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MEMORANDUM

TO: G. W. Johnson

FROM: Walter D. Gibbins

UCRL has a requirement for a suitable ship to be used in the firing and diagnosis of high yield nuclear devices at Taongi Atoll in Operation Hardtack, 1958, and in future operations. Considerable work has been done toward accumulating the necessary requirements to be fulfilled in the choice of such a ship. Several specific ships have been under consideration in obtaining the information necessary for us to arrive at a preference. The ships considered were:

1. Medium troop transport (Liberty type)
2. Hospital ship
3. Light cruiser
4. CVE or CVU (i.e., Cape Esperance)
5. AV-4 (USS Curtiss)

The above ships were considered in an attempt to fill two basic major requirements:

1. Sufficient cabin class quarters
2. Radar tracked armament mounts or stabilized platforms suitable for mounting the diagnostic equipment

The first two ships above were rejected because of insufficient clear elevated deck space in which to mount the radar positioned scientific equipment. Number three was rejected because of excessive size and future operating expense. The two remaining ships, a CVE or CVU type and an AV, the USS Curtiss specifically, were brought under closer scrutiny. The CVE type represents one extreme and the "Curtiss" the other, since the CVE's as presently fitted out, meet practically none of the requirements, while the USS "Curtiss" materially meets all of the needs.

It seems pertinent, therefore, to present our concepts of the operation of the diagnostics ship and those facilities and functions which she must house aboard. Since, from our viewpoint the field has narrowed down to a choice between items four and five above, it also seems pertinent to draw a comparison between the two to aid you in your decision on the basis of suitability and economy.

Concept Of Operation

It is our concept that the ship arrive off Taongi at the same time an LSD would arrive from Bikini, prior to the first shot. Aboard the

2689

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LSD would be the device loaded barge, two H&N LCM's and an LCU loaded with the barge moorings. At slack high water the LSD would discharge the LCU which would proceed through the Pokaakku Passage (widened to 70-100 yards) to the zero site at the north end of Taongi lagoon, and commence the task of placing the moorings for the first barge. The crew of the LCU would be messed and housed aboard the LCU during the one to two day period required for placing the moorings. During this time the LSD and experimental ship would lay to at sea in the leeward crescent of the atoll. Upon completion of the moorings, the LCU would return to the LSD and with the assistance of the two LCM's would proceed to warp the shot barge through the passage, tow it to the zero site and moor and position the barge in its final alignment.

Concurrent with the mooring and barge placement operations supported from the LSD, the experimental groups on the firing and diagnostic ship would make final preparations and would prove out equipment ready for dry runs. At this point the experimental equipment is in readiness and the weapons group would start their final preparations, having been transferred from the ship to the LSD by motor launch in order to board the shot barge prior to flooding down. The LCU and LCM's in turn would have returned into the LSD with their boat crews. On this final day, for purposes of final dry runs, the experimental ship would move to the position chosen for the shot, complete the dry runs, return to the passage entrance offshore, and receive the barge firing party from a ship's launch. Hoisting this last boat aboard constitutes final evacuation, leaving both the aforementioned ships free to move to their final safe shot positions.

Assuming the shot is then detonated early the next morning, the LSD would remain in her safe position while the experimental ship is moved to a suitable safe distance off shore. From this point an aerial rad-safe survey of the lagoon water would be made, both at small boat moorings at the southern end of the lagoon and in the vicinity of the crater. Upon determination that the radiation level at the small boat moorings would permit a mooring operation there, the LSD would discharge the LCU (with a new set of moorings aboard) and the two LCM's. The LSD would then sail for Nan to load and return the next shot barge, leaving the experimental ship laying to at Taongi in support of the next mooring placement operation. The radiation level in the crater proper probably will not drop to a safe working level as rapidly as the level in the southern lagoon. Thus the concept of the small craft being moored first as described to await clearance into the crater is to allow the earliest possible sailing time for the LSD.

In the above concept several points should be emphasized:

1. Deep water operations in the lee of the atoll can be delayed by rough weather and the use of LCU's and LCM's outside of the lagoon is kept to an absolute minimum in the above plan.

2690

2. It is not reasonable to accept the viewpoint that air support is essential from the zero site to the ships for the purpose of personnel transfer.

3. For safe operation, in the one or two personnel transfer trips which must be made, ships launches are safer than LCM's, LCPL's or LCVP's.

4. The first shot will broach the reef and will allow the LSD to anchor and discharge the second shot barge in quiet water.

5. It will be possible to hold small boat moorings in the southern lagoon except for perhaps the last shot.

6. The necessity for return of the experimental ship to Bikini or Eniwetok during the Taongi operation will be only on the basis of need other than personnel transfer.

7. The LSD can be utilized for the transfer of the very few personnel who may have to move between atolls. We are proceeding with our planning on the basis that from the technical standpoint the Taongi operation is to be as independent an operation as possible comprising two main units; the experimental ship and its complement and the LSD and its complement.

8. It is realized that other non-technical support will probably be deemed necessary at Taongi and this plan only encompasses our requirements.

As previously stated in UCRL report on the Taongi proposal, COL-57-11 dated 19 February 1957, it is preferred that the AEC fund for and procure a ship on a fairly long term basis. It is very desirable that the vessel be in AEC control, rather than U. S. Navy, in order to facilitate and expedite any present and future modification work. We wish very much to establish the viewpoint that this ship is representative of a large scientific station. Overall justification for the initial expense, for instance, can be compared to the combined cost of Stations 70, 2300, 1320, Fox Camp, and Station 2-308 at NTS. The combined total for the above stations, bare of scientific equipment from the H&N reports, is approximately $3,000,000. The functions performed in these facilities will all be aboard the experimental ship.

It is preferred that she be manned by a civilian complement with certain routine functions of operational services specifically designated as Holmes and Narver responsibility. We ask for H&N in the performance of the following service operations aboard because we deem it essential for basic morale to provide an equal standard of living to that of T.G. 7.1 at Parry Island.

2691

1. Laundry
2. Complete messing
3. Post Exchange
4. Post Office
5. Barber Shop
6. Bar
7. Library and reading room
8. Movies
9. Medical service
10. Snack Bar
11. Electricians (2-4 in support of diagnostics)
12. Carpenter (For diagnostic program support)
13. Welder
14. Mechanical maintenance men (2-4 in support of diagnostics)

In the interests of economy, it is advisable to maintain a skeleton maintenance crew aboard between operations but not supply the H&N functions during that interim.

We urge that the ship be made available in a San Francisco bay port facility by 1 July 1957. At this time we will start the job of modifications and, later, scientifc equipment installation. It is anticipated that the periods required in outfitting would be divided in three phases, each complete on the date as indicated:

PHASE I (1 July 57 to 1 November 57)

Basic Major Modifications

Installation of cabin spaces as required. Installation or modification of existing controllable mounts. Shipyard maintenance and dry docking. Installation of air conditioning as required.

PHASE II (1 December 57 to 15 February 58)

Instrument Installation

Mounting and wiring of diagnostic gear. Installation of diesel generated instrument power as required. Preliminary electrical check outs.

PHASE III (15 February 58 to 15 April 58)

Instrument Proof and Sea Trials

Final checks on scientific gear before sailing from Z.1. Chandlery period. Sea trials (2 or 3 one day runs) as necessary for final adjustment

2692

and proof of scientific gear and stabilized platforms. Transit time to E.P.G.

Phase I could be accomplished anywhere feasible on the U.S. Pacific Coast but it is preferable to accomplish this phase near Livermore, if practical, to expedite and coordinate diagnostic equipment design. Again, with the thought that the ship is an AEC scientific station, we request that Holmes and Narver assume the responsibility as an AEC contractor for the design and execution of the shipboard modifications necessary to fit her out for our purposes. This channel is established between Task Groups 7.1 and 7.5 and we wish to follow it in handling the ship modifications. The build up of civilian crew and some buildup of H&N personnel aboard can be accomplished, from our viewpoint, during Phases I, II and III. It is planned that only a few diagnostics personnel would make the trip from the Z.I. to EPG aboard the ship.

The technical requirements aboard also include the necessity for the installation of the firing racks, weather radar, release tone equipment and other items essential to the detonation of a nuclear device by radio. All of this equipment must be in an air conditioned space subject to both temperature and humidity control. Such equipment has been housed in a room with an area of 300 square feet. It is essential that this equipment be aboard the same ship as the diagnostic equipment for reasons of interlocking and close coordination with the diagnostics and weapons group representatives during firing.

The most important technical requirement comprises the clear deck area and its elevation above the water line in which diagnostic equipment can be mounted on stabilized platforms.

Designs of the scientific equipment are not yet finalized but certain design parameters are known. These parameters define the space fairly well.

1. A maximum of six stabilized platforms are required.
2. Weights to be carried on these platforms range from approximately 100 to 2,000 pounds.
3. All platform areas must be at least 20 feet above the waterline.
4. Two platform areas must be at least 60 feet above the waterline.
5. The axis of the equipment placed on these platforms must be stabilized in continual coincidence with a line of sight toward the zero site to an accuracy of ±30° divergence.

Considerable information has been gathered on the possibility of using radar tracked gun mounts for this purpose. Most, but not all, of the weight loads to be accommodated are compatible with placement on a 40 mm quad-mounting. We feel that at least one of the mounts should be larger than a 40 mm quad. The U. S. Navy at Mare Island has forwarded an estimate for the placement of a 40 mm twin mount on the flight deck of a CVE as follows:

All material to be government furnished.
Installation aboard C VE to include:

1 - 40 mm MK 1 Mod 2 Twin Gun Mount
1 - MK 63 Mod 6 Gun Director
2 - 30 VDC Generators
Total installation cost $47,000.00

By removal of the two 40 mm guns proper, a single stabilized platform could be mounted in their place although the load carrying capacity of this mount is somewhat less than the maximum required. The cost figure above is the only piece of information we have presently which indicates the cost of installation of such gear.

For purposes of support in aerial rad-safe surveys post shot, it will be necessary to include the capability for storage of two helicopters aboard. It is felt that complete maintenance capability is not necessary aboard the diagnostics ship and that such maintenance can be done at Nan when necessary. The 1 - 2 hour survey flight after each shot represents the only essential demand on helicopter support for the ship.

The ship must be equipped with communications essential to maintain close contact with other elements in the operation. This requires that most, if not all, of the TG 7.1 communications which were used on the TG 7.1 command ship during Operation Redwing, be installed.

Air conditioned laboratory space composed of approximately four dark rooms with a total of 1000 square feet of space is essential in support of group photographic requirements. This space is required to cover the needs of five photographic functions:

a. Fireball
b. Prompt diagnostics
c. Fast cameras
d. Documentary films
e. Rad - safe

These facilities must each be equipped with a temperature controlled fresh water supply.

In support of electronic instrument repair it is deemed necessary to provide 1000 square feet of combined shop and storage space. It is estimated 25% of this space would be storage. All of it must be air conditioned. There is also a requirement for non-air conditioned spare parts electronic storage space which is estimated to be an additional 1000 square feet of storage space.

An estimate of the office space required seems reasonable if placed at 10,000 square feet. This figure is arrived at by the summation of estimated minimum requirements which the various groups and agencies have occupied in the past operations aboard the TG 7.1 command vessel and at a single island camp. Included in this estimate is space for the following participants:

1. AEC
2. Holmes & Narver
3. T.G. 7.2 Security
4. UCRL Prompt Diagnostics
5. T.G. 7.1 Command
6. J.T.F. 7 Liaison
7. UCRL Fast Photo
8. UCRL A-Division
9. UCRL Operations
10. EG&G
11. Sandia Corporation
12. Rad-safe and Personnel Decon.
13. Conference Room
14. FCWT
15. MSTS

Most of the above list is composed of relatively small numbers of people in each group. Space for diagnostics film reading and data reduction is included in the above. It is recommended that all of the above space be air conditioned for personnel comfort.

We feel that cabin class quarters should be provided for all occupants in the above list. A rough estimate of the number of spaces required seems to be 150 at a minimum and errors of ommission will raise this figure. It is recommended that 175 comfortable air conditioned spaces be provided. Due to the confinement, length of stay aboard, the fact that the ship will be dead in the water, or at slow speed with minimum wind ventilation possible, we feel that personnel comfort should be assured by air conditioning the quarters.

The best estimate of machine shop space which can be given at this time is 400 square feet. This space would be occupied by light machine tools in support of the technical programs. It is separate from that required in maintenance of the ship and it is essential that this experimental shop space be fully air conditioned as a protection for the precision equipment against corrosion damage.

The most important basis for a comparison between a CVU (or CVE) and the USS Curtiss which can be applied as an aid in the proper final choice is to directly compare those characteristics which define the operating and maintenance liability to be assumed. It is also important to compare the two ships physically as now outfitted to obtain an initial cost ratio. Some of the characteristics of the two ships are in the following table:

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	CVU	CURTISS
DIMENSIONS		
1. Overall Length in Feet	512	527
2. Length Between Perpendiculars in Feet	490	508
3. Beam Over Plating in Feet	65	69
4. Extreme Beam in Feet	108	69
5. Mean Draft in Feet	19	20
6. Mean Displacement in Tons	8,500	8,200
PERFORMANCE		
7. Economy Speed in Knots	15	14
8. Fuel Consumption in Gals/Day (@Economy Speed)	22,000	18,000
9. Total Range in Naut. Miles (@Economy Speed)	11,000	27,000
10. Maximum Speed in Knots	17	16
U. S. NAVY COMPLEMENTS		
11. Officers	26	26
12. Enlisted Men	380	492
CHARACTERISTICS		
13. No. Evaporators	1	2
14. No. Screws	2	2
15. Fresh Water Production Gal/Day	20,000	40,000
16. Type Power	Steam Reciprocating	Steam Turbine
17. AC Power Generating Capability in K.W.	0	276
18. Present AC Consumption in K.W.	0	138
AUXILIARY EQUIPMENT		
Small Boats		
LCPL's	0	5
26' Motor Whaleboats	2	2
40' Motor Launch	0	1
24' Personnel Boats	0	3
50' Motor Launch	0	1
40' Barge (Temporary)	0	1
10' Punts	0	2
No. Cranes	0	2
Crane Capacity - Tons	0	30
TRACKED ARMAMENT		
5" - 38	0	2
40 mm Quads	0	5
OPERATING COSTS		
19. Annual maintenance & repair allotment	$350,000	$184,000
20. Fuel Cost per Steaming Day	$ 330	$ 270

Sources of above information: MSTS, Ships Officers, BuShips Plans.

~~CONFIDENTIAL~~

2696

Several comments are pertinent concerning the above data.

1. From an examination of the respective dimensions, it is seen that the two ships are roughly the same size. The Curtiss has a slightly larger hull, but less displacement. No heights above the water line are listed above but both ships can meet the elevation requirements necessary for the diagnostic gear. The Curtiss does have the slight advantage of small useful areas higher above the water.

2. The difference in economy speeds is probably of no great significance since the numbers are roughly the same.

3. The efficient power plant in the Curtiss is a great advantage from the standpoint of operating costs. Her power plant is newer and of modern design. This type of equipment is so general that location of reliable shipyard maintenance when needed is no problem. The greater economy in fuel is certainly a very important factor to consider.

4. The Curtiss has over twice the range of the CVU and is a factor to consider since it will certainly decrease the refuels by a large number. This characteristic must be taken into account not only for a single operation but on a long term basis also.

5. The ships officers on the Curtiss maintain that with their Redwing population aboard it was not necessary to curtail fresh water production but that it was necessary to enlist individual cooperation to assure fresh drinking water and showers for everyone. It is felt that the production capacity of a CVU is inadequate.

6. The 138 KW of AC power available on the Curtiss is an advantage since some of the scientific functions must be supplied separately from any instrument power which will be installed in either ship. Examples of needs which are in this category are the electronic shop and the AEC communications.

7. It is our opinion that the 3:4 ratio of U. S. Navy complement is not indicative of an advantage for the CVU. By the time the facilities necessary to support, house, and feed the scientific groups aboard a CVU are added it seems certain that the ratio will be 1:1. There are many more strictly navy functions now being performed aboard the Curtiss than the CVU at the present time. Examples of personnel which are not on the CVU are: Marines, signalmen, gunners mates, weather and intelligence personnel, etc. It is realized that the present plan would cut back the personnel on either ship drastically, and we feel that because of the larger number of navy functions, a greater percentage can be eliminated from the Curtiss. A very good proof of this is the present total number of personnel aboard each ship in the engine department. The CVU has 116 compared to 126 for the Curtiss. This is essentially a 1:1 ratio.

2697

8. The maintenance and repair allotment seems to bear out statements that have been made concerning the reliability as far as engines, piping, boilers, and auxiliaries are concerned. The CVU's were built during wartime on a very fast schedule. It has been stated that the original auxiliaries, boilers, and piping are not uniform and in some cases substandard.

9. As seen from the operational plan previously described, a great deal of importance must be attached to the small boat capability and the cranes which are available to lift them from the water. The larger launches and cranes aboard the Curtiss represent costs which will ensue with a choice of a CVU. The fact that two cranes are being added to the "Cape Esperance" now is a demonstration of continual need.

10. The armament and fire control system on the Curtiss is adequate, we believe, for this particular application. The 40 mm quad mounts, at present, are not connected into the MK 37 gun director but this is a matter of switchboard connections. The 5" 38 guns have been removed but are still held at Hunter's Point as part of the ship. If the same mounts were added to a CVU flight dexk we estimate the installation cost alone to be no less than $350,000.

Some general comments which can be made include the fact that the Atomic Energy Commission has a large investment in the Curtiss, and essentially all of this investment can be saved if the Curtiss is used. The changes that were made aboard her were in support of scientific groups and the facilities as now installed are most useful in support of this program. Both the firing racks and communications have already been installed several times on the Curtiss and can be reinstalled easily.

CONCLUSIONS

A. The Curtiss is justified on the basis of operating cost alone, as compared to a CVU.

B. The inclusion of outside ports on a CVU is not possible and would result in a real morale problem.

C. The facilities as installed on the Curtiss meet all the service operations needs.

D. Very few major modifications are needed on the Curtiss for the scientific needs.

RECOMMENDATIONS

1. It is strongly recommended that immediate action be taken to procure the Curtiss and preserve her great value to the AEC.

2. It is recommended that very careful consideration be given to the possibility of combining other requirements which may exist for other ship support aboard the Curtiss.

3. It is recommended that the acquisition agreement assure the use of the ship for a period of no less than six years and as free from U. S. Navy encumbrance as possible.

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