The Acquisition of Christmas Island

On November 29, 1961, the proposed visit to Christmas Island was approved. Ogle and Ryan were authorized to discuss "restricted data" with U.K. personnel only if necessary to accomplish the purpose of the visit. Very little could be said about the upcoming program and any "restricted data" discussed was to be reported after the trip. Armed with a mass of questions from Goeckermann, the party left Hawaii at 9:15 a.m. on December 5, 1961. The members of the party were Air Commodore J. R. Whelan, RAF; Colonel Carmel M. Shock, AFSWC; Mr. W. E. Jones, AWRE; J. P. Ryan, Holmes & Narver; H. L. Beards, U.K. Ministry of Aviation; and William Ogle, LASL. The British members had been briefed thoroughly on the purpose of the trip and were authorized to discuss possible ramifications of any agreement. Two other members of the Christmas Island RAF staff were told about the real purpose of the visit and were brought into some of the discussions. All other island personnel who asked were told that the visit concerned the possibility of using Christmas as an enlarged missile and satellite tracking facility. (A Pacific Missile Range tracking station was already in operation there.) The U.S. representatives described to the members of the British team the possible activities envisioned, pointing out that the plan was secret and that no decision to carry out an atmospheric operation had been made. The British emphasized the extreme delicacy of the situation on their side, pointing out that politically it would be most unfortunate if the real purpose of the U.S. visit were to become known, or if it should become public knowledge that negotiations on that subject were being held. They asked to be notified immediately of any "leak," pointing out that even a few hours notice might be of great value to them.

In general, the technical facilities were either in poor condition or inadequate, but some things were good. The airplane decontamination area looked promising and the radchem lab was in usable condition. The photo lab appeared to be large enough. Many buildings near the region of the airfield would be useful for labs and offices, if required, although minor rehabilitation, interior painting, and wiring checks would be needed. The forward area was not in good shape, there being a few very small buildings that might be useful. The balloon site was in good shape. Profiles of the ocean bottom had not been run along the southern coast where barges might be anchored, and no measurements of the ocean currents had been made. The channel into the harbor at the Port of London could accommodate LCMs, and probably LCUs, but nothing larger, necessitating lightering for some material. The island could not, at the time, house appreciably more people than were already there. The main camp, which was designed for 2,500 to 3,000 people, looked as if it could be rehabilitated with only moderate effort, but cooking facilities were questionable. The 50-cycle electrical power would be a problem for U.S. equipment. Water was clearly not available in sufficient quantities; additional distillation equipment would be needed. The roads were adequate, but the British drive on the wrong side of the road. There were many light vehicles, but all were British gear. Fuel movement would be a problem. There was a 60-bed hospital, but only the operating room was maintained.

Possible assistance from the British was discussed. They commented that they could house and support perhaps 50 people for a few weeks while we were getting started, but it would be a big strain on them. They offered knowledgeable people to advise us on details of their setup, how their equipment works, etc. The equipment they had, such as trucks and jeeps, would be available to us. A mutual arrangement would have to be made for replacement or pay or whatever. They would operate, or help operate, the airfield control tower, and their technical people would be interested in making some measurements for us if it were desirable. The British said that we should expect very little off-site fallout from airdrops or balloon shots,

since, during Grapple, they had made fallout observations at Fanning, Malden, Kwajalein, Fiji, Aitutaki, Canton, Samoa, Penrhyn, Honolulu, and Rarotonga, and nothing of note was observed. Typically, the wind was out of the north and there were two layers of scattered clouds, one in the region of 6,000 to 7,000 feet and the other between 2,000 and 3,000 feet. They commented that placing airdrops in a large enough hole in the clouds to take satisfactory pictures would hardly ever be a problem.

There was also some discussion of preliminary concepts of operations. The British would require that coconut plantations not be contaminated or damaged in any way, which was no problem since the same ground rules would be followed to protect our own camp and operations center. There must not be any remaining radioactive debris that would be a real hazard to the natives after the tests were done. As a consequence of these rules, tower or surface shots might be very questionable. The British would probably insist on their vetoing our firing if they judged the winds to be improper. Contamination of the native fish supply did not appear likely from barge shots off the south end of the island because of the sea currents, but monitoring would be necessary and native help should not be sought. Normal activities of the native populace must not be disturbed except when shots were actually being fired, and the subject of compensating the native workers for lost time would have to be discussed. The native villages, etc., would be off limits to our testing personnel, and commercial arrangements, either with individuals or organizations, should be made with the Gilbertese people. It was further noted that there were accommodations for only two women on the island. The conclusion of Ogle's trip report is worth noting:

> While Christmas Island is not developed to the extent that is Eniwetok/Bikini, it could be made into an eminently satisfactory site for atmospheric tests. The main point that strikes the observer immediately is that there is so much space, all flat. Airfields, parking ramps, etc., can be as large as necessary. Buildings need not be crowded together, scientific stations can be properly placed. There is no serious fallout hazard. The weather is good. The site seems to be ideal for balloon sites and airdrops. It is more difficult for barge shots because of deep anchorage, but experience would probably teach us how to do even this properly. While there are many problems, it appears that the most serious ones that arise in considering a quick operation have to do with the technical facilities, and particularly those concerned with alpha. For longer-range planning, the main problem is clearly that of docking facilities for large ships. Therefore, from an operational and technical point of view, Christmas Island is to be highly recommended. Politically, of course, the finger may point elsewhere.

In preparation for a joint U.S./U.K. meeting after the survey trip the AEC approved the following guidelines for the U.S. representatives who would attend:

a. The U.K. representatives shall be informed that the decision to test or not to test in the atmosphere is in no way contingent upon the availability of Christmas Island; rather, the use of Christmas Island would facilitate and improve the test program.

b. It will be appropriate for the American representatives to make available to the British the sort of information contained in the letter of November 29 from Chairman Seaborg to the President. (Ed. note: The NSC subcommittee letter giving the proposed program.)

c. The American representatives can agree that the results of individual tests involving the use of Christmas Island will be made available to the U.K.

On December 9 in a memo to the Secretary of State, Phil Farley noted that both the Prime Minister and Foreign Secretary of England would have to be convinced "that our proposed tests are necessary to maintain a free world security and that a sound and consistent public defense of resumption of atmospheric tests can be made in the U.S. and the U.K." He noted that by sending the reconnaissance party to visit Christmas during the week of December 4 and arranging for the review with senior U.K. technical officials of the testing program on December 8, "The two preliminary tests specifically suggested by Prime Minister Macmillan in his letter of November 16 had thus been well taken care of in advance of the Bermuda meeting." He thus suggested that the matter be discussed in Paris with Lord Home, specifically noting that the President had not decided to resume testing, that our tentative test program followed the criteria given by the President and Prime Minister, that we were strongly interested in the use of Christmas Island in view of the undesirability of reactivating Eniwetok, and that we should attempt to ascertain any specific difficulties which the British see beyond those raised in the Prime Minister's letter of November 16.

On December 14 John Foster told Seaborg that, "We continue to feel that Christmas Island can represent the most desirable test location for the atmospheric series if it can be made available for exclusive use by the U.S. from January 1 through July 1, 1962 . . . ." On the same day Al Graves indicated to Betts that LASL fully supported the use of an island such as Christmas.

On December 15 AEC Commissioner Haworth wrote to McGeorge Bundy, the President's Special Assistant for National Security Affairs:

> To summarize, the availability of Christmas Island by January 1962 for the coming series of tests would be highly advantageous in that it would permit the conduct of a more extensive, more carefully instrumented, and operationally simpler program with greater assurances of attainment of test objectives.

He pointed out that if too rigorous restrictions were imposed by the British, for example, on our freedom of operations control, these advantages could be nullified.

On December 21 President Kennedy discussed the use of Christmas with Harold Macmillan in Bermuda. Kennedy pointed out that the U.S. needed British support in any decision to test in the atmosphere and that the British colony of Christmas Island in the central Pacific offered an ideal site for testing in the atmosphere. He asked whether Macmillan would agree to atmospheric tests on Christmas Island if the political situation did not change vis-a-vis Russia, and Macmillan stated that that was a decision for the Cabinet, but noted that Britain and America were partners and we were in this together.*

In other discussions at lower levels during the Bermuda meeting a tentative agreement was reached governing the use of Christmas if it should become available to the U.S. The agreement stated that the island would be used only in conjunction with a test program of an agreed-upon general nature and purposes. Only airdrops or balloon shots would be used. The U.S. would have responsibility for control of the various aspects of the tests, including their selection, scheduling, timing, and the application of safety rules. However, the U.K. would have a base commander who would be a member of the safety committee. The U.S. could construct buildings and facilities as it deemed necessary at its own expense, but approval of major facilities and buildings should come from the U.K. base commander. The U.K. would assist in providing security protection at Christmas Island. The U.S. would, in accordance with

*A. Schlesinger, *A Thousand Days*, page 491.

existing agreements for cooperation (JOWOGs), furnish or otherwise make available to the U.K. detailed information concerning the tests done from Christmas Island. The U.S. would be responsible for handling loss and damage claims following such tests. All arrangements would be made without prejudice to either nation's claims to sovereignty over Christmas Island. On December 27 Phil Farley asked General Betts and Gerry Johnson to review the draft statement of principles.

Early in January 1962 Macmillan, in expressing to Kennedy his unhappiness at the thought of test resumption, noted with strange irony that he should have spent Christmas Day wondering how to commend to his cabinet colleagues the dedication of Christmas Island for this purpose.* In further discussion, he also suggested that the three leaders try once more for general disarmament and a test ban, noting that the forthcoming March meeting of the 18 power disarmament conference in Geneva would be appropriate for this purpose. He did not indicate whether, in his view, the use of Christmas Island was conditioned on U.S. agreement to a disarmament conference at the Summit or whether his agreement to the resumption of American atmospheric testing could come only if the conference failed. On January 12 Rusk suggested that Kennedy's reply should reject any link between the use of Christmas Island and a new disarmament initiative.

On January 17 Luedecke (AEC) sent Phil Farley the results of the DMA and MLC reviews of the draft statement of principles. It was noted that in addition to using Christmas Island as a test site, the AEC felt it important to add that the airfield and other logistics support facilities would be needed for test activities away from Christmas Island. The AEC wished to suggest that the statement of agreement not preclude firing from barges or other types of shots carried out some distance from the island. The preferred interpretation would be that only airdrops or balloon shots would occur near the island. By January 18 the test planners were nervous, and Betts, noting that the island would probably not be secured for AEC use until about February 1 at the earliest, asked the Laboratories if they could still prepare a meaningful experiment to give reliable data within the proposed time scales.

On January 28 Starbird told Ogle that he might describe in detail for the chairmen of the AEC and the MLC the impact on JTF-8 plans of further delay in the Christmas Island decision. In essence he felt that even if the British agreed now we could not use the island because it would take four to five months to prepare it for a major operation; since we were planning to use Jarvis or some other isolated island for a surface shot and had hoped to use Christmas for sampler aircraft operations, we were in trouble on that too; we were making modifications at Johnston Island for sampler operations without intending to operate them from that base, but if we didn't have Christmas we would have to use Johnston. Therefore, he intended to recommend to the Secretary of Defense that the U.S. immediately indicate to the British that we were no longer interested in near-term use of Christmas Island for a major test series, but we should indicate our desire to use it for support of open sea activities. He commented that if we delayed past April 1 even this last possibility might be out. Ogle responded by telephone and TWX, commenting, "Four or five months to get Christmas ready seems long to me--technical end could still be done in remaining time, but difficulty would come in getting camp support, airfield support in time."

On February 2, 1962, Bundy told Betts that on February 8 the British would agree to our use of Christmas Island. As a result Starbird planned to visit Christmas Island starting February 9, but on February 7 the U.K. representatives informed the U.S. State Department that they were adamant that preparations not begin at Christmas

*A. Schlesinger, *A Thousand Days*, page 492.

Island until the intergovernmental agreement was signed and that they would not agree to Starbird's planned visit. They did agree that their Assistant Secretary Anderson (Atomic Energy) and Air Vice Marshal McKinley would fly to Washington on the 9th to meet with Starbird, and that after those discussions they would be prepared to fly with him to Christmas Island if such a trip appeared advisable. They promised that the United Kingdom would react to the State Department's comments on the proposed island agreement by the end of the week, i.e., by February 9. On February 8 the White House issued a statement that the U.K. had agreed to permit the use of Christmas Island by the U.S. for nuclear tests.

The final agreement (with interpretation of certain provisions) for U.S. use follows:

MEMORANDUM OF UNDERSTANDING COVERING ADMINISTRATIVE, FINANCIAL AND SCIENTIFIC COLLABORATION ARRANGEMENTS FOR THE USE OF CHRISTMAS ISLAND BY THE UNITED STATES GOVERNMENT IN CONNECTION WITH THE PROGRAMME OF NUCLEAR TESTS DISCUSSED BY THE PRESIDENT AND PRIME MINISTER AT BERMUDA DECEMBER, 1961

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The High-Altitude Carrier

On November 19, 1961, AFSWC published a report which included a complete outline of the high-altitude program. The report assumed three tests named Bluegill, Kingfish, and Starfish and, on the basis of nuclear safety, eyeburn, and operational suitability, concluded that Johnston Island (others considered were Eniwetok, Kwajalein, Christmas Island, and Vandenberg AFB) was the most promising operational base for the tests. From consideration of boosters available promptly, and noting that Sandia had already accomplished the detailed study of mounting appropriate warhead devices in the Thor reentry vehicle, they stated that "since these warheads fit the yield requirements, they were the logical choices for consideration and the Thor then became a 'first choice for the operation.'" The AFSWC study had also considered the Polaris, Redstone, and Blue Scout missiles. The Redstone, it was noted, did not have the required altitude capability and would require extensive modification of the warhead fusing system. The Polaris could meet the altitude requirements, but would not easily accept all of the warheads and had no provision for attaching external instrumentation packages. However, the operational flexibility of the Polaris was seen as an extremely desirable feature. As for the Thor, it was stated:

> The Thor booster is available from current inventories, can accomplish all altitude requirements, requires only minor modification for adaptation to the proposed warheads, and has an established high degree of reliability. Twenty-three out of twenty-five Thor space boosters launched since October 4, 1960, have been successful. The overall space booster success is 55 out of 62 launches. The Thor also has provisions for installation of external ejectable scientific instrumentation packages.

The conclusion was that the Thor from Johnston Island was the most acceptable

combination for Project Fishbowl.* To provide close-in measurement capability, it was proposed to install on the exterior of the vehicle, at the base, three ejectable scientific instrumentation pods. Additional instrumentation would be positioned by using sounding rockets. The overall cost for the three-shot program (including one spare booster) was estimated to be about $40 million, exclusive of JTF-8 costs, and the preparation time was estimated to be five months under the most accelerated, high-priority conditions. "Limiting items appear to be payload design and fabrication, procurement and installations, and the training of sufficient launch crews to satisfy the small vehicle program." The report further detailed the small rockets required, showed schedules for the total program, and listed desirable experiments to be fielded.

Even before Starbird assumed command of JTF-8 in Washington he reviewed the recommendations for carriers for the high-altitude shots. Both AFSWC and DASA Field Command had recommended the Thor. The use of the Thor would require the use of Johnston Island, although Johnston might be required anyway as a base for launching sounding rockets. During the last week of November and the first week of December Starbird asked the Military Services to propose warhead carriers. The Air Force, together with Douglas representatives, proposed the Thor, and the Navy was quite enthusiastic about using Polaris, pointing out that it might be possible to use the ship "Observation Island" in order to launch from the ocean surface. On the other hand, the Army was less than enthusiastic about the Redstone, which was now an old missile, and the Nike-Hercules, but did point out they were available and could be used. Starbird's outlook, as transmitted to Booth with his final recommendation, is paraphrased below. He had investigated only the three systems, Polaris, Thor, and Redstone, and considered eight questions as follows:

1. Is the booster one which has been proven to be reliable? There is little difference in reliability of the three systems in delivering a payload to a satisfactory position in space, with Redstone having the best record and Thor slightly behind, although both were better than 90 percent; Polaris, although having a lower probability of successful performance, was a newer booster and had remarkable success in its short period of limited firings. (Ed.note: Ogle pointed out to Starbird that, from his point of view, both Redstone missiles had failed in the Teak and Orange tests of Hardtack.)

2. Will a trained team be available to conduct the firings? The Navy would organize experienced personnel into a cadre for a full ship missile team which could be ready in early May. The Air Force proposed to use an experienced contractor team to assemble the equipment, make preshipment checks, perform the installation at Johnston Island, and perform the firings. The Army would assemble immediately an experienced crew. None of the Services proposed to furnish a crew which had been functioning recently as a team, but each could provide a satisfactory team by the proposed date.

3. What data-gathering capability would be incorporated in the missile? The Navy plans would incorporate four powered pods in the nose section, including one nose ejection pod. The Army would use unpowered tail pods as done on Hardtack and would also design and build a nose ejection pod. The Air Force would use unpowered Atlas pods on the tail section and would not have a nose ejection pod.

*The DOD participation in the high-altitude tests of Operation Dominic.

They proposed to position certain items by supplemental rockets. (Of course, the Navy system had not yet been designed, whereas the Air Force had done appreciable work on the proposed Thor pods.)

4. Is any critical engineering and development required for each proposal? Here there is some notable difference between the boosters. The Polaris would require some modifications and new designs: the nose cone shape would be new; the warhead adapter and firing system for the ship would have to be designed and built; and powered pods were a new requirement. Although Navy studies indicated no problems in any of these efforts, the schedule necessary to accomplish two shots by June 15 left no room to remedy unexpected difficulties. For the Redstone, the nose ejection pod and the warhead adapter kit must both be built. The firing and fusing system used on Hardtack would be used again, with some modification still to be designed. As for the Thor, no significant modifications of the warhead nose cone configuration or existing adapter kits would be required. A new firing and fusing system would have to be developed and the Atlas tail pods have been flown on the Thor. In summary, for this question, "It appears that significant engineering and development is required for the Polaris system. That needed by the Redstone is less by considerable degree, and that for the Thor still less, although, in the Thor case, it will be centered around the critical firing and fusing elements." (Sandia had already started working on the firing and fusing systems.)

5. What systems test is possible prior to nuclear testing? Only for the Polaris is a prior systems test proposed by the Services. A full Polaris test with a ship missile crew system would not occur before May 1 and, at that, very little time would remain to remedy any gross deficiencies. As for the Thor, the time required to prepare the fusing and firing set and incorporate the tail pods should allow conducting the test from Vandenberg AFB within 2 or 3 months. A Thor systems test for Johnston Island could not occur probably before mid-May. As for the Redstone, a limited systems test incorporating the nose pod and fusing and firing systems changes could be done at Johnston early in April.

6. Does the system have adequate technical flexibility? Providing the Navy's schedule can be met, the Polaris has by far the most flexible system, which allows firing from the ship and counting down two missiles simultaneously to T minus 1 minute and holding there indefinitely. Additional shots could be performed with minimum time delay and no fixed land base would be required. The Thor can be counted down to about T minus 8 minutes and held there due to the short fueling time required. The Redstone, on the other hand, begins to be fueled at T minus 45 minutes and only holds for periods up to 3 or 4 hours. Further difficulties arise after T minus 15 minutes when the batteries must be replaced if an extended hold is required. As for other considerations of flexibility, the Redstone is limited to about 800 kilometers altitude, whereas the Polaris and Thor can get well over 1,000 kilometers. All three boosters thus meet current requirements, although the possibility of a test at altitudes over 800 kilometers would provide an obvious problem. In summary, "The operational flexibility of being able to operate from any chosen area on certain notice gives to the Polaris a definite advantage over the other two systems. The simultaneous countdown feature and the long T minus 1 minute hold capability are also great assets. Of the liquid fueled systems, the Thor's longer hold capability at T minus 8 also gives a significant advantage over the Redstone. Yet any of the three should be capable of sufficient flexibility to permit the firing to

occur under opportune weather conditions and in coordination with other instrumentation."

7. Does each system give assurance of being able to accomplish the required program within available time? Assuming the Bluegill and Starfish events and a final cutoff of July 1, the final shot should be planned to be done by June 15 in order to take into account delays. The Polaris, requiring ship conversion and a payload redesign, could be scheduled for test early in May, followed by the nuclear shots on June 1 and 15. However, unforeseen engineering, development, or ship conversion delays could retard these dates and it would not be possible to advance either of the firing dates without foregoing the proposed systems tests. The Thor program, which would include a Vandenberg shot, should be capable of executing the two tests on May 15 and 30, providing some time cushion. The Redstone would permit the greatest cushion, with a certification test at Johnston on April 1 and perhaps nuclear tests 15 days thereafter.

8. Does each system give assurance against catastrophe and personal injury? None of the three systems sponsors has yet provided an overall safety analysis or submitted complete hardware designs. The proposed warheads are one-point safe. "As of now, no one of the three systems would appear to be ruled out by a lesser chance to give sufficient protection against premature nuclear detonation or nuclear contamination."

Based on his study, Starbird then recommended the Thor, assuming that a systems test at Vandenberg would be successful. His primary reason for selecting Thor over the Polaris was that it gave greater assurance of conducting the planned firings within the period allowed. His primary reason for recommending Thor over Redstone was the Thor's higher-altitude capability and his belief that we might want to fire the 1,000-kilometer or higher shot during or immediately after the series. Starbird also commented that it was his intent to "assign a special assistant to the Scientific Deputy who will have as his sole responsibility coordination of the high altitude program." Eventually Don Shuster accepted that responsibility. Starbird sent the above recommendation to Booth on December 7 and Booth informed Air Force Headquarters of the decision on December 15, 1961. DASA further requested of the Air Force a propelled pod from the nose for Bluegill and three other pods for each shot.

The decision to use Thor clearly settled the question of the launch site, which would be Johnston Island.

General Observations

During the months of December 1961 and January 1962 the organizations were firmed up, detailed operational and experimental plans were made, and procurement of equipment, ships, airplanes, etc., was started, all in parallel. While the organization continued to change to a certain extent throughout the operation, the Task Force organization was pretty well settled by the end of January. By early December Task Force Headquarters had obtained the use of Barton Hall in Washington. In mid-December U.S. Army Colonel Roger Ray was assigned as a Deputy to Ogle to concern himself with the test device carrier missiles. In late December H&N appointed Paul Spain as construction coordinator for the overseas operation; this was the beginning of the "Spain Committee," which consisted of one member from each Laboratory, EG&G,

Field Command, JTF-8, and the AEC. It was quickly agreed that all construction requirements would be sent to the Spain Committee, who would coordinate these requirements, check for necessity, and arrange that the requirements be fulfilled. Jim Sugden (H&N) was assigned the responsibility for coordinating communications requirements, and EG&G (Frank Strabala) was given the job of collecting requirements and supplying firing signals. Within the Laboratories, similar assignments were quickly made. The LRL appointments have already been noted. For LASL Lee Aamodt took on the job of heading the Task Unit, with Herman Hoerlin as alternate, basically for high-altitude efforts, and later with Austin McGuire as alternate. Shuster was initially responsible for the Sandia Task Unit, but after designation as Deputy to the Scientific Deputy he turned the Task Unit over to others. Frank Strabala ran the EG&G organization.

Thus, through December and January the operational concepts became clearer. The high-altitude operation would clearly be done from Johnston Island. The AEC development program would be done mostly at open sea, either with airdrops or surface detonations, and including one island shot. The ASROC effects test was also part of the program.

The Open Sea Operation

While awaiting a decision on Christmas Island, the AEC Laboratories and the Task Force had no choice but to plan for open sea detonations. The aborted Operation Everready had established a concept which was, somewhat reluctantly, developed further by the testing organization. However, all experimental plans were made and equipment was obtained with the idea of being able to move to Christmas Island if that facility should become available. The concept was hammered out in dozens of meetings during December and January. The intent was to do either airdrops or shots with devices emplaced on Liberty ships, which would, of course, be blown up. For an airdrop there would be a free-floating "target" raft, 20 by 24 feet, outfitted with radar reflectors, lights, and radar beacons. In addition there would be an air array consisting of the B-52 drop aircraft (two were available), the two C-130 diagnostics aircraft that had been obtained for Operation Everready, and a C-121 air array control plane which would be backed up by control from an aircraft carrier. At an appropriate distance from the target would be the command and control ship (the carrier Hornet) and two diagnostics ships (McGraw and Merrill), which were MSTS C2 ships with helicopter pads. On each ship two radars were available for tracking; the ship's radar and one installed by Sandia (584 and GMD radar). A DME system was also provided to determine distances from the ship to the target raft and the bomb. JTF-8 would have its command post on the Hornet.

P2V aircraft stationed at Barbers Point NAS (Hawaii) would be used to clear the test area ahead of time, assisted by two destroyers which also served as weather ships. Additional weather information would be obtained using WB-50 aircraft. B-57 samplers, the B-52 drop aircraft, and the C-130 diagnostic aircraft would also be based at Barbers Point. Other aircraft involved included air/sea rescue and C-135 sample-return planes, all of which would be based at Hickam AFB.

The danger area was to be a 400- by 600-mile area, with its near edge 300 miles south of Oahu, although on occasion it was argued that the boundary could be as close as 100 miles from Oahu. The 300-mile minimum distance from Oahu was, on occasion, somewhat disturbing because the B-57-B's operating radius was only 434 nautical miles, meaning that they had very little sampling time, especially if the detonation were farther on into the danger area.

For an airdrop, the LASL devices would be dropped from 45,000 feet in free fall,

in either Mark 39 or Mark 15 cases, whereas the LRL devices would use Mark 36 cases with drogue parachutes, which would be dropped from an altitude between 25,000 and 35,000 feet. Primary diagnostics were based on the MSTS ships. Fireball cameras were mounted on EG&G-designed tracking platforms which were operated from the ships fire control system. Both LASL and Livermore had optical and EM time interval measuring gear on the ships and on the C-130s, and LRL intended to install additional optical equipment and appropriate EM gear on the Hornet. LASL planned to make alpha measurements on airdrops utilizing an instrumentation drop case together with the device drop case. For this measurement the Mark 28 instrumentation drop case containing alpha detectors and appropriate telemetry gear would be released from the B-52 at an appropriate time before release of the bomb so that the instruments were at the proper distance from the bomb when it detonated, the proper distance being based on the correct intensity range for such a measurement. Data would be telemetered from the instrument case to one of the MSTS ships and recorded by Sandia gear. The B-52 would also be equipped with fireball cameras and bhangmeters. The radar reflectors, lights, and beacons to be used on target rafts were designed and procured by AFSWC with AEC funding and were to be installed on Navy rafts. The Navy would then have the responsibility for proper target placement.

General Samuel directed that all bombing should be done by radar with visual backup, but Ogle was arguing in February that it should be visual bombing with a radar backup because of the previous experience in Nevada.

The ship array would be gently under way at shot time on a heading of 270°; however, that point was still being argued at the end of January since 270° put the ship abeam of swells and that could be very uncomfortable. However, the Laboratories wanted the 270° orientation since the shots would be fired early in the morning and they wanted the optical gear to be looking (westward) into a dark sky to achieve maximum contrast.

There were several hazards to worry about. The B-57 maximum range has already been mentioned. Obviously, shot time would have to be chosen so that attendant weather conditions would not result in a fallout hazard to Hawaii, either for a normal drop or for an accidental detonation on the surface. Starbird worried some about the latter point and suggested a safety link from the bomb that would prevent surface detonation, but Ogle estimated that with the present system, the odds of a surface detonation were about 1 in 10,000, and the safety link would degrade the reliability of the fusing system. Such a link was not used. It was estimated that if the ships were 10 to 20 miles away, then even in the case of a surface burst the base surge radioactivity would not be hazardous. Based on Eniwetok experience, Ogle estimated that the ships would be safe from blast damage if they were six miles from a shot of 100 kilotons yield, 10 miles from 1 megaton, 15 miles from 3 megatons, or 20 miles from 10 megatons. These distances were somewhat conservative compared to later Navy-produced numbers. Because of the possible tsunami problem associated with the tests, Bill Van Dorn of Scripps Institute was asked to help, not only with that general problem for the airdrops, but for any problem that arose in the operation.

The Laboratories initially considered firing several bombs on Liberty ships using a radio link from the command ship. Some six Liberty ships were requested, but by the end of December LASL had withdrawn their request for three of the ships. Livermore continued their request, and on January 23 the Willy Jones arrived in Pearl Harbor to undergo modifications for the Livermore Lute shot. For such a shot the device ship either had to be anchored in deep water or had to have very heavy and deep sea anchors. H&N and the Navy, early in January, set about trying to obtain such anchors.

The Hornet and the MSTS ships were made available for modification on the west

coast in mid-January. On January 19 parallel work on engineering design and modifications began on the Hornet with the intention of putting equipment aboard by February 12, ready or not, in order to meet a first dry run date of February 28. The ships were scheduled to leave the west coast on March 6, arriving at Pearl Harbor on March 12 for any last-minute changes, and leaving on March 22 for practice runs.

Thus, most of the gear for this kind of operation was under construction or in hand and being installed on the ships by early February. However, the President announced on February 8 that arrangements had been made with the British to use Christmas Island. Work continued for the next week on ship modification and equipment installation while a decision was being made on whether or not to move to Christmas. The Lute shot had been canceled late in January, and, hence, work on the vessel Willie Jones was stopped only a very few days after it began. Starbird asked his Deputies and the Laboratories their opinions on the wisdom of trying to move to Christmas Island under the continued constraint of an April 1 readiness date.

Goeckermann answered for Livermore on February 12:

> In the original planning for Operation Dominic, we were instructed to retain the capability to move ashore at Christmas Island. Therefore, our plan for Christmas Island will closely resemble the Hornet installation. Our site arrangement will probably consist of a control point trailer park located near Able Site, two camera stations located along the south shore, and a rocket launcher pad in the vicinity of Able Site. This basic arrangement has the concurrence of the other technical agencies.

He pointed out that LRL planned to have an advance party of eight arrive at Christmas on or about March 1, but other personnel would not arrive until after trailers arrived. He recommended that all equipment on the ships at the moment be taken to Hawaii on those ships, moved into the dry well of an LSD for transport to Christmas Island, where it would be taken ashore in LCUs. Airlift to Christmas would require considerable modification of the trailers. He recommended against sea transfer of the Hornet trailers using ship's tackle. But overall, he concluded that if we moved immediately the April 1 date could be met. Goeckermann also made the point that a move to Christmas would alleviate the bomb tracking problem, permitting smaller camera fields of view, and, hence, better resolution and improved data. The background problems would probably be less, but the C-130s would have to be based at Christmas.

The other organizations answered in similar vein, and the decision was made to move to Christmas Island on February 15, 1962. The Hornet's Captain was furious!

Move to Christmas Island

Starbird immediately left for Christmas Island, taking along an initial party of Laboratory representatives, some of the Deputies, and an initial crew of H&N and AEC people, and just as he left Washington, he grabbed Colonel Phil Hooper. The initial party promptly completed the layout of most of the technical facilities, the assignment of space in the British facilities, etc. Colonel Hooper was informed that he was the U.S. Island Commander and told to stay there, very much to his surprise.

The scientific and support equipment was removed from the aircraft carrier and loaded aboard a U.S. Navy LSD for shipment to Christmas. Other equipment was packaged and shipped via MATS with great cooperation from CINCPAC, PACAF, etc. There were 367 H&N personnel, 74 user personnel, and 152 military personnel (for a total of 593 Americans) on Christmas Island by February 28. While the Americans promptly took over the control tower and airfield operations, the British, throughout the entire operation, met every plane and briefed incoming people on the hazards of the island.

By the end of March there were approximately 1,500 people on the island. Both the Navy and the AEC moved in communications equipment, the first communication van arriving February 20. However, communications were bad for some time; in fact, they were not satisfactory until after April 22. The mess hall and boiler house were in operating condition within seven days after work started, but the mess hall was never satisfactory during the entire operation: the difficulty was the initial attempt to use British equipment. The barracks were quickly rehabilitated and the water wells and British power plants were started up. The Joint Operations Center (JOC) was rehabilitated and the Air Task Group, TG 8.4, began to move in. (A map of Christmas Island showing locations of some of the facilities is in Figure 13.) Since the British power was 50-cycle and there was not very much of it, American generators were promptly brought in and an extra power system was established near the JOC.

By April 21 new target positions had been picked by joint agreement between the technical Task Units; these varied from 10 to 20 miles from the main concentration of experimental gear which was called A or Able site. A survey of depths and currents off the southern part of the island was made so that target mooring could be designed. The target mooring turned out to be a very serious problem, but, fortunately, between the Navy and Bill Van Dorn a method was developed using lighter-than-water rope and three anchors. It worked nicely.

During late February and early March there was appreciable discussion among the Laboratories, AEC Headquarters, and AFTAC concerning possible measurements by the British on the Christmas shots. They wished to make time interval measurements by EM techniques, for which they had very highly developed techniques. After appreciable discussion their participation was agreed to.

By March 3 the Navy Task Group had arranged to moor targets off Christmas Island and by the end of March they had arranged for placement of the first trial target.

On March 2 the President announced the U.S. decision to test (if the Russians did not come to an agreement before we started) in the latter part of April. The President's announcement allowed a little more time for preparations.

However, on March 7, at the JTF-8 scheduling meeting of the Task Units in Denver, the test organization was told that in order to give the President the option of conducting tests before April 23, preparations at Christmas were not to be relaxed. An appreciable flurry was thrown into the system when it was stated that the President might want to start testing in the atmosphere at any moment. A quick review of the situation led to the conclusion that, if necessary, we could fire within a week. However, it was agreed that the first dry run of the ground-based part of the system (diagnostics, etc.) would be on April 1, that there would be dummy drops between April 1 and 10, drops of high explosives between April 10 and 20, and we would then be ready for the first live round on April 23.

By March 7 Colonel Hooper reported the status of Christmas Island to CJTF-8 as follows:

1. Communications: Conditions appear to be improving, but most frequencies continue to present unsatisfactory reception and transmission. Local equipment deficiencies which have been identified have been corrected.

2. Transportation: Vehicle transportation is bad. Personnel vehicles now being received are in as bad or worse condition than original shipment which you saw here. This has been a psychological blow to all here; however, the shock is about over. A small bus and five pickup trucks have arrived from Hickam. These will be available for customers tomorrow.

3. Main Camp: The northeast, east-central, and central areas are completely ready for occupancy. The west area is about 65 percent ready for occupancy and about 40 percent occupied. Rehabilitation continues. We are placing eight men in six-man rooms. Present water supply will not support more than 1,300 men. Previous

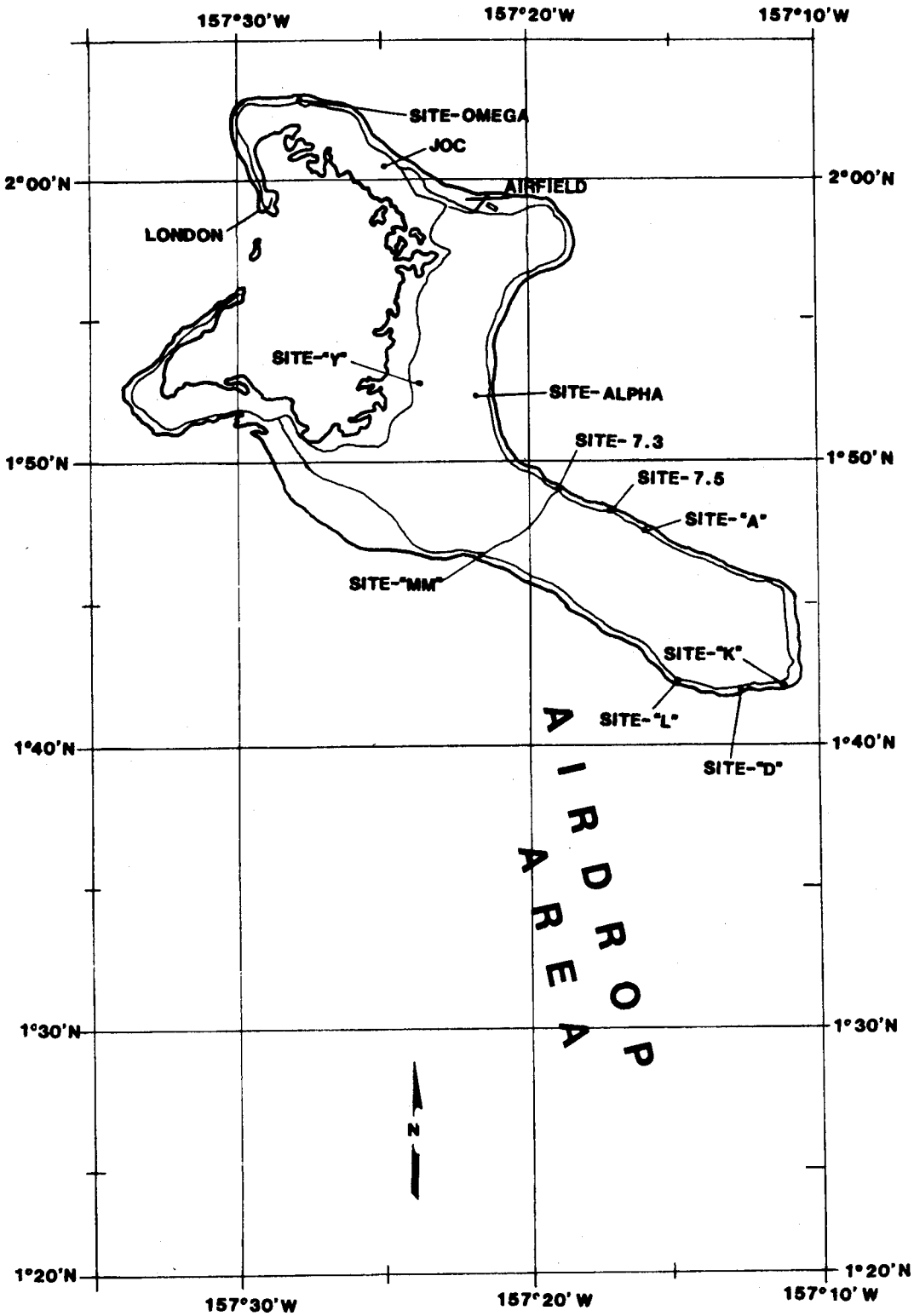

Figure 13.
Map of Christmas Island showing principal facility locations.

U.K. estimates are not proving out. Five distillation units have just arrived on barge. Present population is 1,239.

4. Site "A" Camp: Construction of 250-man camp has been initiated, with site preparations 40 percent complete. Army Port Company is assisting by erecting a temporary camp nearby. This camp will have Port Company kitchen and will permit camp occupancy when trailers arrive.

5. Port Area: To date, the following ships have been off-loaded: Jerome County, Harris County, Monticello, Arikara, three barges, Kabildo, and Snohomish County. The Quapaw, with three barges, has just arrived in harbor with stills and fuels.

6. Airfield construction: Site preparation is in progress. Material and equipment for airfield rehabilitation are due to leave Honolulu on March 7. Field engineering is in progress and preliminary drawings are 30 percent complete.

7. Scientific construction: Site "A"--trailer site is graded and stabilized and material spread ready for fine grading. Trailer site 1,000 feet from main site completely graded. Preliminary drawings and field engineering are in progress. Site MM--access road in and engineering in progress. Site D--bunkers in and shaped. Trailer site is graded and stabilization material hauled in. Site YY--trailer site cleared, no engineering other than site stakeout.

8. JOC Area: Area has been cleared. In process of restoring air conditioning unit . . .

(Ed. Note: No number 9 included in message.)

10. Fuel Farm: U.S. Marine's units are well along on fuel farms as planned. Two 300,000-gallon units are now going in near Boy Scout-Port area. Two 6,000-gallon units are being installed near U.K. farm at airport. We now have a JPK4 capability. Marines working 24 hours a day and are good . . .

(Ed. Note: No number 11 included in message.)

12. U.K. relations continue as excellent. Accounting systems have been discussed with Mr. Pitman, who is returning London with recommendations for simple arrangements.

13. Colonel Fackler of 8.4 has been most helpful in every way.

On that same day, the scientific trailers arrived. By March 15, 1962, a target raft mooring system had been agreed upon between Scripps and 8.3 and by March 26 the sea bottom survey on the south end of Christmas Island was complete. Thus, by early April the first target raft was in place. The raft was equipped with radar reflectors and beacon lights and also served as the anchor for a small balloon flown at about 1,200 feet to assist ground radar systems. (Some of the rafts survived some of the smaller shots. A picture of a raft in place is shown in Figure 14 and a raft after being exposed to a detonation in Figure 15.)

During March a pipeline was run from the deep sea mooring to the airfield to allow aircraft fuel transport. When the pipeline was first operated hardly anything came out of the far end except land crabs, but it was soon in satisfactory operation.

There were several requests for planned detonation altitudes, many of them incompatible. In order to obtain further calibrations on their long-range seismic and electromagnetic detection techniques, AFTAC requested that the height of burst of some 10 shots be varied between 1,200 feet and 12,000 feet. However, other criteria were more compelling. Because of the cloud layers and the operating height of the C-130s, the Laboratories wanted the burst at an altitude which would guarantee a clear

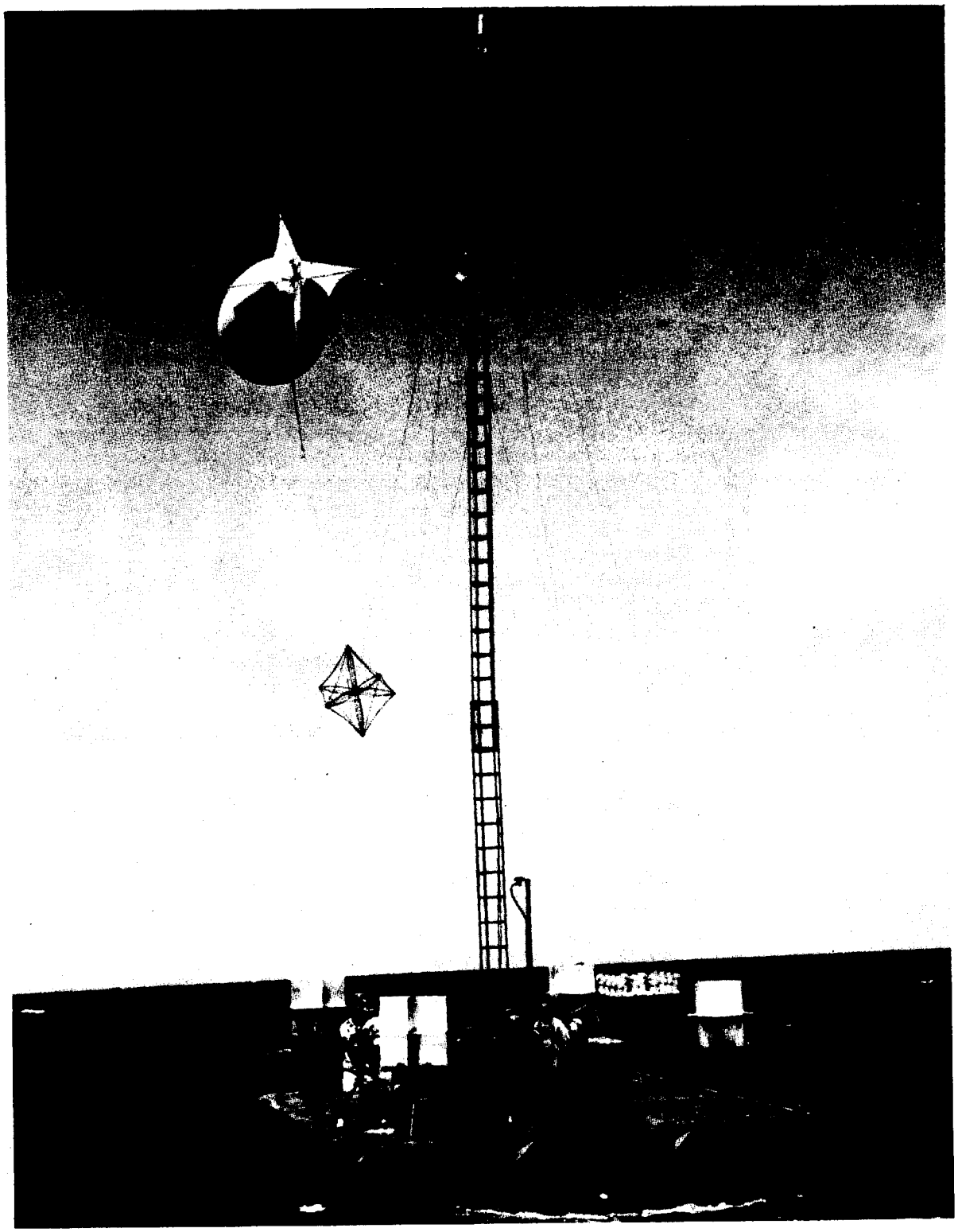

Figure 14.
A Christmas Island airdrop target raft, before detonation: the balloon was called a kytoon.

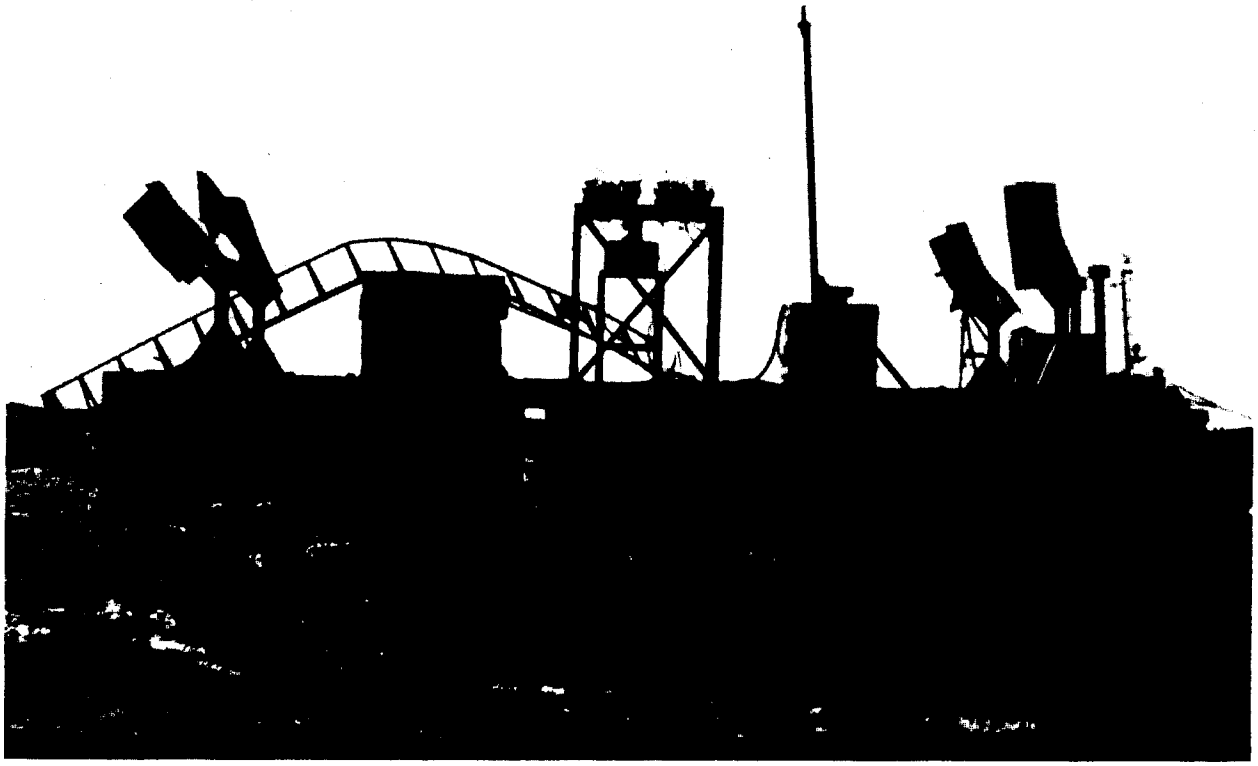

Figure 15.
A Christmas Island target raft after detonation.

line of sight from the ground at A site. The British were, however, concerned with the fallout question and suggested to Ogle use of the following rule:

$$\text{Height of burst} = 270(W)^{0.4} \text{ feet.}$$

On April 5 Jane Hall sent Ogle a message about the planned heights of burst stating:

> **We are concerned about rumors we hear that the heights of burst may be chosen without due regard to the primary purpose of the test, namely, to measure the total yield.**

Ogle answered on the 7th, giving the planned height of burst for the LASL shots (heights from 2,300 to 5,700 feet), and commenting, "Numbers may have to be changed slightly during operation because of joint fallout consideration between ourselves and the British; however, we will be careful to protect purposes of tests and get data. Don't get excited, I still love LASL best."

By mid-March the B-52 crews had had a number of practice flights from Kirtland AFB, and TG 8.4 was able to report that the crews were up to snuff.

By March 26 Colonel Hooper reported a total population of 1,816. Other items in his status report follow:

Telephones installed to date: 51 in JOC, 56 in Main Camp, 9 in Airport, 2 in Site A, 1 in Site Y. The 70-line exchange will be in operation in A Site by March 25. . . . U.S. mattresses and pillows distributed today in Main Camp. . . . Dining facilities have improved in overall efficiency and appearance. Midnight meals as well as odd hours' servings for air crews and work groups are provided. . . . Camp Store started in March 19 with limited items. Supplies expected by ship next Monday and ready for sale March 29. . . . Average water consumption has dropped the last three days; therefore, more water is available at this time. Distillation units should have pilot run at Main Camp Sunday. . . . Work at the scientific sites has progressed at a faster rate than other projects. Permanent power switchover for next Monday. Site Able permanent camp facilities now available for 200 trailers. Continuing initial shakedown. Satisfactory progress at other sites. Target positions are being checked out by Sandia radar. . . . Air conditioning not yet installed in weather central; therefore, all the electronic equipment cannot operate. Plan to complete by March 28. . . . Airfield: This is the most critical item at the present. Construction equipment difficulties have been encountered. H&N are airlifting additional equipment to include a motor patrol to meet taxiway and parking requirements. . . . Have taken 100,000 gallons aviation gas from tanker to Marine tanks. . . . Fifteen target rafts now moored inner harbor. . . . Medical: Have been informed that a 25th Division medical officer is available. Have requested that he be sent here. . . . Dr. Lee Aamodt's presence has been most beneficial. . . . I do not yet see a solution for latrines at airport and JOC. Shaw is working on this with H&N.

On March 22 Starbird felt the Task Force staff on Christmas was ready to make detailed operational plans, and he notified everyone that Lee Aamodt would be Acting Scientific Director at Christmas until the arrival of Ogle. On that same day Ogle sent Aamodt some suggestions on the height of burst for the first shot; tolerances on the target position; suggested operational communications, including TV reproduction of the Sandia plotting board at the JOC; muster and security-sweep items; etc.

At the last minute several other experiments were added. In late March AFSWC obtained permission to use their own B-57-B aircraft to determine the thermal effects of low-altitude nuclear detonations on aircraft. In addition, Guthals arranged for debris cloud pictures to be taken from the sampling B-57s until 2 hours after detonation. Finally, DASA requested approval to do the eyeburn experiments using monkeys and rabbits, which had been suggested for Operation Everready.

Ex.(b)(1)

[redacted]

The problems of protecting the natives on the island occupied an appreciable amount of time in late March, the initial decision being to build a fence 15 feet high behind which they could be placed so they could not see the initial detonation, thereby preventing eyeburn. Food and entertainment were to be furnished at shot time. In case of fallout, it was suggested that the natives be moved to their stone church at London.

Late in March the British representative, Air Vice Marshal McKinley, was convinced by Starbird to agree to the JTF-8 proposal that the danger area include Washington and Fanning Islands, for which there would be specific protective measures.

On April 3 Starbird and Ogle briefed the Governor of Hawaii on the forthcoming operation, assuring him that there was no problem to that territory. Subsequently they went to Christmas Island and established the Task Force Headquarters there, effective on April 4. Late in March TG 8.4 had moved to Hickam and the B-52 bombers moved to Barbers Point NAS. Practice drops of mock drop vehicles (shapes) were made on April 6, 7, and 8, 1962, and everything operated properly. However, on the 10th the first dry run occurred using all the appropriate electronics, beacons, fusing,

etc., (DRM No. 1), leading Ogle to comment in his notebook:

> The dry run on the 10th taught us a lot. The system for getting information from A Site to the Air Operations Center (AOC) was bad, to the Joint Operations Center (JOC) was impossible. The bomber and device beacons could not be picked up, part of the telemetering would not work, the bomber made his first run on a ship, etc. We aborted the first live run (9 a.m.) at minus 11 minutes, let him go on the second to minus 20 seconds, and then aborted and sent him home.

On April 13 the second practice run operated properly. The next dry run, on April 16, was moderately successful except that Sandia lost tracking and had to go to a pre-set position for the cameras, and that operated properly. Communications to the control room were still bad. Dry run No. 4 on April 19 was aborted because of weather (the practices were being done realistically), but it was completed successfully on April 21.

On April 19 Starbird received a message from Luedecke warning him that the Presidential announcement of the U.S. intention to return to testing was expected on the 24th of April: by the 23rd, with only a one-day notice, the system was ready. During the afternoon of April 24 Starbird received a message from Betts transmitting Presidential authority to begin testing.

To summarize the situation at Christmas Island at that point: Bombs were to be dropped on a target (see Figure 15) which was roughly 10 miles from a manned experimental station, the range depending upon the expected yield of the bomb. The station was instrumented jointly by LRL, LASL, EG&G, and Sandia to perform optical and electromagnetic time interval measurements, and to take fireball pictures. Fireball pictures were also taken from a second station. Electromagnetic time interval measurements were made from several points on the island. The same types of measurements were made from the C-130s based at Christmas Island. The Sandia radar continuously tracked the drop aircraft in its orbits and presented that information at A Site, the Headquarters for the technical organizations. Information on aircraft positions could be sent to the JOC either by solid wire from A Site or by radio from the RC-121 control aircraft. The air array positioned itself on the target raft. Sampling aircraft operated out of Christmas and samples were to be returned directly to the Mainland by special C-135 airlift. The aircraft inventory at Christmas Island on April 22 is shown in Table XXXVII.

Other parts of the system which were based in Hawaii consisted of B-52s operating from Barbers Point and the LASL optical KC-135 operating out of Hickam. The KC-135 had been obtained for high-altitude operations, but also carried out long-range optical detection experiments on a number of the Christmas Island tests. Lee Hollingsworth of Sandia, who had been put in charge of all weapons, was also based at Barbers Point, where a weapon assembly facility had been established. Livermore, LASL, and Sandia weapons experts were also based at Barbers Point.

The radiological safety organization set up under Gordon Jacks was based in Hawaii, but it was responsible for those activities at all sites.

Just before the tests started General Samuel had found it necessary to establish another Task Unit at Christmas, headed by Colonel Paul Fackler. Dan Rex had taken on the responsibility of putting together a weather and fallout prediction system on Christmas Island, and various members of the Ad Hoc Safety Panel (Orin Stopinski, Vay Shelton, etc.) were always present to assist in judgments about hazards on the shots. As agreed upon with the British, the final Safety Panel included Air Vice Marshal McKinley, whatever Deputy Commanders were present (all were there for the first shot), and the Task Unit Commander representing the Laboratory whose shot was being fired. The Safety Panel was chaired by the Scientific Deputy or, in his absence, his designated alternate (in general, either Aamodt or Goeckermann). The Laboratory Task

Unit Commander had final say on behalf of the sponsoring Laboratory, that is, he could always stop the shot, but he could not turn it on without agreement from the Safety Panel and the Task Force Commander.

TABLE XXXVII
AIRCRAFT ON CHRISTMAS ISLAND
April 22, 1962

Type	Number	Unit of Assignment
WB-50	5	55th WRS, McClellan AFB, California
B-57 B/C	11	1211th Test Sq., Kirtland AFB, New Mexico
B-57 D	6	1211th Test Sq., Kirtland AFB, New Mexico
B-57 B	2	Aeronautical Systems Division (USAF), Wright-Patterson AFB, Ohio
B-57 D	1	Hughes Aircraft
RC-121	2	52nd Airborne Early Warning & Control Wing, McClellan AFB, California
C-130	2	Stewart AFB, Tennessee
P2V	14	Navy
C-54	2	APCS
SC-54	2	Air Rescue Service
H-21	6	Stead AFB, Nevada
C-118	1	General Starbird
L-19	1	General Starbird

NOTE: B-52s and C-135s (sampler return) at NASBP.

The Jarvis, Baker, Howland Connection

Ex.(b)(1)

Ex.(b)(3)

[redacted] Within the Laboratory the choice quickly became either Jarvis Island or the Baker-Howland group. A search of the World War II records showed that it would be difficult to operate landing ships at Baker and Howland, which had been used as staging islands for aircraft going into the Pacific theater. The island had to be fairly large and have some moderately flat area for the very large experimental array planned.

As a result of the President's unhappiness about the number of shots Ex.(b)(1) Ex.(b)(1) there was an attempt to combine the Livermore (Sioux) vulnerability and effects experiments with the LASL shot. LASL also introduced into the experiment some vulnerability measurements. However, the basic experimental arrangement would consist of a multiplicity of long pipes fanning out in all directions from the device, each pipe fitted with appropriate neutron detection systems on the end (Phonex). LASL also planned to make close-in electromagnetic effects measurements on this shot.

On November 30 LASL asked the Task Force and the AEC to begin looking for an island, and suggested Jarvis as a first try. Colonel McMillan of the DMA test office met with representatives of the State and Interior Departments on December 11 to discuss the possible use of Jarvis, Baker, or Howland. Since the islands belonged to

the U.S. and were uninhabited, State had no concerns from a political point of view, but were concerned with the fallout hazard. The birds on Jarvis were mentioned, but without concern. The conclusion of the meeting was that DMA should send letters to both the State and Interior Departments describing the proposed uses of the islands, outlining the safety aspects, and requesting approval. The State and Interior Department representatives felt an affirmative answer would be forthcoming. On December 22 H&N began to estimate costs for the test preparation work on the island. After a bit more study DMA recommended the use of Baker, if possible, rather than Jarvis because of Interior Department information that there were about a million birds inhabiting Jarvis Island. On the other hand, Ogle and Starbird preferred Jarvis because it was closer to Christmas and sampling for a test done there would be possible using aircraft operating from Christmas. On December 27 Bradbury formally asked Betts to arrange for the Laboratory's use of Jarvis and to notify the Lab of the island's availability by the first of the year. On that same day Ogle and Starbird agreed on a danger area around the island, 250 by 400 miles on a side, with most of the area downwind.

The LASL operational concept as of early January 1962 was to occupy a camp on the island on the 1st of April, spend the next six weeks preparing scientific stations, evacuate the island on May 14, and fire on the 15th. Thus, H&N would have to deploy to the island, build a camp, and get heavy equipment there by April 1, only three months hence. A 10-ton crane, bulldozers, and other vehicles would be necessary, and somewhat more than 50 technical people would be on the island then. LASL requested a ship to hold some of their nine trailers, and, in addition, adequate ship-to-shore transportation. Since the fireball yield was desired, fireball camera stations would be built on the same island as far away as possible from ground zero. That requirement made Jarvis look a little better than Baker. If Baker were picked, sampling might be done by aircraft based at Canton Island, and if Jarvis were picked, sampling might be done by aircraft from Christmas, if we had use of it. If not, perhaps samples could be obtained by A4D aircraft operating from a Navy carrier, and Admiral Mustin was queried on that point. LASL requested that an LSD-sized channel be opened into Jarvis, and that, while waiting, any maps available, overhead photography, etc., be obtained. JTF-8 promptly asked CINCPAC to arrange for overhead photography of Jarvis and Baker Island, the results to be provided as soon as possible, and also requested that they plan an inspection trip to all three islands to begin on January 22.

On January 19 Secretary Udall informed Seaborg that Jarvis would be acceptable as a site. Although a large number of birds would be destroyed, there was no danger of extinction of any bird species. Udall concluded that the military necessities for the shots overrode the substantial wildlife losses.

The late January survey of Jarvis and Baker showed that appreciable blasting would be necessary to clear a boat channel into Jarvis, that the seas were very rough, and that nothing larger than an LCU would be feasible for putting equipment on Jarvis. Baker would take about the same effort, but the World War II airstrip could be made operational in about a week by ten men with some equipment. It was estimated that the number of birds on Baker was about one-tenth the number on Jarvis. By the end of January Starbird had indicated his unhappiness at using Jarvis, because of the birds, and had asked Farley of the State Department to investigate the possibility of using Canton Island for sampler aircraft operations and logistics backup. If that were feasible Baker might be a better choice than Jarvis, assuming we did not get authority to use Christmas Island. Since sovereignty over Canton was also contested between the Americans and the British, Farley thought it would be just about as difficult to arrange use of that island as it would be to use Christmas. By the end of January a complete experimental plan had been transmitted to those involved, the

logistics requirements were known, H&N was designing the construction required, and LASL was building the detector systems and other equipment needed for whichever site was selected.

On January 31 George W. Ball, Acting Secretary of State, stated there was no objection to the use of any of the three islands, provided precautions were taken to avoid hazards and fallout, but he did feel that it would be advisable to take any reasonable steps to minimize destruction of the birds. Upon their return, the survey team strongly recommended the use of Baker Island since, with a minimum amount of work, the beach at Baker could be usable for landing craft, not so many birds would be killed, and the airstrip could quickly be made operational. The requirement for fireball cameras was canceled after Livermore agreed that flying both C-130s on the Baker Island shot would provide sufficient fireball photographic data.

On February 6, 1962, Bradbury offered to forego the Baker Island shot in partial exchange for approval of the deep space shot, Urraca. Betts and Brown took him up on it, and the Baker shot was canceled (as was Urraca, later). The vulnerability and EM experiments were instead transferred to the NTS Smallboy shot.

Betts put it slight differently to the Commission. On February 7, 1962, the Commission Secretary, W. B. McCool, recorded:

> General Betts stated that the Los Alamos Scientific Laboratory had recently submitted a proposal for a 1,000- to 2,000-kilometer atmospheric test to replace a test previously proposed for Baker Island. The Chairman said that he was in accord with LASL's recommendation, although he would like the Department of Defense to concur in it. The Commission approved, after coordination with the DOD, planning for the 1,000- to 2,000-kilometer experiment.

The Navy had already gone ahead on procurement of the ship Monticello for support of the Baker Island operation, and the Air Force had indicated a need for 43 officers and 90 airmen at Canton in support of that effort. All of this was canceled on February 8, 1962.

Swordfish (ASROC Effects Test)

Ex.(b)(1) [redacted] Furthermore, it was initially planned for execution in the Atlantic, but now a Task Force had been formed. Thus, two changes had to be made by the Navy. One was to put together an entire effects program that would fit with the firing of the ASROC device, and the second was to decide what DOD organization would be responsible for the operational aspects. It did not take long to decide the relevant responsibility question. To Booth it was obvious that since ASROC had been redesignated as an effects test, it should now, by military rules, come under DASA, who were, in principle, in charge of effects experiments. Thus, Booth suggested to the Joint Chiefs of Staff on December 12, 1961, that ASROC responsibility should be assigned to JTF-8 under Chief, DASA. There were obvious difficulties because ASROC had been planned for the Atlantic and Starbird had made it clear that he did not wish to operate in two oceans. Starbird also told Booth that if the operation were conducted under JTF-8 it would not be under Field Command, DASA, but would be directly under JTF-8. The ASROC shot was assigned to JTF-8 on January 12, 1962, for incorporation into the Dominic series.

Since the test was now an effects test the Navy had to come up with an effects experiment test plan, which they did in just a little over two weeks, with appreciable assistance from the David Taylor Model Basin organization. By February 2, 1962, the Navy outlined the objectives of the experiment as follows:

Ex.(b)(1)

[redacted]

Ex.(b)(1)

[redacted]

On that same day DASA released funds to the organizations responsible for the Swordfish projects and started planning the measurements. The proposed date for the shot was May 1. On February 21 Mustin assumed operational technical cognizance of Swordfish and on March 3 he announced the formation of Task Unit 8.3.4, specifically assigning that group the mission of planning and coordinating the Swordfish test.

Since the operation would need facilities of the same type used for other portions of Dominic, the Task Force Headquarters initially planned that Swordfish be done near Christmas Island, somewhere in the danger area to be established for the airdrop operation, and they so announced on February 20. The President, on March 2, announced that testing would resume and on the same day Task Force 8 publicly announced its formation and mission, stating that the detonations would be carried out in the Johnston and Christmas Island danger areas. Three days later, Roger Revelle, who, as Science Advisor to the Secretary of the Interior, had been involved in many of the earlier Eniwetok/Bikini operations, wrote to the AEC expressing his concern about the test of the ASROC in the Christmas Island area and suggesting instead the Wigwam area off the coast of California. As background for the suggestion he noted that the Wigwam area had been studied extensively in the past from an oceanographic and biological standpoint with the result that "virtually no marine life of economic importance would be affected in the Wigwam area, and these conclusions were borne out by the observed distribution of radioactivity after the tests." (The Wigwam event occurred in 1955.) He also wrote: "On the other hand, the Christmas Island region is close to one of the most fertile areas in the ocean and is extensively used by Japanese fishermen."