.40	4,233.75	32.26	1,177.39
11-17-57	30,991.33	26,595.47	4,395.86	4,120.00	19.13	256.73
12-15-57	38,526.67	31,719.93	6,806.74	4,480.00	81.01	2,245.73
1-19-58	42,294.80	34,706.87	7,587.93	5,838.75	509.62	1,239.56
2-16-58	46,130.63	39,525.92	6,604.71	5,760.00	40.06	804.65
3-16-58	62,515.71	53,241.07	9,274.64	6,466.25	41.44	2,766.95
4-20-58	93,497.39	79,083.63	14,413.76	8,661.25	83.42	5,669.09
5-18-58	77,462.07	68,483.29	8,978.78	6,800.00	51.48	2,127.30
6-29-58	109,993.17	88,610.98	21,382.19	9,680.00	98.54	11,603.65
7-20-58	57,550.33	50,858.53	6,691.80	4,538.30	24.72	2,128.78
STMT. ADJ.		13.30	<13.30>			<13.30>
TOTALS	$657,166.20	$553,484.92	$103,681.28	$70,605.80	$1,037.45	$32,038.03

Table No. 4-9. Camp Store — Monthly Operating Statement.

Shortages were experienced in some items, due partially to an underestimation of populations; also, the impracticability of attempting to estimate sizes and tastes of newcomers; a run on Contractor-operated stores because of shortages in the PX at Fred and in the Canteens of Task Force vessels contributed to other shortages. In spite of these problems it is believed that, when all factors are considered, the Camp Store operation was satisfactory.

SNACK BARS.

A snack bar operated at Elmer was well patronized. This bar sold light meals, sandwiches, coffee, and fountain drinks, and on Sunday morning a late breakfast was available at reasonable prices. Experience with this operation indicated that the relocation and expansion of this facility during the interim period will contribute to morale, inasmuch as this facility is high on the popularity list.

POST OFFICE.

During the interim period, H&N-operated APO 435 served as the central facility for all activities except Fred. In the operational period, APO 437 at Elmer and APO 436 at Nan were activated with Armed Forces personnel. During this period, the H&N facilities functioned primarily as distribution centers. However, to provide for a more workable system for transfers of money than was possible under existing postal regulations for postal money orders, Holmes & Narver, acting as a subagent, sold American Express Money Orders at each camp postal facility. This was satisfactory in every respect. Cooperation between the Armed Forces and H&N-operated facilities was excellent, and the services provided met satisfactorily the requirements of the Operation.

LAUNDRY.

A completely outfitted laundry was operated at Elmer only, but the service of this laundry was made available to personnel at all sites and finished laundry was provided within four to five days to all sites. Throughout the Operation, no limitations were placed on the quantity of finished laundry service for each individual.

Automatic-type washing machines were installed at all temporary camps. These were operated by H&N personnel and provided spun-dry service within 24 hours. This service met with favor and was widely used.

Washing of radioactive-contaminated clothing was accomplished at the laundry on Elmer in a machine set aside solely for this use, and in Bikini Atoll on the Rad-safety barge. The washing of contaminated clothing was under the guidance of Rad-safety personnel.

At Elmer facilities were available for repair of torn clothing and replacement of zippers at no cost. During the peak of the operational period, shift work was required to maintain schedules and overtime was required only in those cases where it was necessary to make up lost time because of equipment failures. These cases were few, and overtime, therefore, was kept at a minimum.

BARBER SHOPS.

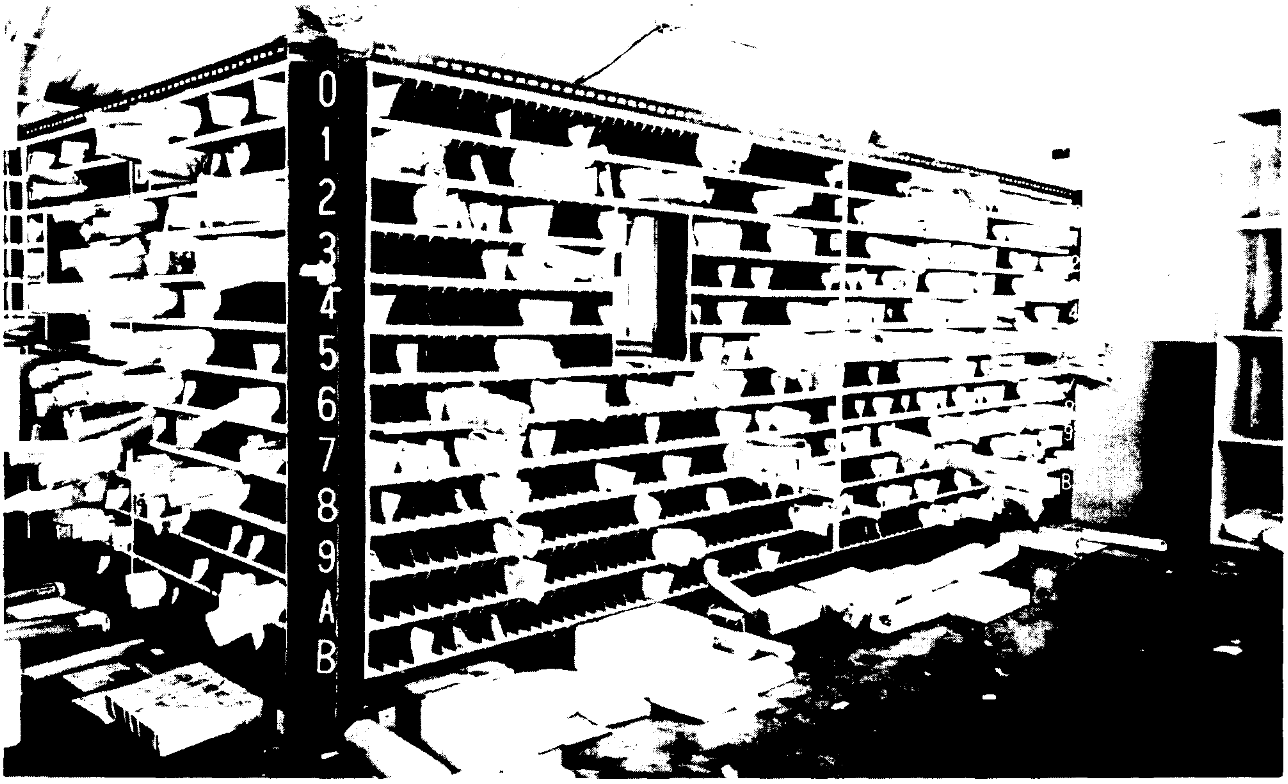
During previous Operations, barber services were provided by volunteer barbers who worked during free time from their regular tasks. In response to requests from Users, barbers were placed under contract and were employed at both Elmer and Nan. This permitted the furnishing of barber services from 0800 hours to 2000 hours which could not generally be done with volunteer barbers. The use of contract barbers provided a needed service but entailed a heavy expense that should be appraised before the next Operation. The 75-cent charge for a haircut resulted in a loss of approximately $150 per week during the peak of operations at Elmer; however, weekly records indicate that a $1 charge for haircuts would cover present labor costs.

OFF-ATOLL CAMPS.

Off-atoll camps operated by H&N were located at Wotho, Ujelang, Utirik, and Rongelap. Each camp was provided with the required messing and housing facilities and was furnished a limited supply of Camp Store and bar items. Only package sales of alcoholic beverages was permitted. Resupply for the camps was effected through a schedule of seaplanes with weekly calls at each camp. The operation of these camps was, in general, satisfactory; however, the frequency of emergency requests for cold storage items indicated an increase in reefer capacity at each site would be desirable for future Operations.

PEST CONTROL.

A continuous and effective campaign was conducted against insects and rodents. General area spraying was done on a regular schedule at all occupied sites and was supplemented by spot spraying as needed. Malathion was used for general area work and spot spraying outside of living and working spaces; Chlorodane-base spray was used for inside spraying. For rodents both trapping and poison were used. Trapping was considered less efficient than poison because of the large number of man-hours required to run trap lines daily. Warfarin poison stations required tending only when they were emptied and could be used to reduce the rodent population of uninhabited sites, in preparation for occupation, by setting out stations in advance.



(Neg. No. W-720-1)

Figure No. 4-6. Post Office — Elmer.

(Neg. No. W-V-274-1)

Figure No. 4-7. TG 7.1 Club — Nan.

COMPARATIVE STATEMENT OF INVENTORIES

Beginning Inventory 19 August 1956

INVENTORY DATE	TOTAL MANPOWER	FOOD INVENTORY TOTAL	FOOD INVENTORY AVERAGE PER MAN	STORE INVENTORY TOTAL	STORE INVENTORY AVERAGE PER MAN	BEER HALL AND BAR TOTAL	BEER HALL AND BAR AVERAGE PER MAN
9 Aug 1956	1,164	$152,503.42	$131.02	$ 81,833.51	$70.30	$45,226.65	$38.85
16 Sept 1956	1,033	155,987.96	151.00	78,561.20	76.05	46,450.60	44.96
1 Oct 1956	909	115,247.27	126.78	79,480.00	87.44	35,716.22	39.29
8 Nov 1956	870	100,919.58	116.00	86,712.85	99.67	31,486.16	36.19
16 Dec 1956	799	68,817.88	86.13	78,047.30	97.68	23,609.55	29.55
0 Jan 1957	810	$106,260.14	$131.19	$ 88,962.15	$109.83	$26,432.04	$32.63
7 Feb 1957	837	68,980.31	82.41	81,769.43	97.69	19,973.18	23.86
7 Mar 1957	869	101,158.94	116.41	98,231.61	113.04	33,576.00	38.64
1 Apr 1957	965	111,286.95	115.32	107,873.48	111.79	30,574.71	31.68
9 May 1957	1,040	179,649.53	172.74	102,686.97	98.74	44,251.50	42.55
6 Jun 1957	1,258	135,451.48	107.67	93,360.47	74.21	40,452.93	32.16
0 Jun 1957	1,366	233,670.00	171.06	96,324.28	70.52	42,618.67	31.20
1 Jul 1957	1,472	183,267.18	124.50	84,260.19	57.24	40,730.22	27.67
8 Aug 1957	1,552	293,152.03	188.89	97,075.40	62.55	74,643.01	48.09
5 Sep 1957	1,633	330,877.89	202.61	93,650.61	57.35	92,545.22	56.67
0 Oct 1957	1,728	414,952.31	240.13	141,284.27	81.76	105,439.41	61.02
7 Nov 1957	1,949	394,411.42	202.36	151,620.19	77.79	128,165.25	65.75
5 Dec 1957	2,281	430,387.18	188.68	161,460.11	70.78	109,398.14	47.96
9 Jan 1958	2,585	$401,944.42	$155.49	$154,130.19	$59.62	$ 98,388.43	$38.06
6 Feb 1958	3,203	418,624.00	130.70	140,359.04	43.82	100,583.16	31.40
6 Mar 1958	4,239	440,169.69	103.84	150,633.17	35.54	133,544.74	31.50
0 Apr 1958	4,762	579,402.05	121.67	131,076.87	27.52	120,673.01	25.34
8 May 1958	5,001	585,212.48	117.02	133,508.17	26.26	130.010.64	26.00
9 Jun 1958	4,673	599,293.84	128.25	109,867.71	23.51	117,727.39	25.19
0 Jul 1958	4,245	488,968.36	115.19	105,072.95	24.75	93,438.37	22.01
7 Aug 1958	3,599	578,259.87	160.67	87,850.49	24.41	81,135.12	22.54
1 Sept 1958	1,650	564,174.77	341.92	104,524.38	63.34	55,365.15	33.55

Table No. 4-10. Food, Camp Store, and Bar Inventories vs. Population.

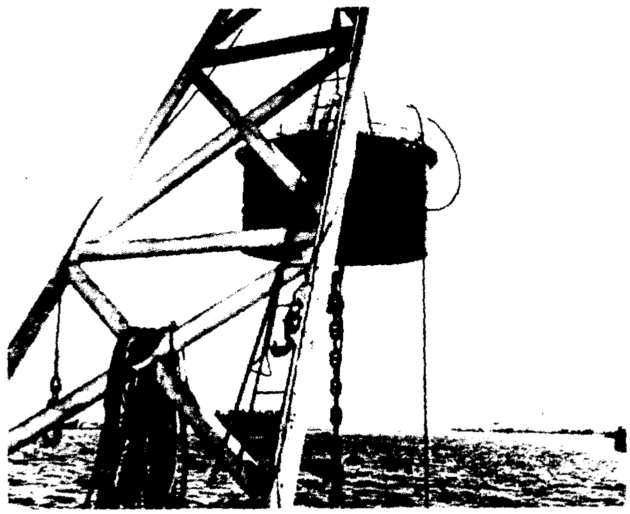
SECTION 2
MARINE OPERATIONS

The Marine Operations Department was di-ectly supervised by a Marine Superintendent nd was responsible for operating and main-aining facilities to provide intra-atoll and inter-toll water transportation for cargo and person-iel; locating, improving, and marking channels; nstalling and maintaining approximately 250 nooring buoys; providing tug services to ocean-going vessels in docking; moving scientific and cargo barges and houseboats; installing and maintaining underwater pipelines; operating cable-laying boats; furnishing deep and shallow water divers; mooring scientific barges and other scientific afloat stations; and operating the ocean-going vessel MV ALOTO.

Perhaps the most significant factor of the HARDTACK Operation with respect to marine activity was that of 37 zero stations prepared, 23 were located on barges and 5 were on LCU hulls. With this increase in shot stations afloat in HARDTACK over previous Operations, marine support services increased proportionally. Houseboats were widely used, requiring 24-hour services of LCM's and DUKW's; LCU's with specially-fitted, large, cable winches were used to lay and retrieve cables to detectors and recorders. Extensive shallow-water diving was required on caisson work in connection with Pinex barges and other Scientific Stations; and varied support in materials and personnel was furnished the Users in their instrumentation activities.

The USS CREE, towing Stations 3 and 8 to Bikini from Eniwetok, had to set Station 3 adrift approximately 35 miles from its destination. This Station, carrying a heavy sand ballast load, sprung a leak, became almost totally submerged, and floated on end with approximately 20 feet of its 120-foot length above water. After the USS CREE delivered Station 8 to Bikini, she recovered Station 3, which she towed to Eniwetok, where it was raised and placed in drydock for repairs.

The major portion of the construction of Barge and LCU Hull Stations was accomplished at Elmer. Those destined for use in Bikini Atoll were either towed or carried there in an LSD. A newly-constructed barge slip was constructed at Nan, and final outfitting of the barges and loading of the test devices were accomplished at this facility for the Bikini shots. This slip differed from the one at Elmer in that it was provided with gates at the seaward end and hinged loading ramps at the inshore end, which facilitated movement onto and off the barges in addition to providing for smoother operations in loading the test device and its instrumentation.



(Neg. No. W-743-5)

Figure No. 4-8. Lifting Mooring Buoy to Sea Mule Deck.

Since the first use of Barge Zero Stations in Operation CASTLE, there have been evolved methods and techniques for mooring and positioning which have proved effective for expediting the operation and maintenance of tolerances required in barge movements. The 585-ton Army-type BC barge and the standard LCU (stripped of engines and equipment) were modified to meet the scientific criteria for each station. Of particular interest was the innovation of the Pinex barge, which required considerable construction to the underwater body. Pinex tubes extended through the barge structure approximately 25 feet below the water line, and it was found most economical and feasible to perform the construction in drydock. The extent of the work involved, combined with the fact that Pinex criteria were late in being developed, led to the acquisition of a second floating drydock (AFDL-27) so that two barges could be worked concurrently, thereby enabling the meeting of completion dates. The docking of these Pinex barges was rather unusual in that the dock blocks were doubled in height, and approximately one-third of the barge extended beyond the stern of the drydock.

Inter-island transportation of cargo and personnel was provided by boats on scheduled runs between camp sites or by assignment of craft

INTRA-ATOLL WATER TRANSPORTATION (6-MONTH PEAK ACTIVITY)

MONTH	LOCATION	PASSENGERS						CARGO (TONS)			
		LCM	LCU	DUKW	TAXI	BARGE	YTL	LCM	LCU	BARGE	DUKW
March 1958	Eniwetok	12107	2294	5263	4863	—	—	52125	68437	10690	—
March	Bikini	753	647	3946	—	—	—	15037	45400	—	—
April	Eniwetok	11618	4979	11480	14523	—	—	40914	79756	6980	—
April	Bikini	2955	2023	4752	—	—	—	15078	40530	—	—
May	Eniwetok	9824	4328	3756	14618	—	—	40421	54616	1200	—
May	Bikini	5432	2378	5650	—	—	—	9189	16796	—	—
May	Johnston	582	254	1151	—	14	—	1701	10789	2800	9
June	Eniwetok	7813	2398	3022	10378	—	—	34379	36031	—	—
June	Bikini	2978	790	6268	—	—	—	8470	21871	—	—
June	Johnston	516	530	421	—	3	—	2307	18873	200	10
July	Eniwetok	6064	2849	3310	9926	—	—	29194	35557	—	—
July	Bikini	250	1191	5112	—	—	—	608	21768	—	—
July	Johnston	445	1719	643	—	—	13	1656	3471	—	—
August	Eniwetok	5329	1463	4449	7760	—	19	24775	29091	—	—
August	Bikini	350	27	370	—	—	—	1067	493	—	370
August	Johnston	1134	2241	636	—	—	—	5585	6359	—	636

Table No. 4-11. Intra-Atoll Water Transportation.

CRAFT AVAILABLE FROM 1 JANUARY TO 31 MAY 1958

CRAFT	ENIWETOK ATOLL	BIKINI ATOLL PEAK NUMBERS	JOHNSTON ISLAND	PEAK TOTAL
DUKW	37	14	4	46
LCM	22	13	3	34
LCU	25	8	3	31
YTL	2	0	0	2
YTB	0	0	1	1
Water Taxi	3	0	0	3
Barges	29	12	1	31

Table No. 4-12. Available Marine Craft.

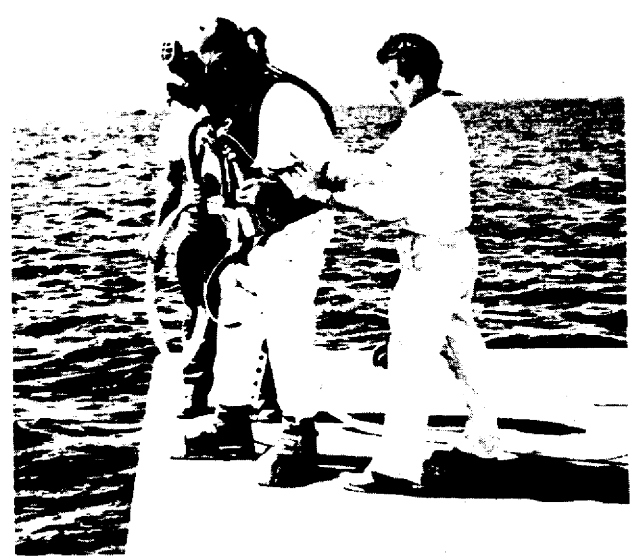
to specific missions. The assignment of craft was coordinated through a Marine Dispatcher located at each camp site whose responsibility it was to ensure the optimum use of craft. A voice radio network with outlets to all Marine Dispatch offices and in each craft provided the means for the interchange of operating information.

The requirements for the movement of heavy equipment to Johnston Island in LCU's, loaded in LSD's, combined with that of a Weather Station mission, called for the absence of eight LCU's from the EPG during a part of the operational period. The shortage caused thereby was overcome by rapidly activating and manning five LCU's that were available and destined for use as houseboats later in the operation.

The demand for tug services was exceptionally heavy. There was a definite need for frequent shifting of the scientific barges from barge slip to dock space or to buoys during the construction and outfitting of the stations, and the services of tugs were required for the movement of the large helicopter barges which formed part of the array of each Barge Zero Station. The frequency of ship arrivals in both interatoll and overseas service was greater than ever before and resulted in a proportionate increase in tug service demands. Tug services were also required in the frequent movement of the various marine craft used as the target array of the underwater events. A significant factor of this service was the definite need for higher powered tugs than were available. Action was initiated towards the close of the Operation to acquire two tugs of 600 horsepower, which will be necessary in future Operations similar to HARDTACK.

A problem area in HARDTACK was inadequacy of dock space. Because of the heavy shipping schedule combined with the need for dock space to augment the scientific barge outfitting slip, there were times when the harbor facilities were overloaded. This hampered smooth and economic operations requiring such dock space. Also, the small personnel piers at both Elmer and Fred were inadequate for the large number of personnel craft of the many ships of the Task Force, in addition to Contractor-operated water taxis.

With respect to boat operations, HARDTACK may be categorized as an Operation of unusual occurrences. One LCM loaded with cable reels capsized while making passage across the wide entrance south of Nan; however, all personnel were rescued, and the cable reels and boat



(Neg. No. W-V-71-11)

Figure No. 4-9. Deep Sea Diver Ready for Plunge.

were salvaged. One tug boat broke away from its mooring during the night, was found undamaged the next morning three miles at sea, and was returned to the mooring under her own power. One LCM grounded off Site Charlie on the night of D minus 1 of the SYCAMORE event, and another was grounded off Site George on the night of D minus 1 of the POPLAR event. Because of the evacuation to sea for these events, the boats were temporarily abandoned. As soon as permissible after each of these events, both of the boats were salvaged, with minor damage in each case.

Through years of experience with EPG activities, H&N has evolved procedural techniques so that such activities as cable laying, houseboat operation, and maintenance of underwater pipe lines have become more or less routine. However, the extent of this type of work in HARDTACK was a significant factor in the over-all work load. Of particular significance also was the extent of diving operations arising primarily because of the work in connection with Pinex barges. To provide the support required for these operations, eight sets of aqua-lung gear were acquired. This gear was adequate, and all diving requirements were satisfactorily fulfilled.

HARDTACK marked the first Operation in which an ocean-going vessel was acquired by the AEC and placed under the operational control of the Contractor. The USS LSM 444, later named the MV ALOTO, was obtained on a loan basis in accordance with the existing agreement between the Navy Department and the AEC for the loan of Navy craft. This vessel was activated and modified for EPG service. The principal modifications consisted of raising the bow opening to permit high trailer loading across the bow ramp, and air conditioning all living spaces. The vessel was towed to the Eniwetok Proving Ground and placed in active service; she departed Elmer for Nan on 30 December 1957 with the first load and has since operated on a continuous schedule. The advantage of having a vessel under AEC control was most strikingly illustrated during the early days of the Johnston Island operation. At that time, the entry of LST's into Johnston Island harbor was questionable, and it was through the availability of the ALOTO that the materials for Station 6001 could be rushed to that site. The availability of these materials had a direct bearing on the fact that the Johnston Island construction was expedited and that the station was readied ahead of schedule. There were other incidents in which the ALOTO paid off. Her operation by a Contractor crew was satisfactory and provided a long-needed AEC service.

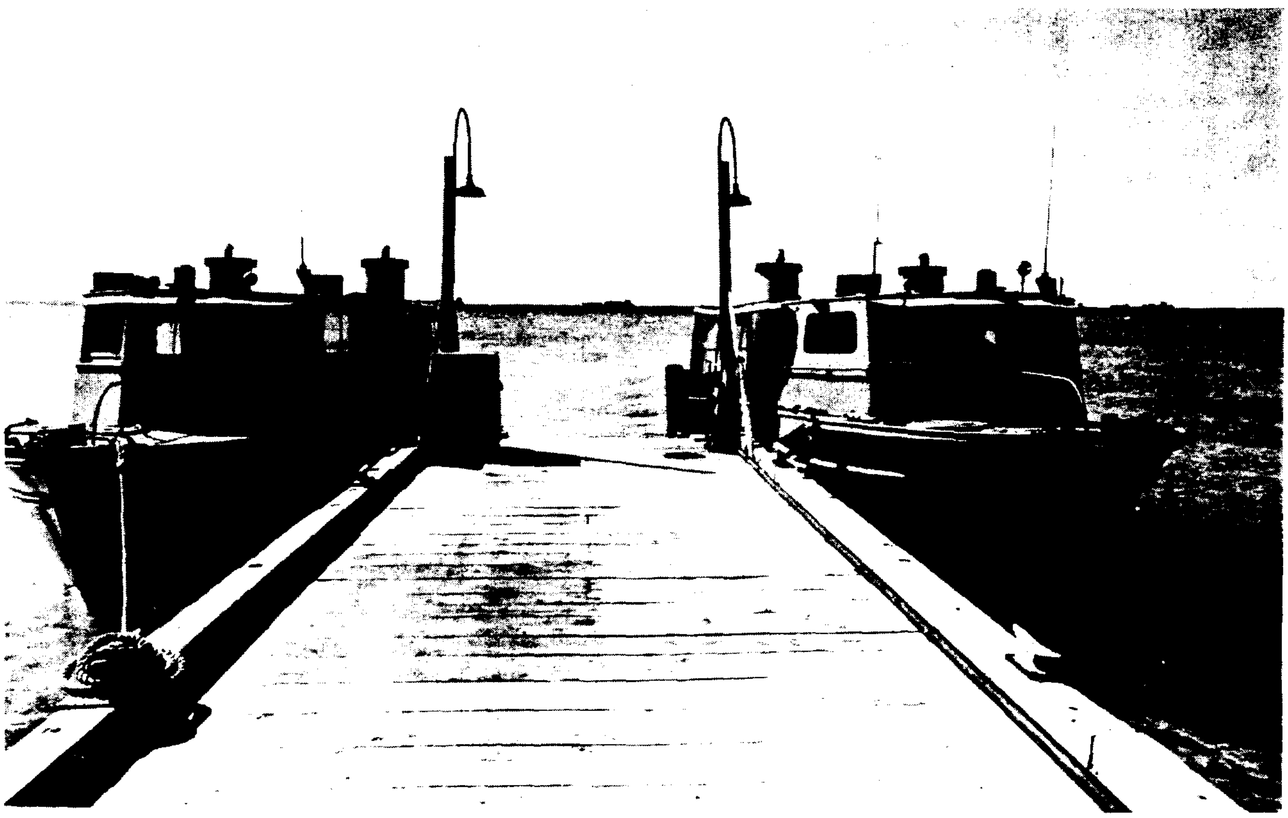


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Figure No. 4-10. Water Taxis Docked at Personnel Pier — Elmer.

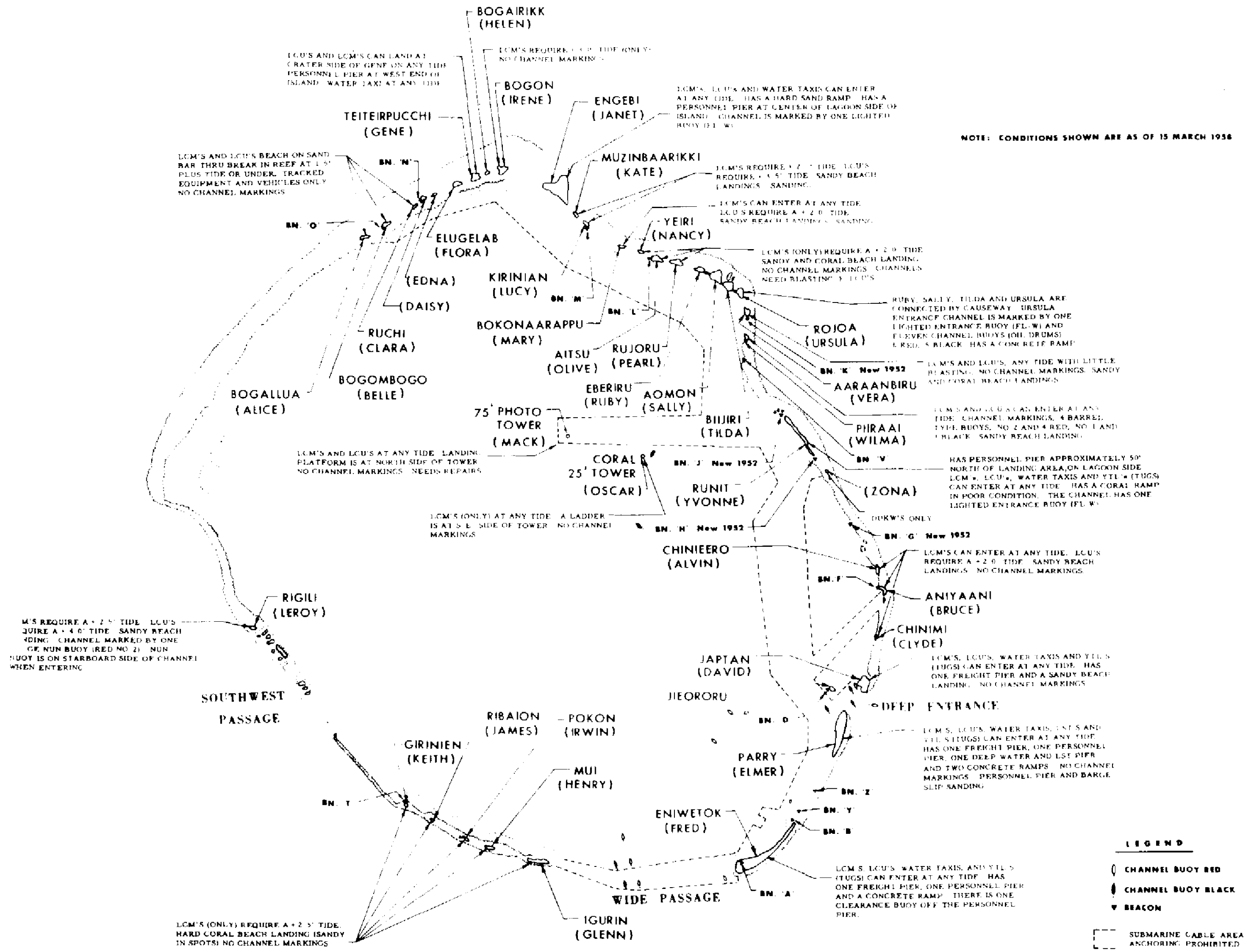


Chart No. 4-10. Beaching Conditions — Eniwetok Atoll.

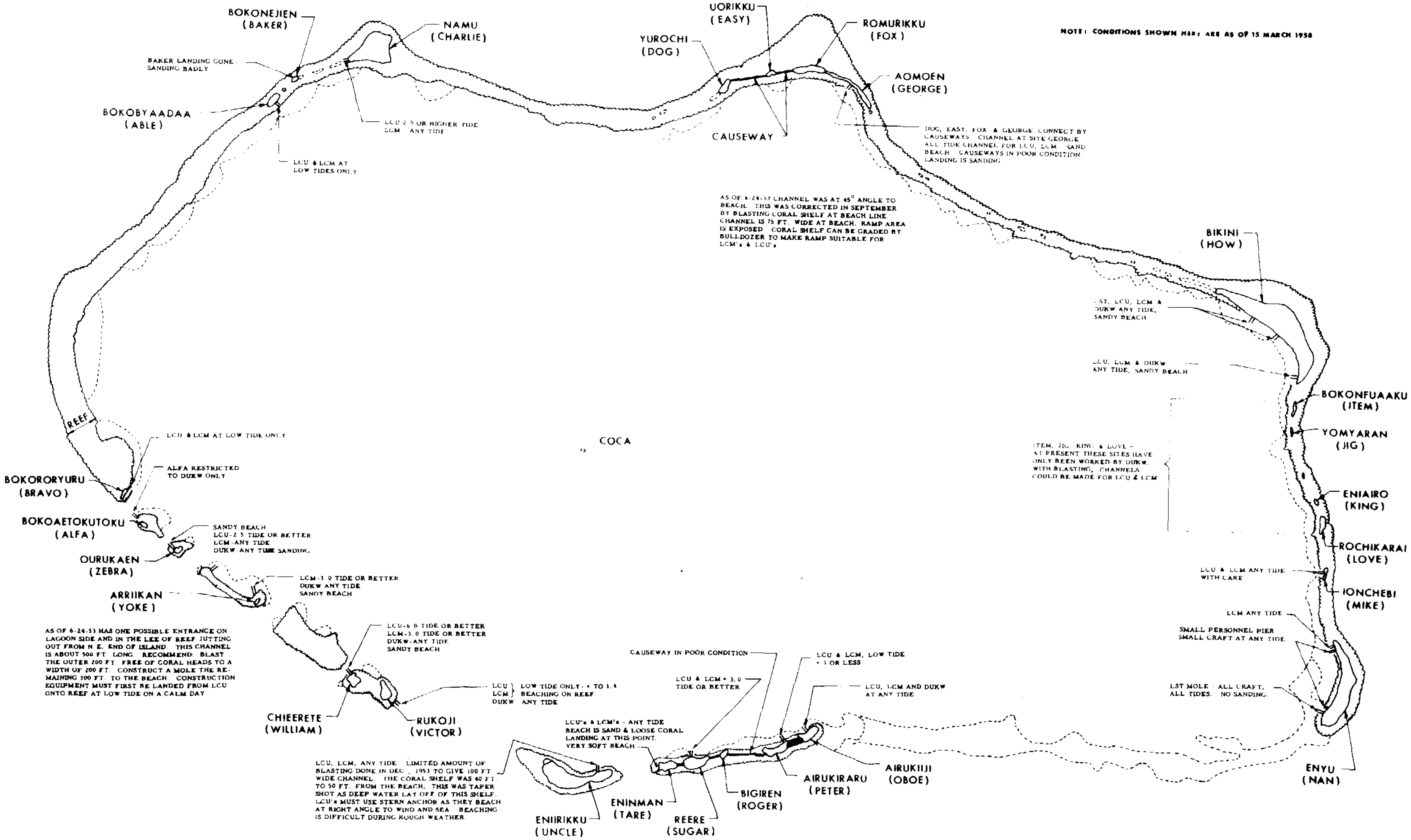
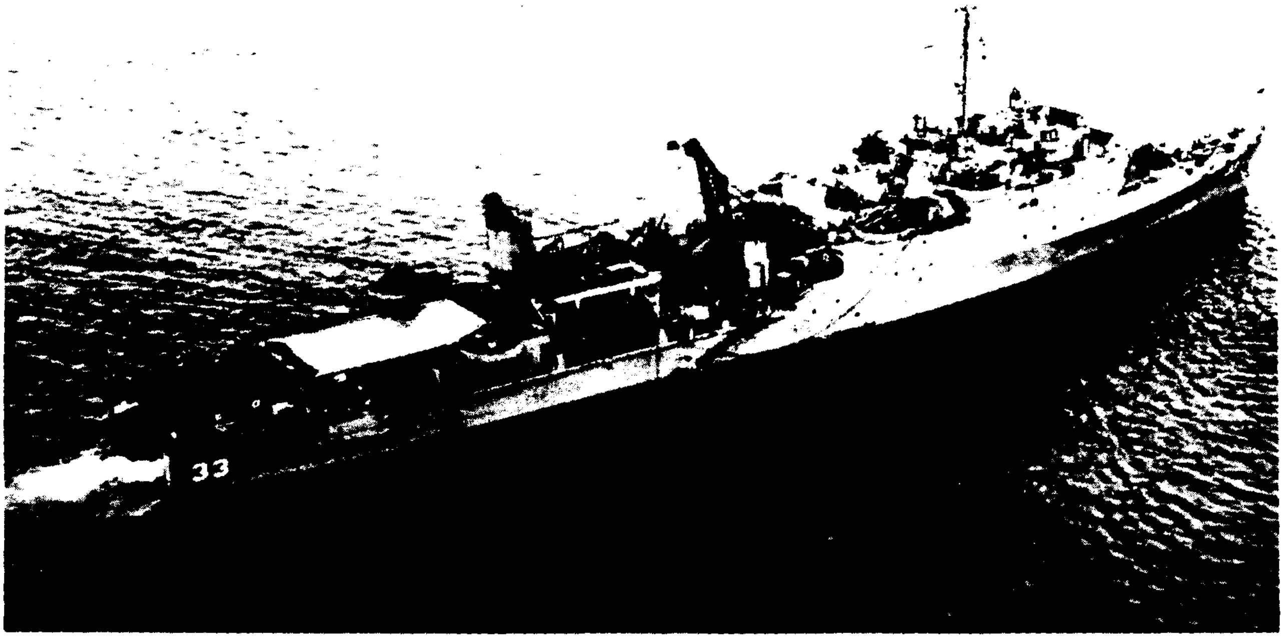


Chart No. 4-11. Beaching Conditions — Bikini Atoll.



(Neg. No. W-707-3)

Figure No. 4-11. LCU Entering Well-Deck of LSD.

(Neg. No. W-743-8)

Figure No. 4-12. Gilhoist Lifting LCM from Water.

SECTION 3
ELECTRIC POWER GENERATION AND DISTRIBUTION

The electric power generation and distribution function was the responsibility of a Superintendent, who was assisted by Assistant Superintendents for both electric power and water facilities. Upon completion of roll-up after REDWING, all power plants were de-activated except those on Elmer, Fred, and David. About 80% of the power required for Fred was supplied by cable from Elmer, which source was augmented by three 150-kw Caterpillar units located adjacent to Building 539 on Fred. As construction activity for Operation HARDTACK increased, power demands at Elmer and Fred increased progressively at these two sites, and it became necessary to re-activate the Fred plant and then augument the generating capacities at each site with portable units. At times, there were three separate plants in operation at both Elmer and Fred.

During Operation HARDTACK, the old Fairbanks-Morse units at Nan Station 500 plant were replaced by three 300-kw units, which had to be augumented for peak operation by the temporary installation of three 150-kw portable units located outside the station. During the period of replacement, five 150-kw Caterpillar units were used to provide the required power. Because of the blast consideration, the large radiators for the new 300-kw units in Station 500 were located within the wingwalls of the plant, and as a result this plant had to be operated with rather high temperatures.

As the off-island camps were being constructed, power demands were met by the use of portable generators until the camp power plant could be activated. These plants were set up in expendable structures, which also served to house the distillation plant. One crew operated both plants; this was possible through on-the-job training of selected personnel. Plants at Wotho, Rongelap, Utirik, and Ujelang were operated by the Contractor. All other off-atoll plants were operated by Air Force personnel and service calls were made by Contractor personnel to these camps at scheduled intervals.

Of particular significance in power generation and distribution was the operating, refuel-

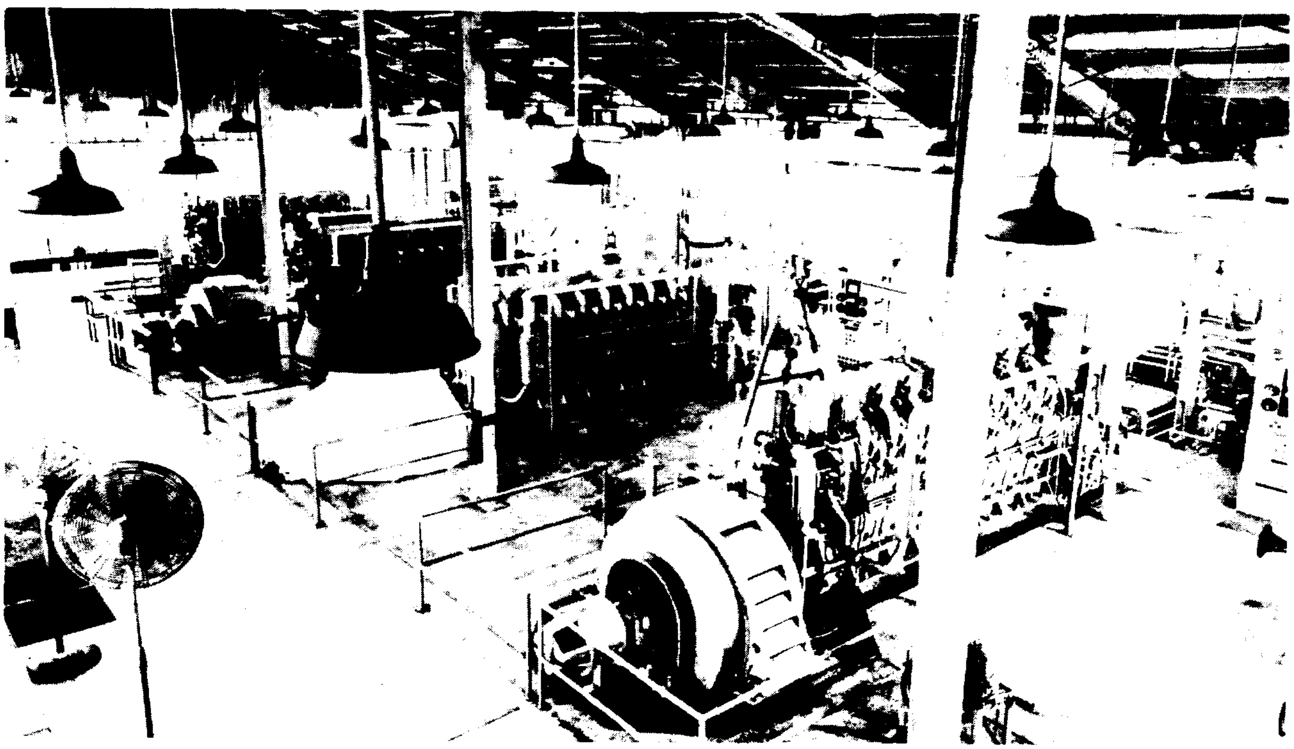


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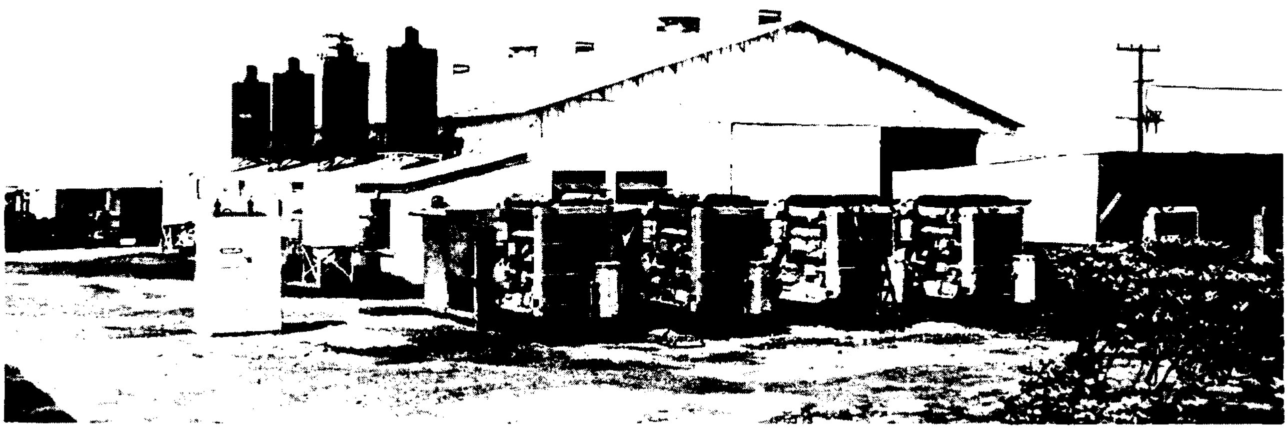
Figure No. 4-13. Four 1000-KW Generators — Building 339 — Elmer.



(Neg. No. W-680-1)

Figure No. 4-14. Power Plant, Building 339 — Elmer.

ing, and other services required for approximately 165 generators used entirely or partly in support of the scientific program. Generators were adequate for the use indicated, and the requirements for reliability and continuity of power through zero time for the various test detonations were satisfactorily met.

Distribution was through both overhead and underground lines, depending on blast resistance and other factors such as passing under airstrips. Elmer distribution was converted to 4160 volts, and 4160 volts or 2400 volts were used at other sites. Power was delivered at 208/117 volts through conveniently located transformers. There were several outages at the base camps during critical test operational periods, without serious results, due principally to distribution line difficulties. In two cases outages were due to traveling cranes cutting the lines, while other incidents were caused by the salt-laden atmosphere. An unusual incident occurred as a result of the wave action from the OAK event. The salt water intake to Building 347 on Elmer was completely bared as the wave receded; the intake became buoyant and broke loose so that the end remaining was in about three feet of water at low tide. Air-cooled radiator units were readied in case it became necessary to secure the salt water-cooled engines. Emergency replacement of the intake was effected in minimum time.

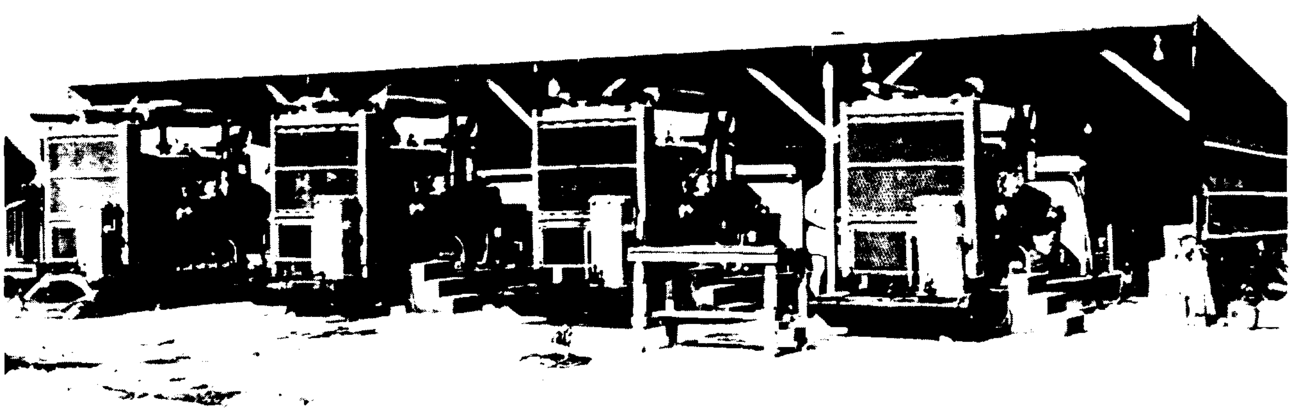


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Figure No. 4-15. Auxiliary Power Plant — Nan.

SITE	NO. OF UNITS	RATED CAPACITY EACH	TOTAL CAPACITY (kw)
ELMER	4	1,000 kw 3/60/4160	4,000
	1	500 kw 3/60/4160	500
	3	150 kw 3/60/4160	450
Total	8		4,950
FRED	4	122 kw 3/60/2400	488
	1	169 kw 3/60/2400	169
	1	500 kw 3/60/2400	500
	2	600 kw 3/60/2400	1,200
	2	75 kw 3/60/120/208	150
	1	50 kw 3/60/120/208	50
Total	11		2,557
JANET	2	75 kw 3/60/120/208	150
	1	50 kw 3/60/120/208	50
Total	3		200
YVONNE	4	150 kw 3/60/4160	600
DAVID	2	135 kw 3/60/2400	270
NAN	3	300 kw 3/60/2400	900
	3	150 kw 3/60/2400	450
Total	6		1,350
HOW	2	75 kw 3/60/120/240	150
	1	50 kw 3/60/120/240	50
Total	3		200
OBOE	4	75 kw 3/60/120/208	300
GEORGE	1	60 kw 3/60/120/208	60
	1	30 kw 3/60/120/208	30
Total	2		90

Table No. 4-13. Base Power Plants.

HOUSEBOAT NUMBER	KW	QTY	GENERATOR NO.
453	30	2	G571, G572
454	30	2	G565, G566
455	30	2	G567, G568
469	30	2	G569, G570
484	30	2	G573, G574

BARGE STATION NUMBER	KW	QTY	GENERATOR NO.
2	25	2	G472, 474
3	20	4	G555, 564, 562, 563
4	20	2	G530, 531
5	20	2	G543, 544
6	20	2	G532, 533
7	20	2	G545, 548
8	20	2	G560, 561
9	20	2	G588, 589
10	20	2	G557, 558
11	20	2	G553, 554
12	20	2	G551, 590
13	20	2	G542, 597
16	20	2	G406, 602
17	20	2	G549, 598
22	20	1	G541

BARGE STATION NUMBER	KW	QTY	GENERATOR NO.
23	20	1	G559
24	20	1	G596
25	20	1	G593
27	20	1	G547
28	20	1	G556
29	20	1	G552
30	20	1	G546
32	20	1	G595
33	20	2	G586, 587
34	20	1	G550
37	20	1	G594
38	30	2	G522, 523
39	30	2	G414, 514

SITE	KW	QTY	GENERATOR NO.
Kusaie	60	3	G499, 500, 501
	15	2	G323, 331
Kapingamarangi	60	3	G496, 497, 498
Tarawa	60	3	G402, 503, 504
Nauru	60	3	G505, 506, 507
Wotho	60	2	G493, 494
Ujelang	60	2	G491, 492
Rongelap	60	3	G508, 509, 250
Utirik	60	3	G253, 487, 488

Table No. 4-14. Generator Requirements (Sheet 1 of 4).

SITE	STA. NO.	KW	QTY	GENERATOR NO.
ALICE	1512	25	-	
BRUCE	1710	30	2	G408,515
	7.4 Trailer	30	3	G518,519,525
DAVID	Bldg. 180	135	2	G182,183
	Bldg. 101	50	1	UF*
	Bldg. 149	10	1	UF*
ELMER	Reefer Evac.	75	2	G161,176
	82.01	40	1	UF*
	Bldg. 105	5	1	UF*
	Bldg. 339	1000	4	G117,118,119 165
	Adj. to 339	500	1	G490
	Adj. to 339	150	4	G344,444,446, 402
GENE	21	30	2	G516,517
	1213	100	1	G448
HELEN	322.03	1	1	UF*
	322.03	2	1	UF*
HENRY	121.02	3	1	G206
FRED	NASWF	35	6	UF*
	NASWF	30	4	UF*
	Project 5.4	2.5	3	UF*
	Lanai	75	2	G157,145
	Lanai	50	1	G151
	Bldg. 56	122	4	G40,114,116, 94
	Bldg. 56	169	1	G84
	Reefers	75	1	G177
	Reefers	75	3	Army
	Bldg. 339	600	2	G526,527
	Bldg. 339	500	1	G489
	Bldg. 3	100	2	Army
	Bldg. 15	50	3	Army
	Bldg. 87	10	1	Army
	Bldg. 90G	100	1	Army
	Bldg. 638	60	1	Army
	Bldg. 24	30	2	Army
	Bldg. 33	75	3	Army
	Bldg. 143	60	2	Army
	Bldg. 629	25	1	Army
	Bldg. 629	30	1	Army
MARY	2131.01	2	1	G354
SALLY	2131.02	5	1	G227

*User-furnished

Table No. 4-14-A. Generator Requirements (Sheet 2 of 4).

SITE	STA. NO.	KW	QTY	GENERATOR NO.
IRENE	182.02	5	1	UF*
	322.02	1	1	UF*
	322.04	1	1	UF*
	1524	60	4	G579,580, 581,582
	173.02	10	1	UF*
JANET	Bldg. 205	75	2	G148,149
	Bldg. 205	50	1	G152
	1312	100	2	G528,529
MACK	92.02	25	1	G451
	92.02	10	1	G240
BRAVO	1812	2	1	G346
CHARLIE	78.01	2	1	G263
	78.01	5	6	G264,267,221, 223,194,226
GEORGE	P/D Plant	30	1	G3000
	P/D Plant	60	1	G228
	1030	30	2	G180,181
	1030	60	3	G511,512,513
	1810	40	2	G470,471

SITE	STA. NO.	KW	QTY	GENERATOR NO.
WILMA	92.01	10	1	G435
	92.01	30	1	G416
YVONNE	Bldg. 75	150	4	G342,399 400,401
	182.01	2	1	UF*
LAGOON	941	5	2	UF*
	941	5	1	H&N
	941	15	1	H&N
HOW	Bldg. 334	75	2	G156,155
	Bldg. 334	50	1	G150
	6001	150	3	G398,445,439
	6001	100	1	G447
	1514.03	30	2	G418,419
	3231.01	UK**	1	UF*
	3231.02	UK**	1	UF*
	3231.03	UK**	1	UF*
	3231.04	UK**	1	UF*
	3231.05	UK**	1	UF*
	3231.06	UK**	1	UF*
UNCLE	3240.03	10	1	UF*
	3240.03	10	1	G269
	3260.06	3	1	G184

*User-furnished
**Unknown

Table No. 4-14-B. Generator Requirements (Sheet 3 of 4).

SITE	STA. NO.	KW	QTY	GENERATOR NO.
MIKE	3250	2	1	G359
NAN	Bldg. 204	150	1	G440
	8.6 Trailer	15	1	UF*
	862	30	1	UF*
	3240.01	10	1	UF*
	Sta. 70	30	1	G410
	Bldg. 47	300	3	G484,485,486
	Adj. to 47	150	2	G403,443
OBOE	Bldg. 60	75	4	G1,21,22,145
	1515, 2130, 2132	10	1	G423
	74.01	30	3	G520,521,524
	74.01	2	2	G360,361
	74.01	3	2	G186,187
PETER	2300	50	1	G539
	2300	35	1	G394
	3240.02	10	1	UF*
SUGAR	2200	100	2	G585,591
	2200	35	2	G536,538
	2200	25	1	G537
WILLIAM	92.04	30	1	G412
	1514.04	30	1	G413
JOHNSTON ISLAND				
	Main Plant	500	1	UK**
	Adj. to Main Plant	500	1	UK**
	Main Plant	232	3	UK**
	6001	150	4	G345,398, 439,445

*User-furnished
**Unknown

Table No. 4-14-C. Generator Requirements (Sheet 4 of 4)

DATE	ELMER	FRED	DAVID	YVONNE	URSULA	NAN	JANET	HOW	OBOE	GEORGE	JOHNSTON	OLIVE
1956 JUL	59,479	21,491	826	1,144	2,010	7,217						
AUG	49,987	18,979	772			6,064						
SEP	41,930	13,619	848			2,800						
OCT	46,243	9,090	951									
NOV	46,256	7,048	919									
DEC	44,194	6,426	939									
1957 JAN	45,374	6,254	896									
FEB	43,133	6,466	936									
MAR	44,444	6,669	1,363									
APR	44,513	6,735	1,351									
MAY	44,870	6,758	1,336									
JUN	45,402	7,052	1,355			2,000						
JUL	45,031	8,809	1,431			3,800						
AUG	45,995	8,690	1,401			4,500						
SEP	47,722	7,433	1,286			4,780						
OCT	47,338	8,765	1,344			5,269	1,038					
NOV	44,896	12,641	1,285			5,220	943	1,195				
DEC	44,708	11,304	1,248			4,907	923	1,319				
1958 JAN	45,693	11,843	1,237	1,390		5,555	931	1,263	1,167			
FEB	40,805	15,197	1,260	1,618		6,065	1,022	1,423	1,183			
MAR	46,671	19,171	1,347	1,826		7,586	1,223	1,499	1,265			
APR	60,439	27,092	1,480	12,767		10,981	1,583	2,946	1,507	375		
MAY	71,933	30,279	1,466	2,424		15,318	1,133	8,547	1,297	1,350		
JUN	76,051	34,161	1,486	1,675		15,055			1,157		9,560	
JUL	70,469	32,093	1,415	964		14,834					13,047	1,427

Table No. 4-15. Daily Average of KW Hours Produced.

SITE	NO. UNITS	TYPE	PLANT OUTPUT GAL PER 24 HOUR	PEAK GAL PER DAY	DATE PEAK OUTPUT	DATE ACTIVATED	DATE DE-ACTIVATED
ENIWETOK ATOLL							
ELMER	6 5 1	DVC 60 E S 600 D S 2100 D	208,800	221,675	4-14-58	CONTINUOUS OPERATION AS REQUIRED	
FRED	8 9	DVC 60 E S 600 D	244,800	214,423	4-13-58	CONTINUOUS OPERATION AS REQUIRED	
DAVID	1	S 200 D	4,800	2,025	5-23-58	CONTINUOUS OPERATION AS REQUIRED	
JANET	1 1	S 600 D S 200 D	19,200	18,517	4-14-58	10-2-57	4-27-58
YVONNE	3	S 600 D	14,400	13,497	4-7-58	12-16-57	4-24-58
BIKINI ATOLL							
NAN	5	S 600 D	72,000	56,419	4-29-58	5-20-57	8-19-58
HOW	4	S 200 D	19,200	16,254	4-12-58	11-4-57	4-25-58
OBOE	3	S 200 D	14,400	10,640	4-3-58	11-11-57	7-14-58
GEORGE	1	S 200 D	4,800	2,920	4-14-58	3-8-58	4-18-58

Table No. 4-16. Distillation Plants.

(Neg. No. W-842-12)

Figure No. 4-16. Distillation Plant — Nan.

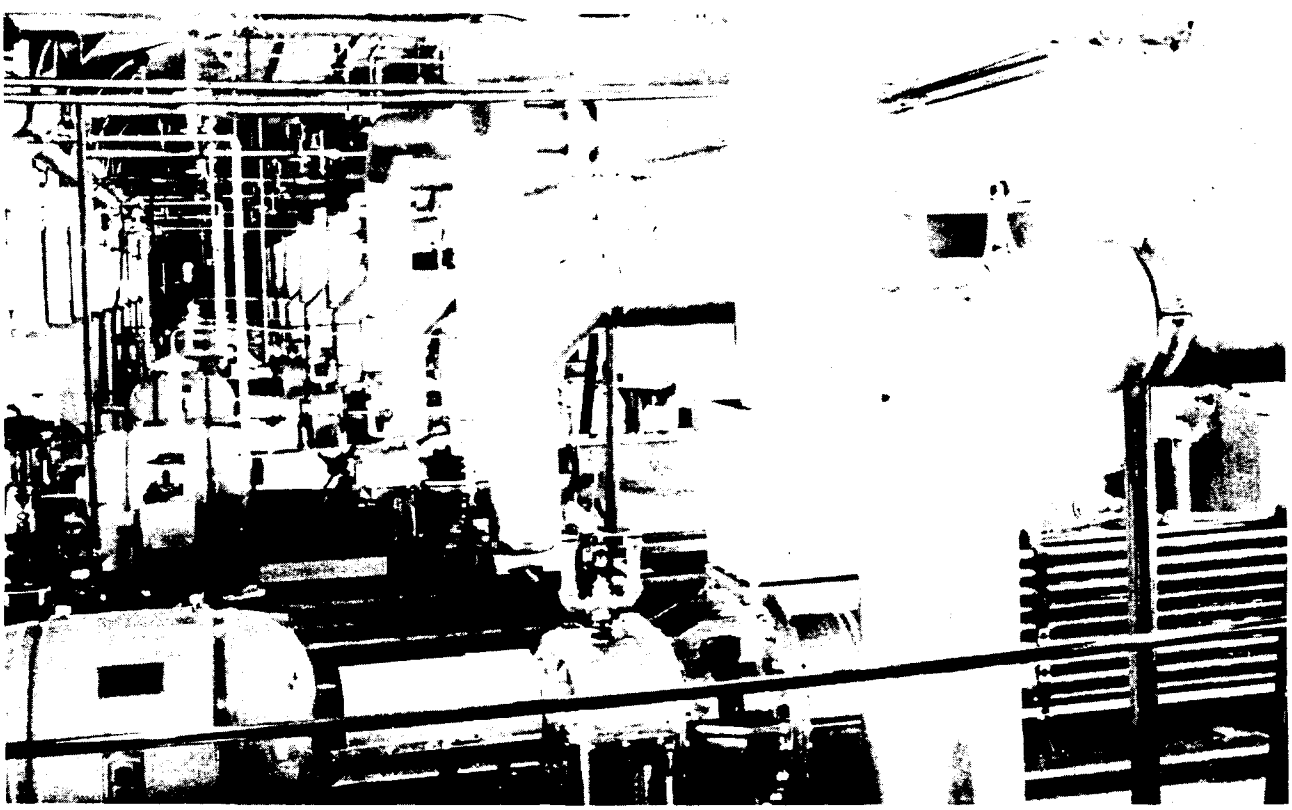
SECTION 4
WATER DISTILLATION AND DISTRIBUTION

The water distillation and distribution functions were the responsibility of the Power and Distillation Operations Department under a Superintendent, who was assisted by Assistant Superintendents of Utilities. The Department operated water distillation plant facilities at all camps within the EPG and at Wotho, Rongelap, Utirik, and Ujelang Rad-safety Stations. The water distillation plants at Kapingamarangi, Kusaie, Tarawa, and Nauru were operated by Air Force personnel, and service calls were made, as required, by H&N. At Johnston Island H&N also installed and operated a plant to augment the Base Command facilities.

Plant capacities were adequate, though for a relatively short period at Fred consumption was greater than production. During this period, with a population of 3200, the per capita daily consumption was 64 gallons. By initiating a program of water conservation and more stringent water discipline, the consumption at this

ELMER	250,000
FRED	431,000
DAVID	8,400
JANET	25,200
YVONNE	25,000
NAN	88,200
HOW	25,200
OBOE	25,200
GEORGE	7,200
TOTAL	885,600

Table No. 4-17. Total Fresh Water Storage Facilities (in gallons).



(Neg. No. PL-35-20-30-14)

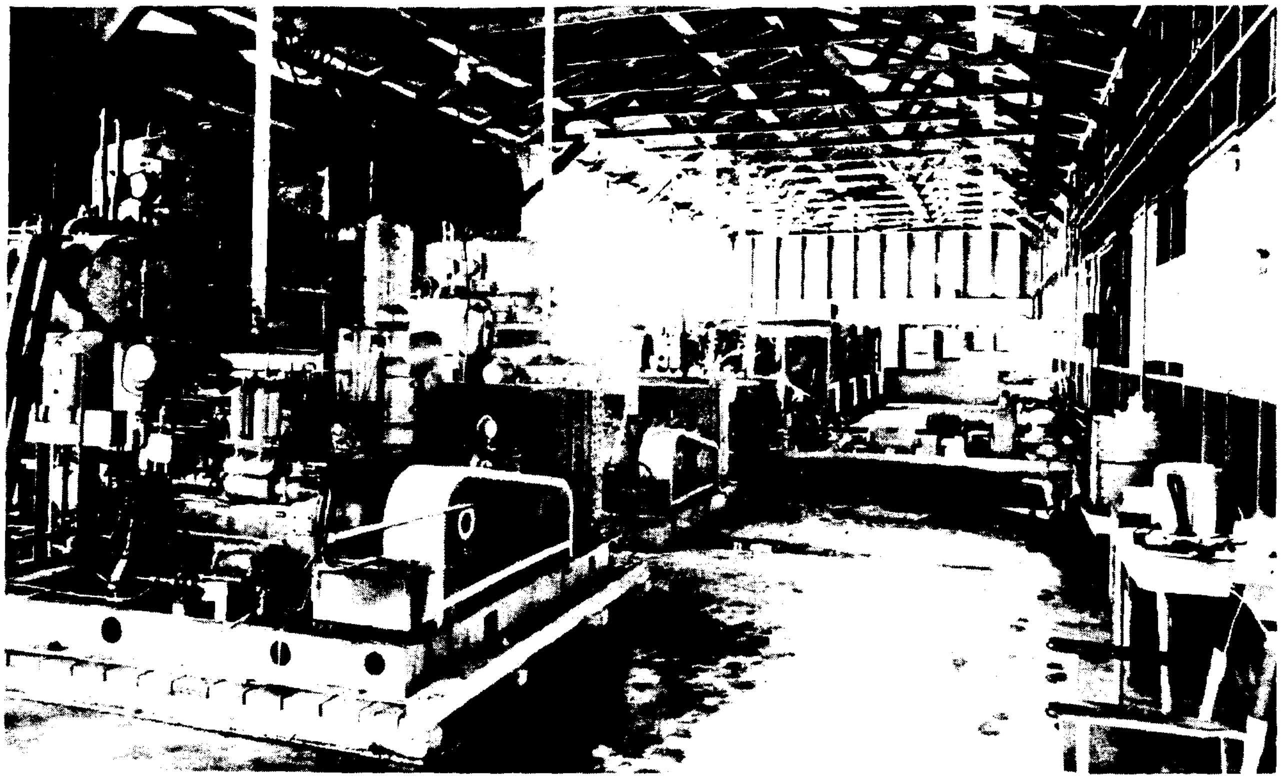
Figure No. 4-17. Distillation Plant — Fred.

SITE	DATE ACTIVATED	DATE DE-ACTIVATED	1957 CALENDAR YEAR	1958 BUILD-UP PERIOD 1 JAN TO 10 MAR	1958 OPERATIONAL PERIOD 10 MAR TO 11 AUG
ELMER	CONTINUOUS		26,378,894	7,459,180	22,287,180
FRED	CONTINUOUS		26,822,450	7,577,580	27,043,433
DAVID	CONTINUOUS		278,009	70,101	237,499
JANET	10-2-57	4-24-58	549,599	642,250	719,920
YVONNE	12-16-57	4-28-58	92,374	472,613	539,530
NAN	6-5-57	8-19-58	3,911,423	1,549,660	8,510,645
HOW	11-4-57	4-24-58	331,644	466,778	532,209
OBOE	11-18-57	7-14-58	262,379	408,441	896,180
GEORGE	3-8-58	4-18-58	—	—	74,026
TOTALS			58,626,722	18,646,603	60,840,622

Table No. 4-18. Fresh Water Production (in gallons).

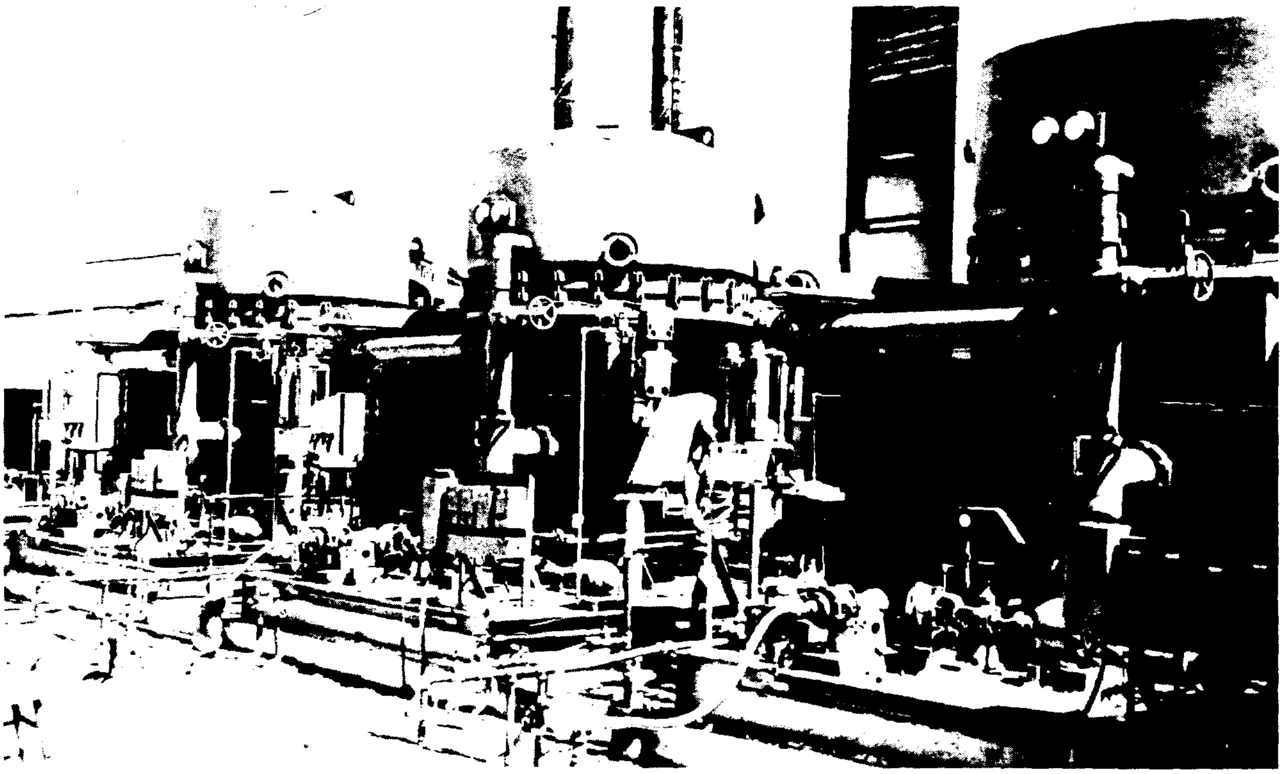
SITE	DATE ACTIVATED	DATE DE-ACTIVATED	1957 CALENDAR YEAR	1958 BUILD-UP PERIOD 1 JAN TO 10 MAR	1958 OPERATIONAL PERIOD 10 MAR TO 11 AUG
ELMER	CONTINUOUS		77	70	58
FRED	CONTINUOUS		81	66	58
DAVID	CONTINUOUS		50	46	50
JANET	10-2-57	4-24-58	61	57	72
YVONNE	12-16-57	4-28-58	72	61	52
NAN	6-5-57	8-19-58	52	41	49
HOW	11-4-57	4-24-58	68	52	48
OBOE	11-18-57	7-14-58	67	58	50
GEORGE	3-8-58	4-18-58	—	—	38
TOTAL AVERAGE FOR EPG			66	56.3	52.7

Table No. 4-19. Average Per Capita Daily Fresh Water Consumption (in gallons).



(Neg. No. W-V-125-2)

Figure No. 4-18. Distillation and Power Plant — Oboe.



(Neg. No. W-961-4)

Figure No. 4-19. Distillation Plant — Johnston Island — 85% Complete.

USER	1957 CALENDAR YEAR	1958 BUILD-UP PERIOD 1 JANUARY TO 10 MARCH	1958 OPERATIONAL PERIOD 10 MARCH TO 11 AUGUST
RAD-SAFE BARGE	—	—	135,440
DECONTAMINATION (AIRCRAFT)	—	—	286,500
MARINE CRAFT (NOT H&N OPERATED)	207,737	129,050	175,770
TOTAL	207,737	129,050	597,710

Table No. 4-20. Fresh Water Furnished for Decontamination and Transient Vessels (in gallons).

site was brought within the productive capacity of the plant. Close surveillance of the use of fresh water from midnight to 0400 hours over a period of years has provided an indicator of leakages in the system. During the heavy construction period on Elmer, in the early months of 1958, the frequency of breaks in the transite pipe of the distribution system was relatively high, but through a coordinated system of testing and repairs losses were kept at a minimum.

Complete operating, production, and consumption records were maintained and reported monthly to the AEC which indicated that the demands for fresh water are increasing with each Operation. As an example, per capita daily consumption of fresh water during the operational months of REDWING was 54 gallons at Elmer and 47 at Fred as compared to 58 for Elmer and 58 for Fred for HARDTACK. The increasing consumption was partially due to greater operational requirements for washing down planes and other equipment and for decontamination. More and more calls for fresh water were received from transient ships visiting EPG, with issues limited to quantities necessary to make the next port-of-call.

An unusual requirement was that of ionized water for use in the missiles of the TEAK and ORANGE events. Specifications for water were established by the User group at a maximum impurity content as follows: 6 ppm Sodium Chloride (NaCl), 6 ppm Calcium Carbonate ($CaCO_3$), and a minimum specific resistance of 35,500 ohms/cc. A total of 2800 gallons of water conforming to these specifications was required to be delivered in two lots of 1300 gallons each in appropriate tank or container with pump and metering device located on a mobile unit and 100 gallons each in 5-gallon glass or plastic containers.

On 2 April 1958 arrangements were made to supply the water meeting the specifications. To meet the requirements, distillate produced from Cleaver-Brooks S-2100-D Unit was redistilled through the use of a Cleaver-Brooks S-600-D Unit. Redistilled condensate tested the following: 3.0 ppm NaCl, 0.5 ppm $CaCO_3$, and a specific resistance of 68,000 ohms/cc. Redistilled condensate of the above impurity content met the requirements as specified.

Original planning provided for the making of the water at distillation facilities at Elmer and its transport to How when required; however, the relocation of the ABMA facilities necessitated the shipment of distillation equipment, together with auxiliaries required for unit operation, to Johnston Island, where the facility was activated on 17 July 1958. Through the use of four stainless steel tanks, three S-600-D Distillation Units, and appropriate piping arrangements, 3000 gallons of redistilled condensate were produced to specifications. The final readings of samples taken prior to deliveries for the TEAK and ORANGE events were 840,000 ohms specific resistance at 84° F, 0.0 ppm $CaCO_3$, and 0.0 ppm NaCl.

CHAPTER V
MAINTENANCE

SECTION I
CONSTRUCTION EQUIPMENT

GENERAL.

The Contractor was responsible for the maintenance of all buildings, grounds, utilities, and all AEC-owned equipment, as well as for certain equipment belonging to the Using agencies. The maintenance program was continuous and predicated on preventive maintenance, normal wear and tear, atmospheric conditions, and non-scheduled repairs. All except the latter were cost-coded and were charged against particular job accounts for continuing maintenance work. Non-scheduled repairs and modifications were charged against specific Work Orders when approved by the AEC Branch Chief. Since 1 July 1956 more than 500 specific Maintenance Work Orders were issued.

Due to the critical requirement for continuous operation, reefers, generators, and pumps were checked and serviced daily and any breakdowns were cause for immediate repair, either day or night. The same policy prevailed for equipment installed in Scientific Stations. A continuous check of air-conditioning units at Elmer, Fred, and Nan camps was required, and servicing was done when necessary. The overhaul program for all spare equipment was constant, though drastically reduced during the peak of the Operation in order to meet the needs of periodic maintenance requirements and repairs on operational equipment. Maintenance of buildings and utilities increased proportionately with the increase in population during the build-up period, when additional facilities were put into use. The majority of overhaul work on operational equipment was accomplished during the interim period, which resulted in a high realization of equipment efficiency during the peak of operational activities.

One trouble spot concerning maintenance activities during Operation HARDTACK was the requirement for constantly repairing distillation and power equipment at off-atoll sites operated by the Air Force. In comparison to the off-atoll sites operated by H&N, the maintenance on power and distillation at off-atoll sites operaated by the Air Force was considered excessive. Due to the lack of experienced Air Force operating personnel, emergency maintenance trips to these sites by H&N personnel were necessary throughout the operational period.

CONSTRUCTION EQUIPMENT.

Preventive maintenance was practiced to the fullest extent because of operational requirements for the equipment, the minimum stock levels of replacement parts available in the field, the extensive time for replacement items to reach Jobsite, and the severe climatic conditions. Because of the latter and also because of extensive hours of operation, equipment was given more frequent inspections and lubrication service than is normally recommended by the manufacturers. Stress was placed on the accuracy of the Operator's Daily Maintenance form for all mobile and stationary equipment, such as generators, compressors, pumps, and welding machines. Stationary equipment was inspected and maintained each day by assigned personnel. All equipment was rigidly scheduled for lubrication and inspection, and breakdowns were often forestalled by timely replacement or overhaul of parts. Equipment used in the field which was not readily accessible to the repair shops was inspected and serviced at the working locations. Crankcases, drive-gear boxes, etc., on equipment working in salt water were drained and serviced at the end of each working day.

BUILDINGS AND STRUCTURES.

Apart from the repair or replacement of shutters, doors, shutter-arms, etc., routine maintenance was confined to greasing hinges, painting steel structural members, and tightening bolts on aluminum buildings. Preventive maintenance included precautions taken for the test events, such as securing all doors and shutters in an open position to prevent shock wave damage. Some buildings were given additional support with guy cables, while others were braced internally with cantilever-type arches supported by posts.

Prior to the build-up phase of HARDTACK, maintenance on Scientific structures was continuous, with records kept reflecting the maintenance checks for each of the stations. Specific Maintenance Work Orders were issued for the rehabilitation of certain of these stations during the build-up period. Interiors of such stations were sandblasted and painted and in some cases the blast doors required extensive repair work. Subsequent to HARDTACK all mechanical equipment installed in stations remained in place, with the provision that the equipment be operated every two weeks for maintenance purposes.

With the exception of the large communications antennas, which were made of anodized aluminum, all tower structures and steel storage tanks were sandblasted and painted each year. No particular maintenance difficulties were experienced in the use of tents with flies; however, occasional replacements were necessary following heavy wind storms or because of damage from normal wear and tear.

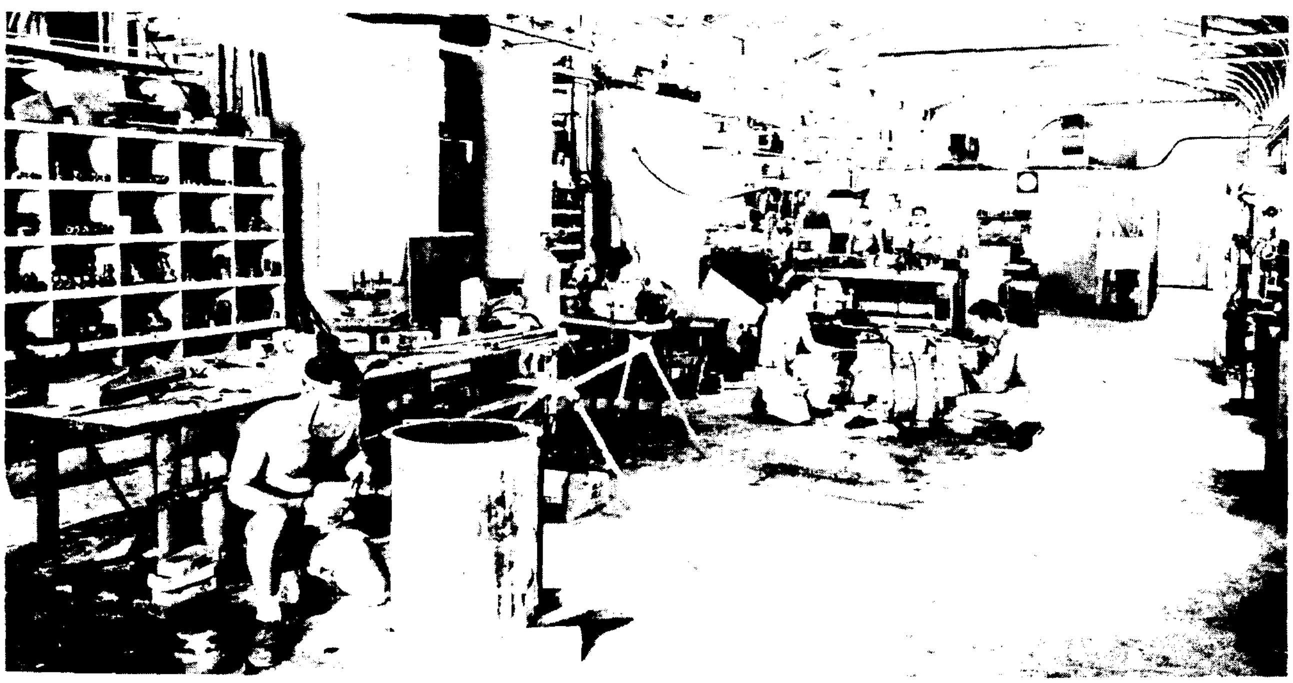
TRANSPORTATION EQUIPMENT.

The vehicle maintenance program was predicated on anticipated hard usage and climatic conditions. Vehicles within the EPG were seldom worn out by accumulated mileage but by abuse from climatic forces and difficult operating conditions. To combat those conditions, the frequency of lubrication and inspection checks was increased so that all vehicles were scheduled to the grease rack every two weeks. While being lubricated the vehicles were also checked for brake, clutch, carburetor, and ignition adjustments, and any necessary parts replacement.

During the operational phase, the Contractor was also responsible for the preventive maintenance and minor repair of all military-owned vehicles except those located at Site Fred. A working agreement was reached wherby Military Inspectors furnished the Contractor a list of the work to be accomplished on each Military-owned vehicle, by serial number. The same system prevailed in preparing Military-owned vehicles for return shipment to the United States at the close of the Operation.

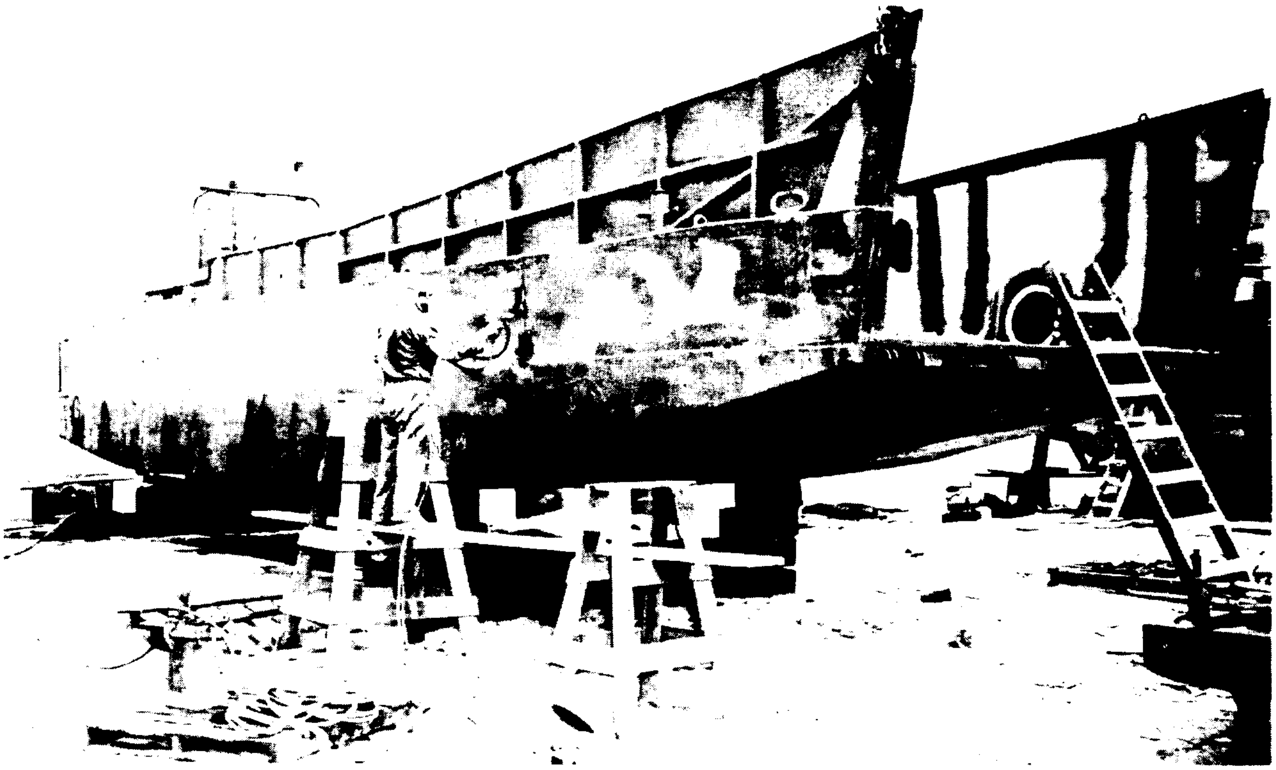
Clutch replacements averaged two a week, which is a low figure considering the number of vehicles which were operated in deep coral sand. All accessories removed were overhauled in the Auto-Electric Shop and returned to service.

Body, fender, and paint work was continuous. All vehicles were completely painted at least once a year and spot-painted as required. Several tests were made with different kinds of primer coats to determine which was best suited to withstand the excessive corrosion conditions. In the older vehicles, incessant corrosion, already present in the cracks between body members and underneath battery hold-down straps, ate through the paint in the course of a few months. Undercoating proved successful on those parts which could be reached through the use of a spray gun. Good results were obtained by removing the fenders from newly-received vehicles and applying undercoating along the lines of intersection between the fenders and body. Efforts were also made to seal body cracks by applying undercoating with a caulking gun prior to painting. Radiators and mufflers required replacement at least once a year; the cooling fins on the former corrode and flake to pieces, and replacements are deemed more economical than the rebuilding of the radiators.



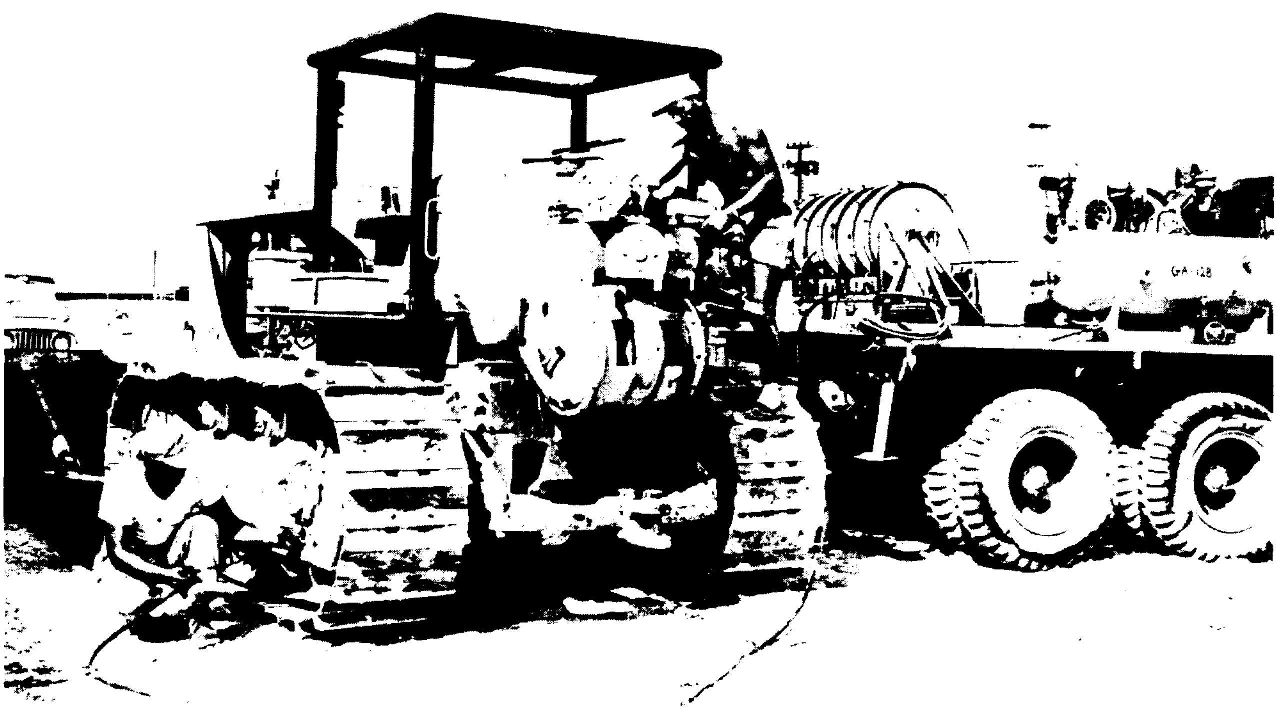
(Neg. No. W-719-3)

Figure No. 5-1. Distillation Repair Shop — Elmer.



(Neg. No. W-747-12)

Figure No. 5-2. Repainting LCM Hull.



(Neg. No. W-747-5)

Figure No. 5-3. Mobile Lube Truck Servicing Heavy Equipment.

Maintenance of marine equipment on loan from the U.S. Navy was also a prime responsibility of the Contractor. In addition, work was accomplished on Army, Navy, and Air Force small craft on specific Maintenance Work Orders. LCM craft and Water Taxis were given a thorough inspection and oil change every 100 hours of operation and were beached only when it was necessary for on-shore repair work. LCU craft were maintained by the crew assigned to the craft, except for major repairs. Operators of all small craft were charged with keeping an accurate record of engine hours of operation. The anticipated operating time of marine engines between overhauls was set at 3500 hours, based on Navy standards; however, engines were usually removed and overhauled after every 3000 hours of operation.

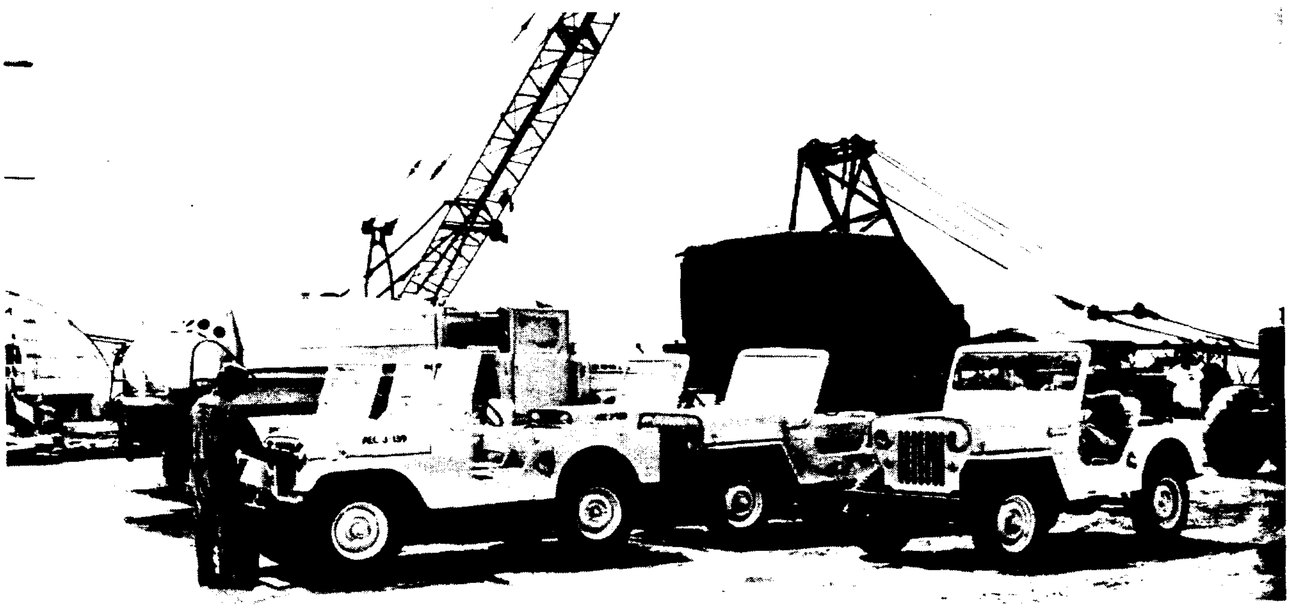
Maintenance repairs were largely confined to engines, bottom and hull plating, replacement of stringers and stiffeners, and replacement or repair of propellers and shafts. To accomplish these repairs, small craft were beached by use of a "Gilhoist" rig or placed in a floating drydock. Ramp winches and winch clutches required frequent maintenance due to continual usage, and a supply problem arose because of the fact that the LCM craft in use were of three different types; however, through modification, all LCM winches were standardized to utilize like parts. Some bottom plating was required on barges used for lighter service. Chipping, painting, and plating were performed continuously on all craft. One of the most modern pieces of test equipment—for the testing and adjustment of fuel pumps and fuel injectors—was available in the Marine Equipment Repair Shop on Elmer, allowing eight fuel pumps or fuel injectors to be tested at one time. In addition to the marine repair facilities on Elmer, a Marine Repair Shop was established at Nan to serve the small craft assigned to Bikini Atoll.

Plans were formulated for beaching all small craft at Site Elmer not required during the interim period. LCM's were thoroughly reconditioned, with engines being removed and overhauled before being placed in storage.

ROADS AND AIRSTRIPS.

Road maintenance was continuous at all sites. On Elmer, roads were frequenty graded and watered to reduce dust nuisance. Roads along the water front and in the warehouse area were constantly cut up by the movement of track-type equipment and required continual recompaction as well as grading. On Fred the surfaced roads required spot repairs as a result of damage caused by heavy vehicular traffic, particularly following a dearth of rain. Road work on Nan and the off-island camps was constant, requiring much grading and recompaction because of the damage inflicted by the movement of heavy construction equipment.

Following the rehabilitation of the airfields, maintenance work at these installations was sweeping, re-marking, and clearing brush and other obstacles from the strips. Some electrical maintenance was necessary at those airfields which were equipped with night-lighting facilities. Both airfields and helicopter pads required infrequent replacement of the wind socks. Most of the maintenance on the Fred Airfield was



(Neg. No. W-610-10)

Figure No. 5-4. Repainted Jeeps and Crane — Elmer.

(Neg. No. W-789)

Figure No. 5-5. Overhead Crane Installation, Vehicle Repair Shop — Elmer.

limited to the repair of pavement at the turning points and parking areas.

UTILITY SYSTEMS.

Pipelines were subject to breakage, leaks, and stoppages, and electrical lines were exposed to breakage and deterioration. Maintenance repairs on pipelines and the electrical lines were effected as quickly as possible in order to maintain continuous operations. Breaks in the salt water system were immediately repaired, since they endangered water distillation production and fire-fighting capabilities. One maintenance function peculiar to the EPG was the occasional washing of overhead electric cables, insulators, and transformers to eliminate accumulations of salt. Washing was done with fresh water sprayed under pressure from a truck equipped with an adjustable boom.

The biggest problem area in the salt water system was the maintenance of the diesel-pump assemblies at the intake portion of the system; pumps were operated 24 hours a day, and maintenance personnel were on "stand-by" at all times. Maintenance services were required almost daily to free the salt water intake screens of debris, which collected there during almost every low-tide condition.

A night "call-out" system was invoked for the maintenance or repair of electrical and water systems, as well as for refrigeration equipment, whereby maintenance personnel notified the telephone operator of their location at all times. The necessity for utilities maintenance and repairs in barracks, warehouses, and Administrative Buildings was due largely to routine breakage or corrosion. Use of salt water in the latrine facilities increased the corrosion factor and the deterioration of the plumbing lines. Brass and copper components in electrical fixtures are highly vulnerable to the effects of salt-air moisture, resulting in a high replacement figure. Efforts were made to reduce exposure to moisture by closing electrical fixture openings with grease.

POWER AND DISTILLATION.

Power and distillation personnel were charged with the maintenance of all component parts of distillation plants, except electrical parts, and all mechanical components of power plants. During the operational period of HARDTACK, power and distillation mechanics were assigned to four off-atoll sites to operate and maintain the units and also to act as senior members of H&N personnel assigned to these sites.

The main effort during the early periods of the Operation was directed toward final major repairs on equipment at permanent camps to minimize lost operating time during the operational peak. Later, the main effort was shifted to the installation of power and distillation equipment on the various off-island and off-atoll sites.

Continuous periodic inspections and preventive maintenance were carried out at all sites, with the exception of the off-atoll stations, which were serviced only on request. With a few exceptions, all units installed on a temporary basis were removed after the Operation and were returned to Elmer for overhaul, maintenance, and storage, as required.

Power and distillation equipment performed very satisfactorily throughout Operation HARDTACK. The most critical problem encountered was the rapid erosion of tube walls in the heat exchangers for the generator units installed in the Yvonne power plant.

CHAPTER VI
TEST OPERATIONS AND ROLL-UP

SECTION I
TEST OPERATIONS

At the time TG 7.5 staff appointments were made, H&N was assigned the responsibility of furnishing the following staff positions:

E-3, Plans and Operations;

E-4, Transportation and Supply; and

E-5, Communications (Alternate).

The start of the operational phase of Operation HARDTACK was 15 March 1958, with the first event assigned a target date of 21 April 1958. Because of various considerations, FIR was rescheduled and YUCCA was scheduled as the first event to take place on 26 April 1958. The final event of the series was scheduled for 13 August 1958; this event was executed on 18 August 1958.

Prior to 15 March, E-3 of TG 7.5 had appointed specific individuals to assist in the operations and planning functions for the Operation. These consisted of Evacuation Officers for personnel and camp facilities, Muster Officers, Beach Masters, and Transportation Control Agents and were drawn from H&N supervisory personnel. In addition, Airlift Priority Agents were provided at Sites Fred and Nan to assist in the assignment of passenger and cargo space allocations to all elements of the Task Force. Detailed plans were issued to these personnel which covered all aspects of muster and evacuation procedures both before and after each event, and Embarkation Points and Assembly Areas were established at both atolls for all elements of the Task Force. At the same time, a detailed plan was initiated for the protection of food and water against contamination from fall-out. Well in advance of the Operation, a bulletin was issued to all TG 7.5 personnel which explained the danger of not evacuating personal effects from forward areas during test events and which instituted a plan to be followed to protect personal gear in all cases.

A parallel organizational plan was instituted for Johnston Island upon relocation of the TEAK and ORANGE events to that site. Because of the relatively small number of personnel affected, the control assignments were limited to an Evacuation Officer, a Muster Officer, a Ship Muster Officer, and a Beach Master. The scope of responsibilities was outlined to provide for emergency evacuations, safe operations, and the protection of life and property during the events scheduled at Johnston Island.

A natural disaster plan was established detailing activities of key personnel and areas of responsibility to ensure immediate and effective evacuation, if required. A hostile alert plan was also published specifying the support H&N would furnish to all units of the Task Group in a hostile alert situation. This plan supplemented TG 7.2 Emergency Operation Plan 1-58.

A "Schedule of Camp Operations in Support of the HARDTACK Events" was published for both atolls. This schedule served as a check list for Evacuation Officers and also as a guide to Using personnel; it was prepared by event and outlined all camp activities at existing locations from D minus 2 through D-Day. In addition, a "Preliminary Evacuation Plan — Camps and Events" for both atolls was published; it was prepared by event, station number, and site and outlined evacuation policy and procedure for all existing camp sites. The specific plans concerning TG 7.5 support requirements for individual events was coordinated with J-3 of TG 7.1 and incorporated into the "Check List" published by that office for each event. When this list seemed inadequate, special letters and bulletins were initiated outlining detailed instructions to ensure maximum safety to personnel and Government property. These two considerations were uppermost in mind in all planning and in the implementation of all plans.

In the early stages of the operational period, a plan was initiated for the shut-down of air-conditioning and dehumidification units in the event of radioactive fall-out. This plan listed all buildings affected and detailed instructions for complete shut-down or partial shut-down, as required in each case. Where essential and highly technical equipment was affected, the intake vents were closed and the units operated by re-circulation of air within the structure. This plan also included instructions to ensure that two or more individuals at each building were familiar with the location of switches and controls to shut down the units upon evacuation.

1 MAY 1958

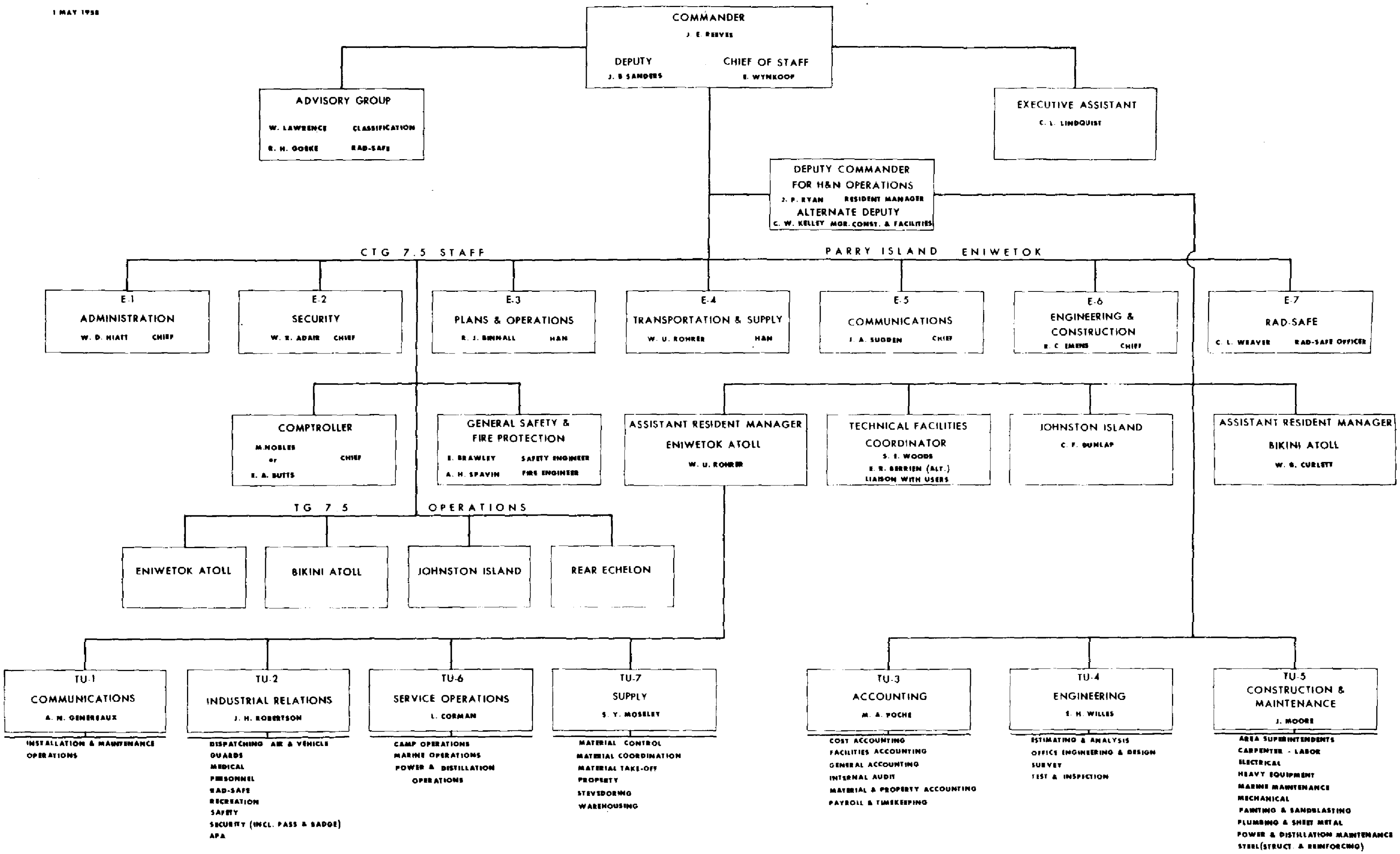


Chart No. 6-1. TG 7.5 Organization.

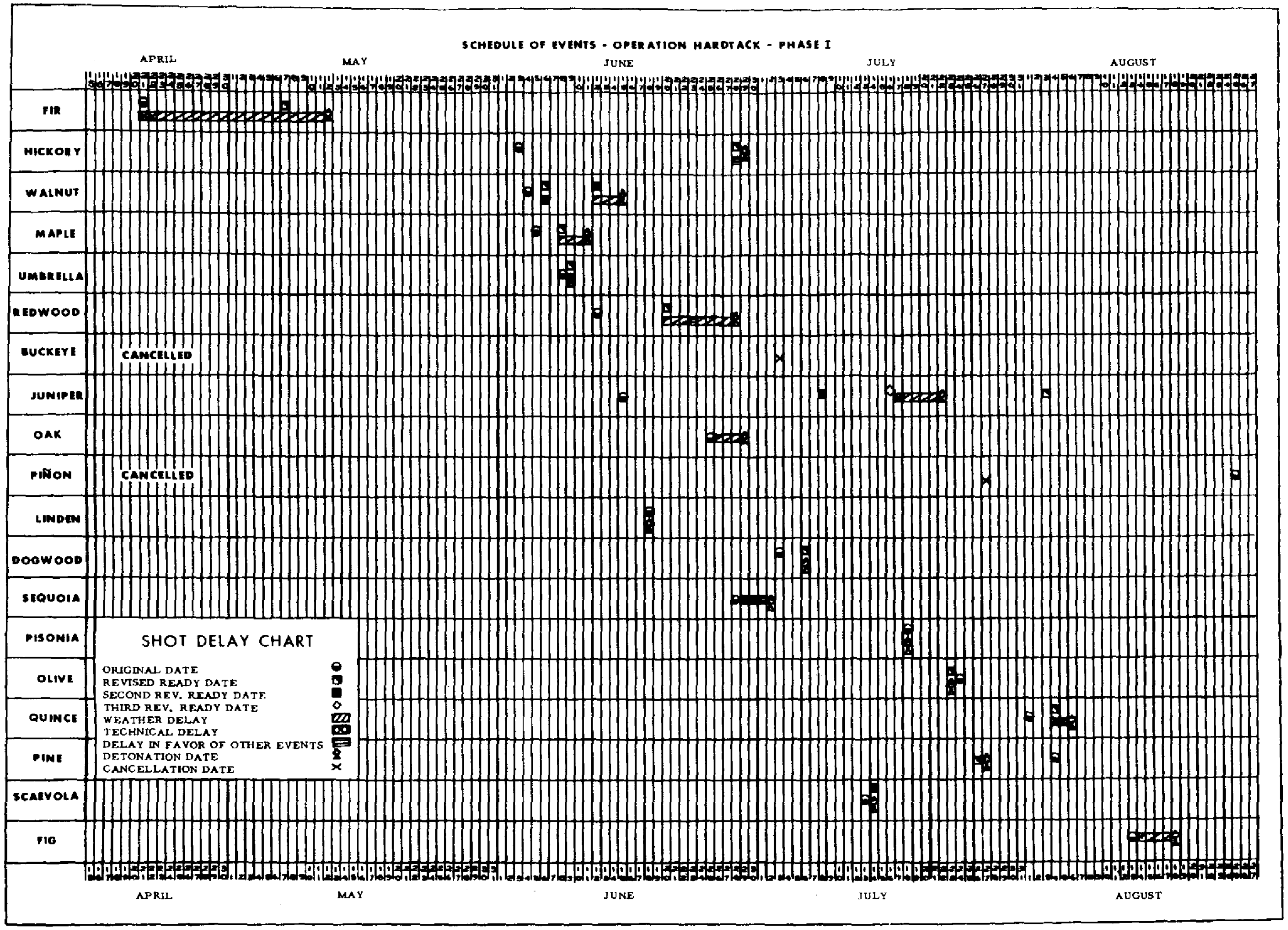


Chart No. 6-2. Shot Delay Chart (Sheet 1 of 2).

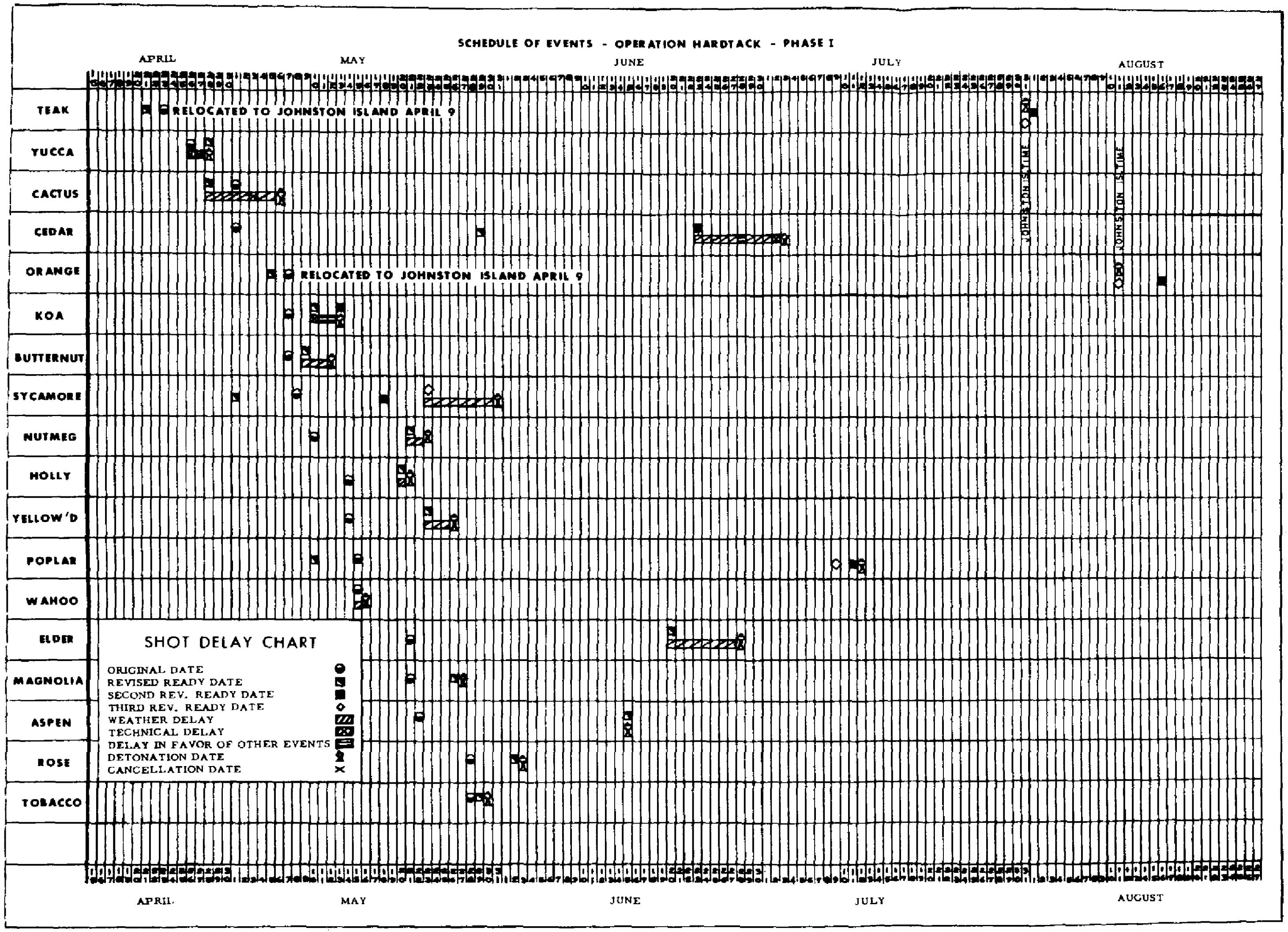


Chart No. 6-2-A. Shot Delay Chart (Sheet 2 of 2).

SECTION 2
PROTECTIVE MEASURES

Precautionary procedures were published and put into effect for all test events. These included siren signals, colored lights and flags, clearly marked points and routes for assembly and embarkation purposes, and a loud speaker system which included a count-down for each event. Every precaution was taken for each event to ensure the safety of personnel. Prior to each event, a bulletin was given bedside distribution which properly informed personnel of the time, place, and name of the event, and of precautions to be taken.

During the evening before a scheduled event a loud speaker-equipped jeep was driven through the occupied areas of Elmer and Nan. The announcer covered all essential information necessary for safe and orderly conduct during the event, including a reminder about the colored light and flag signals mounted on the water towers at these sites. An announcement was also made at the theatre just prior to the show. The operation of this system was as follows:

SITE ELMER

GREEN LIGHT ON — Event scheduled for Eniwetok Atoll will go as scheduled.

RED LIGHT ON — Event scheduled for Eniwetok Atoll has been postponed.

YELLOW LIGHT ON — Event scheduled for Bikini Atoll will go as scheduled.

YELLOW LIGHT OFF — Event scheduled for Bikini Atoll has been postponed.

SITE NAN

GREEN LIGHT ON — Event scheduled for Bikini Atoll will go as scheduled.

RED LIGHT ON — Event scheduled for Bikini Atoll has been postponed.

YELLOW LIGHT ON — Event scheduled for Eniwetok Atoll will go as scheduled.

YELLOW LIGHT OFF — Event scheduled for Eniwetok Atoll has been postponed.

Note: The use of colored flags was coincidental with the system of colored lights.

At H minus 45 minutes on the day an event was scheduled for early morning, a fire truck covered the occupied areas of the camp with its siren blowing to ensure that all personnel were awakened. At H minus 30 minutes all personnel were cautioned by loud speaker to proceed to the assembly areas, where the count-down announcer issued safety instructions applicable to each event. Guards circulated through all living quarters after the H minus 30 minute signal to clear the quarters. During the 15 minutes prior to H-hour all instructions were issued over the count-down system. At the H minus 1 minute siren all personnel were instructed to put on their high-density goggles or face away from the direction of the blast. Depending on the type of event, additional instructions were issued to ensure safety of personnel and property; for instance, instructions for additional clothing for protection from thermal radiation, for sitting down to observe shot, for bracing of structures, and for locating personnel at places removed from danger of wave action and falling objects. At the "all clear" signal or postponement announcement, all personnel cleared the areas as instructed. The prompt and enthusiastic cooperation by all personnel indicated their awareness of the necessity of strict enforcement of regulations to ensure a safe Operation.

Protective measures were taken at all sites prior to each event. These measures provided for protection of not only permanent facilities, but also semi-permanent and expendable construction necessary for support during subsequent events. Each situation presented specific requirements and was handled accordingly. For instance, at a camp where occupancy or re-entry was planned, the protective measures included bracing, guying, and removing broad surfaces to protect facilities from blast effects, while at camps to be abandoned the main concern was salvage and removal of property and equipment which might be used in future Operations.

Significant factors which in all probability would have caused extensive damage to permanent facilities at Sites Fred, Elmer, and David were: (1) predicted overpressures resultant from YELLOWWOOD, OAK, PINE, and PINYON events, and (2) the predicted wave heights in consequence of the OAK, PINE, and PINYON events.

To alleviate possible blast damage to permanent structures, a joint study was made by the Home Office Structural Engineering Section and the Home Office Blast Study Group. This study resulted in the internal and external bracing and guying of many buildings and structures. For protection against possible wave damage, a study of contours and elevations on Sites Elmer, Fred, and David was made jointly by Project 50.1 personnel and H&N, and recommendations for sand-bagging and berming various installations were promulgated.

The recommendations were effectively carried out by the Construction Division, and only minor damage from high overpressures and wave action was experienced.

Because it was mandatory to maintain a camp at Site Oboe until the last event on Site Tare, it was necessary to provide numerous protective measures. A 6-foot-high earth berm was constructed around the north and east perimeters, followed by a building-re-inforcing program which was completed in late May 1958; provisions were made to maintain an exit at the marine ramp for the movement of equipment which could be closed and opened after each event. Subsequent requirements made it necessary to provide further re-inforcing and dismantling of buildings and removing of equipment from the camp. Panels were removed from buildings, banded, and stored, and other equipment and facilities which remained on the site were secured. After the last event at Site Tare these panels were replaced, and all buildings were given a protective coat of paint.

The possibility of radioactive contamination resulting from the test events at Johnston Island was very remote; however, precautionary measures were taken for the protection of foodstuffs, dishes, and galley equipment. Also, all air intake systems supplying the underground bunkers and other manned stations were shut down prior to missile launch time. All personnel remaining ashore during events were issued full rad-safety protective clothing and film badges in case of a possible "one point" detonation resulting from missile malfunction.

Based on the prediction of thermal radiation and blast overpressures from the ORANGE event, a complete camp clean-up program was effected to preclude the possibility of fire destruction, and buildings were opened to the fullest extent to allow pressure equalization. The realized thermal radiation was much lower than anticipated, which consequently precluded the fire hazard. However, the resultant overpressures closely paralleled predictions, and even though buildings were opened a few window glass panes were broken.

SECTION 3
EVACUATION

The evacuation of personnel from all northern Eniwetok sites to David, Elmer, and Fred was effected for every event at that atoll. The only exception was TG 7.1 personnel who were required to remain on station at Site Bruce. Personnel evacuations at both atolls were closely coordinated with J-3, JTF-7, and J-3, TG 7.1. In all cases, evacuations were planned to bring about full-scale support to the Using agencies and still afford maximum protection and safety to all personnel.

The capability to conduct an emergency post-shot evacuation of all personnel at both atolls was maintained throughout the Operation. Evacuation Officers, Muster Officers, Beach Masters, and Transportation Control Agents were issued special instructions to follow in the event of an emergency evacuation to ensure orderly, safe, and expeditious departure of all personnel.

Upon receipt of instructions for evacuation, all TG 7.5 personnel were accounted for by procedures outlined in instructions from E-3. Normally, by D minus 5 Day all personnel excess to operations were evacuated to main base camps at Elmer and Nan, and by noon of D minus 1 Day all nonessential personnel and equipment had been evacuated in readiness for the event. Only authorized personnel were then permitted to enter or remain in these areas. By 1630 hours of D minus 1 Day all personnel were accounted for by sight muster through the Muster Officers, who reported any irregularities to E-3. Rosters of personnel accountability were maintained on an hourly basis, or more frequently if required.

At Bikini Atoll it was necessary to evacuate all nonessential personnel to ships for the SYCAMORE and POPLAR events; only those personnel essential to test operations were permitted ashore, and well in advance of the shot, musters were reported to ensure their presence in either Station 70 or Building 204 on Nan. During the SYCAMORE delay period, only essential personnel were permitted to leave the ships daily to perform duties necessary for support missions. In the planning stage it was determined to evacuate personnel from all sites to Nan for all other events, but because of the housing shortage it was necessary to evacuate some personnel to ships for the FIR and NUTMEG events. Subsequent to NUTMEG, JTF-7 approved the plan to occupy the Oboe camp during events in the northern part of Bikini Atoll and evacuate only for the three events at Site Tare.

DATE	EVENT	TO "AINSWORTH" FROM OBOE	TO "AINSWORTH" FROM HOW	TO "AINSWORTH" FROM NAN	TO "BOXER" FROM JOHNSTON ISLAND	TO "BOXER" FROM NAN	TO LSD FROM OBOE	TO LSD FROM NAN	TOTAL 7.5 EVACUATION
April 24	FIR	117	112						229
April 25	FIR	117	115						232
April 26	FIR	112							112
April 27	FIR	112							112
April 28	FIR	112							112
April 29	FIR	110							110
May 2	FIR	107							107
May 3	FIR	105							105
May 4	FIR	105							105
May 5	FIR	105							105
May 6	FIR	105							105
May 7	FIR	105							105
May 9	FIR	106							106
May 10	FIR	50							50
May 11	FIR	103							103
May 12	FIR	103							103
May 20	NUTMEG	94							94
May 21	NUTMEG	94							94
May 22	NUTMEG	94							94
May 22	SYCAMORE	94		473		21			588
May 23	SYCAMORE	94							94
May 24	SYCAMORE	94							94
May 25	SYCAMORE	70							70
May 26	SYCAMORE	93							93
May 27	SYCAMORE	70							70
May 28	SYCAMORE	91							91
May 29	SYCAMORE	91		466		21			578
May 30	SYCAMORE	91		464		23			578
May 31	SYCAMORE	91		464		23			578
July 11	POPLAR	94		393				13	500
July 30	TEAK				187				187
July 31	TEAK				727				727
Aug 11	ORANGE				880				880

Table No. 6-1. Evacuation Schedule.

With the exception of certain personnel required to stay ashore for scientific support functions and emergency evacuation capabilities, all TG 7.5 personnel were evacuated to sea from Johnston Island for both the TEAK and ORANGE events. For the TEAK event, 24 people remained ashore; for the ORANGE event, 25. To provide maximum safety to these persons, a muster plan was effected whereby all personnel were known to be in their assigned underground bunkers 30 minutes prior to shot-time.

Due to sea conditions at the USS BOXER anchorage, the original plan to use the LCM craft and the personnel float as the principal means of personnel evacuation was discarded. In lieu of this, a personnel cage was designed and fabricated by H&N which permitted a safe and expeditious means of personnel transfer from the deck of LCU craft to the hangar deck of the USS BOXER. To preclude the possibility of not meeting deadline evacuation schedules, 187 persons were evacuated on D minus 1 Day of the TEAK event. From the experience gained during the TEAK evacuation, it was possible to delete the D minus 1 Day withdrawal and evacuate the entire afloat contingent of 880 persons on the ORANGE D-Day. Both evacuations were accomplished without mishap.

SECTION 4
ROLL-UP

The roll-up phase began with the return of equipment from the temporary camp sites. The newer equipment was selected to go into storage, leaving the older equipment in operation for later overhaul and mothballing. All heavy equipment, including rock-crushers and batch plants, was sandblasted and painted prior to lubricating and cocooning. Due to climatic conditions, equipment with moving parts could not be placed in a true dead-storage status, since this equipment had to be moved and operated each week to preclude freezing of moving parts by salt air corrosion.

Detailed roll-up plans were prepared by A/CS E-3, TG 7.5, for Sites Yvonne and Janet. The phase-out of equipment and materials at these two locations was planned and effected on the basis of camp population and related support during the roll-up period. Appointed representatives of E-3 coordinated this planning with the Site Evacuation Officers to enable the fullest utilization of camp facilities required for convenient billeting and still maintain the capability of a complete facility evacuation by a given hour on D minus 1 Day.

Prior to the CACTUS event on Yvonne and the KOA event on Gene, the camps at Yvonne and Janet were rolled up on 5 May and 9 May 1958 respectively, and personnel, property, and equipment were evacuated to Elmer.

Camp facilities at Sites How and George were phased out subsequent to the decision of CJTF-7 to move the missile facilities required for the TEAK and ORANGE events to Johnston Island. Priority was given to the removal and transshipment of scientific items, which precluded scheduling the evacuation of the camp facilities.

A departure from prior roll-up operations was the retention of the majority of landing craft at EPG. Following the completion of previous Operations, the landing craft on loan from the Military which were in excess of the needs of the interim period were returned for overhaul and de-activation. However, during Operation HARDTACK a complete appraisal of the work involved was undertaken, and it was determined that the overhaul and de-activation could be performed as economically at the EPG as in a Navy Yard. Keeping this type of craft at the EPG has the decided advantage of availability when required for a future Operation and permits essential modifications for the type of services that will be needed.

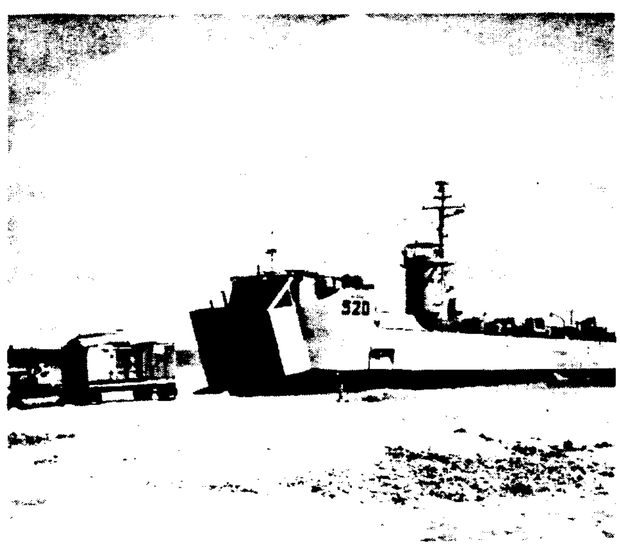


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Figure No. 6-1. M V. ALOTO During Roll-Up of Ujelang.

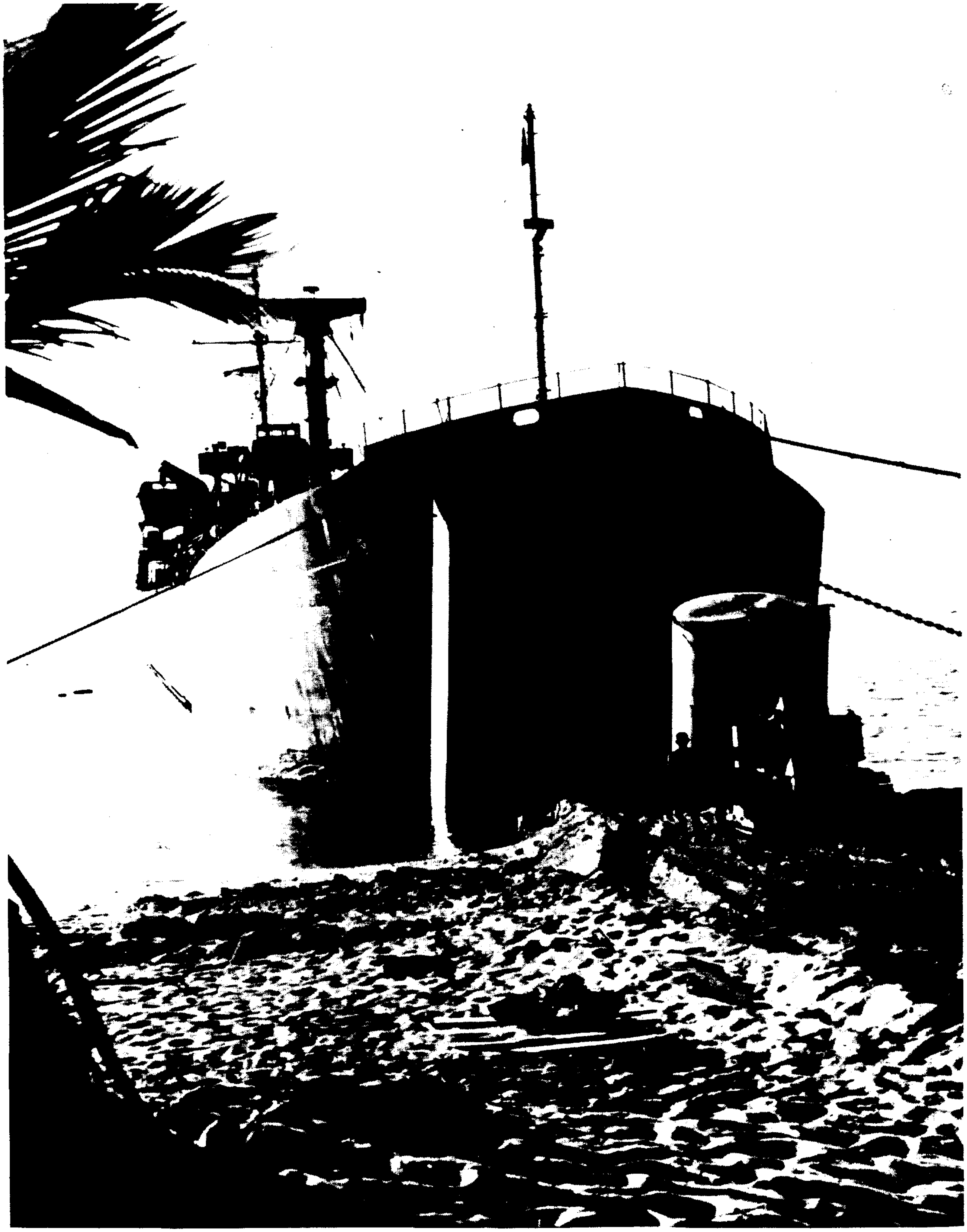

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Figure No. 6-2. Loading LST During Off-Atoll Roll-Up.

During the roll-up of Bikini Atoll, equipment was returned to Site Elmer as requirements permitted, leaving only essential equipment at the site to accomplish maintenance missions during the interim period. The entire program was accomplished according to detailed instructions issued in the form of Work Orders; these listed the desired status of all Scientific Stations, and the work necessary to bring them to that condition, and directed the buttoning up of other facilities. Buildings at Nan and Oboe had been given a coat of aluminum paint earlier in the program. The main camp at Sit Nan was closed, and Bikini was completely evacuated on 19 August 1958.

Upon receipt of information that the weather and rad-safety facilities were no longer required, a schedule was established for the roll-up of these facilities. Because of the difficulties encountered in transportation occasioned by widespread locations, careful coordination was necessary to accomplish this program with a minimum of time and expense. Where it was possible to do so, two or more sites were scheduled for roll-up by using the same crews and transportation. Tarawa, Kusaie, Rongelap, and Wotho were combined in this manner. All other stations were scheduled as separate operations. All Weather and Rad-safety Stations, except Utirik, were completely rolled up on schedule; a crane breakdown at Utirik made it necessary to return to that site to remove equipment which could not be loaded on the first trip.

Prior to the ORANGE event, various meetings weree held between J-4, JTF-7, J-4, TG 7.1, and the H&N staff to establish a roll-up schedule

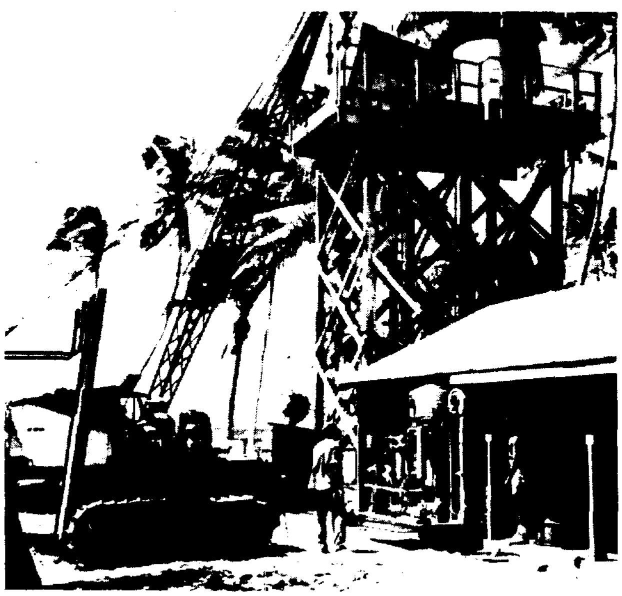

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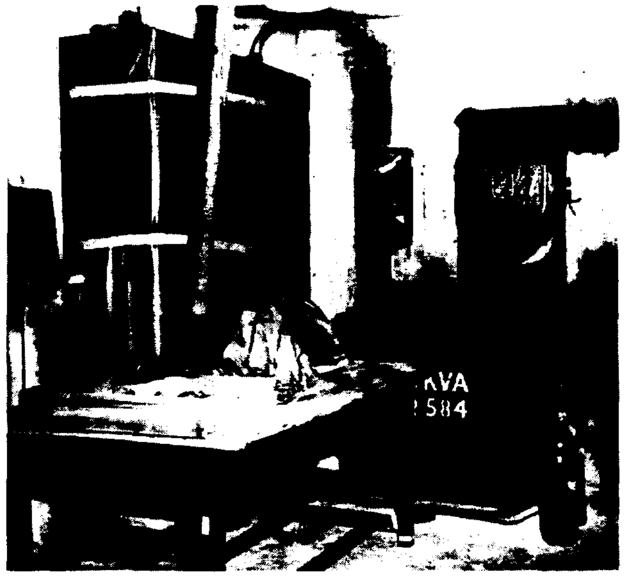
Figure No. 6-3. Rolling Up Water Tower and Distillation Plant — Ujelang.



(Neg. No. W-V-433-12)

Figure No. 6-4. Mothballed Electrical Equipment, Station 1520 — Yvonne.

for Johnston Island. The schedule included obtaining the weight and cube measurements of all equipment of the Task Groups and JTF-7 headquarters. This information was used as a basis for scheduling LST- and LSD-type ships at Johnston Island. Discussions were held with the Air Force Base Command and JTF-7 headquarters relative to the return of the base services operated by H&N and the possibility of the Air Force procuring camp store, liquor, and subsistence items on inventory at the time these services were returned. As a result of these discussions, dates were established for joint inventory activities and the re-assumption of operational control by the Air Force.

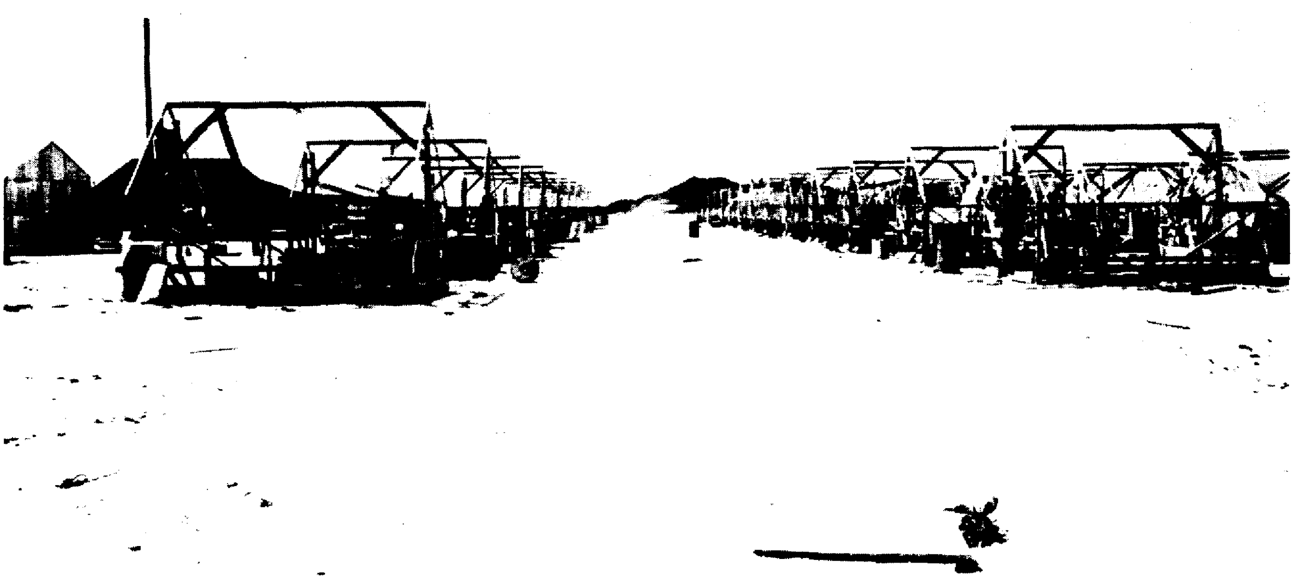
Although a two and one-half day "hold" was placed on the full-scale roll-up operation pending a decision as to whether or not another test event was to be held at this site, the overall roll-up schedule was not affected to any significant extent. Due to the fact that Sandia Corporation participation in the third event at Johnston Island would have been of relatively negligible significance, it was possible to start dismantling rocket launchers and loading certain trailers on the day following the ORANGE event. Upon receipt of information that ORANGE was the last test event to be held at Johnston Island, roll-up activities were accelerated and it was possible to sail the first LSD loaded with User equipment and materials to Pearl Harbor on 19 August 1958. By 1 September operational control of all functions had been returned to the Air Force, and the roll-up was complete with the exception of final ship loadings. On 19 September the final LST sailed from Johnston Island to Eniwetok.

ROLL-UP OF WEATHER & RAD-SAFETY STATIONS*
(all dates shown are in 1958)

STATION	TYPE	ROLL-UP STARTED	ROLL-UP COMPLETED	CRAFT USED
Nauru	Weather	30 July	1 August	LST 664
Kapingamarangi	Weather	1 August	2 August	LSD MONTICELLO
Tarawa	Weather	5 August	8 August	LST 618
Ujelang	Rad-Safety	6 August	7 August	LSM ALOTO
Utirik	Weather	7 August	9 August	LSD MONTICELLO
		15 September	16 September	LSM ALOTO
Rongelap	Rad-Safety	9 August	11 August	LST 664
Kusaie	Weather	11 August	13 August	LST 618
Wotho	Rad-Safety	12 August	14 August	LST 664

*Truk and Ponape were not rolled up; they were transferred to the U. S. Weather Bureau by the AEC.

Table No. 6-2. Roll-Up of Off-Atoll Sites.



(Neg. No. W-906-3)

Figure No. 6-5. Janet Campsite After Roll-Up.

APPENDIX A

The following standard abbreviations are furnished for use in official communications at EPG. Their use in official correspondence outside EPG should be limited to those organizations where the term is of common usage.

AACS	Airways and Air Communications Service
ABMA	Army Ballistics Missile Agency
ACC	Army Chemical Center
ADC	Air Defense Command
AEC	Atomic Energy Commission
AECM	Architect-Engineer-Construction-Management (contract)
AEP	Atomic Energy Project UCLA
AFF	Army Field Forces
AFCRC	Air Force Cambridge Research Center
AFL	Applied Fisheries Laboratory
AFOAT	Air Force Office for Atomic Energy
AFOSR	Air Force Office for Scientific Research
AFSWC	Air Force Special Weapons Center
ASFWP	Armed Forces Special Weapons Project
ALO	Albuquerque Operations
AMC	Air Materiel Command
AMC	Army Medical Center
ANL	Argonne National Laboratory
APA	Air Priorities Agent
ARF	Armour Research Foundation
ATCOM	Atoll Commander
AWS	Air Weather Service
AZ	Air Zero
BAO	Bikini Air Operations Office, Site Nan
BNL	Brookhaven National Laboratory
BRD	Broadview Research & Development
BRL	Ballistics Research Laboratory
BuAer	Bureau of Aeronautics, USN
BuDocks or BuYard	Bureau of Yards and Docks, USN
BuMed	Bureau of Medicine and Surgery, USN
BuOrd	Bureau of Ordnance, USN
BuShips	Bureau of Ships, USN
CAMCO	Cambridge Corporation
CE	Circular Error

CFRES	California Forest and Range Experimental Station
CIC	Combat Information Center
CINPAC	Commander in Chief, Pacific
CJTF	Commander, Joint Task Force
CNO	Chief of Naval Operations
COI	Communications Operating Instructions
COMNAVSTAKWAJ	Commander, Naval Station, Kwajalein
COMWESEAFRON	Commander, Western Sea Frontier
COMFOURTEEN	Commander, 14th Naval District, Pearl Harbor, T.H.
CONUS	Continental United States
CRL	Chemical and Radiological Laboratory
CTG	Commander Task Group
CVS	Carrier Vessel, Support
CWL	Chemical Warfare Laboratories
DIS	Division of Information Services, AEC
DISTAD	District Administrator
DBM	Division of Biology and Medicine, AEC
DC	Department of Commerce
D-Day	Shot Day
DHEW	Department of Health, Education and Welfare
DMA	Division of Military Application, AEC
DOC	Documentary Photography
DOD	Department of Defense
DTMB	David Taylor Model Basin
EAO	Eniwetok Air Operations Office, Site Fred
EB	Eniwetok Branch, AEC
EG&G	Edgerton, Germeshausen and Grier, Inc.
EMBL	Eniwetok Marine Biological Laboratory
EPG	Eniwetok Proving Ground
ERDL	Engineer Research and Development Laboratories
ESL	Evans Signal Laboratory
FA	Forward Area (EPG)
FC/AFSWP	Field Command, Armed Forces Special Weapons Project
FCDA	Federal Civil Defense Administration
FDA	Food and Drug Administration
FEAF	Far East Air Force
FMFPAC	Fleet Marine Force, Pacific
GZ	Ground Zero
HASL	Health and Safety Laboratory,NYOO
HICOMTER PACIS	High Commissioner, Trust Territory of the Pacific Islands

H&N	Holmes & Narver, Inc.
HMR(L)	Marine Helicopter Squadron (Light)
Hono	Honolulu, Territory of Hawaii
H-Hour	Detonation Time (Hours)
IBDA	Indirect Bomb Damage Assessment
J-1, LASL	Personnel and Administration
J-2, LASL	Intelligence and Security
J-3, LASL	Plans and Operations
J-4, LASL	Logistics and Fiscal
J-6, LASL	Test Facilities
JTF	Joint Task Force
KAFB	Kirtland Air Force Base, New Mexico
L1, UCRL	Personnel and Administration
L2, UCRL	Intelligence and Security
L3, UCRL	Plans and Operations
L4, UCRL	Logistics and Fiscal
L5, UCRL	Communications
L6, UCRL	Test Facilities
LAAO	Los Alamos Area Office, AEC
LASL	Los Alamos Scientific Laboratory
LML	Lookout Mountain Laboratory
LVB	Las Vegas Branch, AEC
MATS	Military Air Transport Service
MEG	Military Effects Group
MLC	Military Liaison Committee
MOTS	Multiple Object Tracking System
MSQ-1	Radar Control Equipment (Close Support Control Radar)
NADC	Naval Air Development Center, USN
NAMC	Naval Air Materiel Center
NAS	Naval Air Station
NASWF	Naval Air Special Weapons Facility
NAVCEL	Naval Civil Engineering Laboratory
NBS	Naval Bureau of Standards
NEL	Naval Electronics Laboratory
NIH	National Institutes of Health
NML	Naval Materiel Laboratory
NMRI	Naval Medical Research Institute
NOL	Naval Ordnance Laboratory
NOTS	Naval Ordnance Test Station
NRDL	Naval Radiological Defense Laboratory

NRL	Naval Research Laboratory
NYOO	New York Operations Office
OCE	Office of Chief Engineer
ONR	Office of Naval Research
PLOG	Pacific Liaison Control Group
POL	Petroleum, Oil, and Lubricants
RADC	Rome Air Development Center
R&D	Research and Development
R/D	Restricted Data
SAC	Strategic Air Command
SAM	School of Aviation Medicine
SAM	Special Air Mission
SAN	San Francisco Operations Office, AEC
SAR	Sea Air Rescue
SC	Sandia Corporation
SIO	Scripps Institution of Oceanography
SOP	Standard Operating Procedure
SRI	Stanford Research Institute
TAC	Tactical Air Command
TAT	To accompany troops
TAU	Test Aircraft Unit
TBU	Test Base Unit
TSU	Test Services Unit
TG	Task Group
To	Time Zero
UCRL	University of California Radiation Laboratory
USARPAC	United States Army, Pacific
USCGS	United States Coast and Geodetic Survey
USFS	United States Forest Service
USGS	United States Geological Survey
USMC	United States Marine Corps
USN	United States Navy
USWB	United States Weather Bureau
UWAFL	University of Washington Applied Fisheries Laboratory
WADC	Wright Air Development Center
WETD	Weapons Effects Test Division, FC/AFSWP
WES	Waterways Experiment Station
ZI	Zone of Interior
Z-Time	GMT — Greenwich Mean Time

APPENDIX B

ENIWETOK ATOLL

GEOGRAPHIC NAME	CODE NAME
Bogallua	Alice
Bongombogo	Belle
Ruchi	Clara
Cochiti	Daisy
Sanildefenso	Edna
Elugelab	Flora
Teiteiripucchi	Gene
Bogairikk	Helen
Bogon	Irene
None	Noah
Engebi	Janet
Muzinbaarikku	Kate
Kirinian	Lucy
None	Percy
Bokonaarappu	Mary
Yeiri	Nancy
Aitsu	Olive
Rujoru	Pearl
Eberiru	Ruby
Aomon	Sally
Biijiri	Tilda
Rojoa	Ursula
Aaraanbiru	Vera
Piiraai	Wilma
Runit	Yvonne
None	Zona
None	Sam
None	Tom
None	Uriah
None	Van
Chinierro	Alvin
Aniyaanii	Bruce
Chinimi	Clyde
Jieroru	Rex
Japtan	David
Parry	Elmer
Eniwetok	Fred
Igurin	Glenn
Mui	Henry
Pokon	Irwin
Ribaion	James
Giriinien	Keith
Rigili	Leroy

BIKINI ATOLL

GEOGRAPHIC NAME	CODE NAME
Bokobyaadaa	Able
Bokonejien	Baker
Namu	Charlie
Yurochi	Dog
Uorikku	Easy
Romurikku	Fox
Aomoen	George
Bikini	How
Bokonfuaaku	Item
Yomyaran	Jig
Eniairo	King
Rochikarai	Love
Ionchebi	Mike
Enyu	Nan
Airukiiji	Oboe
Airukiraru	Peter
Bigiren	Roger
Reere	Sugar
Eninman	Tare
Eniirikku	Uncle
Rukoji	Victor
Chieerete	William
Arriikan	Yoke
Ourukaen	Zebra
Bokoaetokutoku	Alfa
Bokororyuru	Bravo

~~This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.~~