SECRET

MEMORANDUM TO THE SECRETARY:

From: Commandant

Subj: Loran Planning Study, USCG, 1963; transmittal of

1. The Department of Defense requirements for a high-accuracy, long range navigation system (LORAN) on a world-wide basis are coordinated with the Joint Chiefs of Staff and subsequently then promulgated by JCS in a document entitled "LORAN INSTALLATION PLAN (year)." This document is periodically updated and revised. The Coast Guard, in accordance with 14 USC 61, establishes and operates Loran stations to meet Department of Defense requirements.

2. Based upon many years of operation of LORAN, the Coast Guard is generally recognized as an expert in this field. Advice relating to development, capability, limitations and operation of the system is offered as guidance to the Department of Defense to assist in the planning of its requirements. Accordingly, it is necessary periodically for the Coast Guard to develop a study, or analysis, of present and future capabilities of the system, together with suggested general objectives, procedures and policies. An estimate of ultimate LORAN requirements, and comments relative to possible future development of other Long Range Navigation Systems is included. The attached LORAN PLANNING STUDY, USCG, 1963 serves that purpose.

3. In order to facilitate Department of Defense review of the attached LORAN PLANNING STUDY, USCG, 1963, and its incorporation into DOD documents, the study has been prepared in DOD format.

4. It is recommended that the enclosed LORAN PLANNING STUDY, USCG, 1963 be approved, and that the letter of transmittal addressed to the Secretary of Defense be signed.

D. McG. MORRISON
Acting

Encl: (1) Secretary of Treasury ltr to the Department of Defense

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23149 TREAS., USCG, WASH., D.C.
SECRET

AUG 22 1963

Dear Mr. Secretary:

As you know, the Joint Chiefs of Staff LORAN Installation Plan, 1961, sets forth the requirements of the Department of Defense for the establishment of LORAN stations to meet military requirements. Periodically the Plan is reviewed and revised to indicate changing and newly established requirements.

The attached LORAN Planning Study, USCG, 1963, is the result of current Coast Guard analysis and study. It is offered to the Department of Defense for use in the determination of future LORAN requirements.

The study indicates that development of other navigation systems such as OMEGA and TRANSIT may have significant effects on LORAN planning in the next few years, and that it is desirable to consider these systems in the current revision of the LORAN Installation Plan, 1961.

As has been the practice in the past, it is recommended that funds for construction of LORAN stations be provided by the Department of Defense.

The Commandant, United States Coast Guard is authorized to communicate directly with the Chief of Naval Operations and Chief of Staff, United States Air Force for such operations, logistics and engineering assistance as can be made available by those services.

Sincerely,

(Signed) James Pomeroy Hendrick

James Pomeroy Hendrick
Acting Assistant Secretary of the Treasury

The Honorable
Robert S. McNamara
Secretary of Defense
Washington 25, D.C.
Enclosure

Retyped: rab 8/22/63
LORAN PLANNING STUDY

U.S. C.G. 1963
SECRET

LORAN PLANNING STUDY, USCG, 1963

PROBLEM

1. To provide a current basis for the planning and management of the Loran programs, to indicate the relation of Loran with other navigation systems, to outline areas of program responsibility for the Coast Guard and the Department of Defense, to present the navigational service areas presently in existence and to estimate ultimate Loran requirements.

Facts Bearing on the Problem

2. Loran-A is a medium range, general purpose navigation system operating in the 2 Mc/s frequency band. It is widely used by military and commercial ships and aircraft. The number of existing stations and associated coverage is shown in the attached booklet entitled "LORAN STUDY, 1962", Enclosure (1).

3. Loran-C is a long range, high accuracy navigation system operating in the 90 - 110 kc/s band. Loran-C is used where precise information is required for surface and subsurface navigation or survey such as is required for the Polaris program. The existing stations and associated coverage are shown in the booklet "LORAN STUDY, 1962."

4. Omega is a long range, general purpose navigation system operating in the 10 - 11 kc/s frequency band. Omega is currently in the development and experimental stage and has not been declared operational. Omega is theoretically capable of providing worldwide coverage for general navigational use.

5. Satellite Navigation Systems. "Transit" is a high accuracy artificial satellite navigation system operating in and above the very high frequency (VHF) band. Transit has a limited use at the present time because of the complexity and cost of user equipment and lack of operational satellites. In its present form, it is capable of being used for precise surface navigation or as a survey system where time lapsed between fixes can be tolerated. Considerable development and implementation will be required to allow Transit to be used as a general navigation system. No other developments have been undertaken in satellite navigation although a number of suggestions have been offered, and NASA is studying the problem.

6. The United States National Policy on long distance aids to navigation is "inter alia, to promote as a continuing goal, national and international standardization of a single type ground-based long distance radio aid to navigation suited to the needs of all users."

**** ACC Paper 58/12.1E dated 30 December 1958

DECLASSIFIED AUTHORITY: NND 978.245
By: NARA. Date: 7/4/91

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY
DECLASSIFIED. DOD 51R 5200.10
(air, surface, and subsurface); in the meantime, to standardize on the minimum number of types of aids necessary to meet the requirements of the various users."

7. The Military Policy on long distance aids, pending standardization on a single system, is to continue operation and expansion of LORAN-A, non-directional radio beacons, and LORAN-C. Of the systems thus far developed the Department of Defense (DOD) has endorsed** LORAN-C as the most promising candidate for international adoption and has recommended LORAN-C as the national long distance radio aid to navigation in the frequency band 90 - 110 kc/s.

8. The Secretary of Defense has concurred*** in USCG Loran Planning Study, 1960, which had the following objectives:

   a. As an interim objective selected LORAN-A and LORAN-C stations will be arranged so that both LORAN-A and LORAN-C data are transmitted from the same station. These changes will take place as new requirements develop or as major maintenance and rehabilitation becomes necessary. This will minimize the total Loran facilities required and can be accomplished without critical reduction of LORAN-A coverage. The extensive coverage capability of LORAN-C will supplement those areas where minor reduction of LORAN-A is expected.

   b. The final objective will be the phasing out of the LORAN-A transmissions from dual LORAN A/C stations as LORAN-C receivers come into general use.

9. The LORAN INSTALLATION PLAN 1961, as amended, is the basis for current implementation of the Coast Guard Loran Construction Program.

10. Responsibility for implementation and operation of the Loran system is shared between the Coast Guard (under 14 USC 61) and the Department of Defense as follows:

   a. The Department of Defense budgets for all costs involved in implementation of the Loran Installation Plan.

   b. The Coast Guard, with DOD funding is responsible for execution of the program as defined by the Loran Installation Plan. This funding provides for development and procurement of Loran Transmitting equipment, including spares; necessary personnel build-up; station construction and logistic support related thereto; monitor stations and other ancillary facilities; initial test operation of the new station; system area calibration; system improvements and other incidental costs related to execution of the plan.

   c. The Coast Guard budgets for all operational, maintenance and support costs subsequent to the operational date of the station.
d. The Coast Guard is authorized (14 USC 81) to establish, maintain and operate Loran stations required to serve the needs of the Armed Forces of the United States.

e. The Department of Defense is responsible for development of user equipment for military application including special security measures, and other ancillary equipment and systems.

f. The Coast Guard has responsibility for radio frequency coordination and clearances as are required for Loran operation. In this task the Coast Guard has and must continue to receive support from the Departments of Defense and State.

g. Negotiations for Base Rights are a joint DOD/USA and State Department responsibility, with Coast Guard providing such technical assistance as may be required to facilitate proceedings.

11. Installation of Loran-C stations in countries other than the United States or its territories has been accomplished by use of vigorous advertising of the commercial user aspects of the system, specifically use of Loran A/C receivers and less sophisticated Loran-C equipment.

12. Ancillary uses of Loran-C include:

a. Transmission of time signals with microsecond accuracy

b. Nuclear detonation detection (ASTRE) synchronization

c. Civil Defense warning

d. Data Transmission (Communications)

e. Ionospheric propagation studies

13. Personnel problems are currently requiring the Coast Guard to consider utilizing contract civilians to man and operate isolated Loran stations. The item of major concern is the high percentage of isolated duty for electronics technicians and heavy continuing workload on the Electronic Engineering Force.

14. The Coast Guard has prepared a booklet "LORAN STUDY, 1962," which is enclosure 1.
15. One of the objectives in the Loran Installation Plan is concurrent transmission of LORAN-A and LORAN-C signals from the same site. This plan would provide for gradual phase-out of LORAN-A as its coverage areas are replaced by LORAN-C. New developments and testing of the CHATHA and Satellite systems may, within five years, yield results which will enable a better decision to be made concerning the phasing out of Loran systems. Since CHATHA is planned to provide worldwide navigation coverage with few stations, it is conceivable a replacement for LORAN-A. The system is still under development and, therefore, its capability to meet the requirements has yet to be proved.

16. LORAN-C has been proven as a high accuracy, long range, ground wave system capable of providing survey accuracy in some applications, and within the ground wave area, accuracy sufficient to satisfy the + 1/2 nautical mile Polaris requirement. LORAN-C permits navigation fixing with reduced accuracy using skywave reception. Investigations to date of LORAN-C skywave capabilities have been very limited. Thorough investigation of this area of interest is essential. The Coast Guard has commenced these studies on a relatively small scale.

17. In order to gain entry into foreign countries for essential LORAN-C site acquisition, a vigorous campaign has been utilized by the Coast Guard and the Department of State to sell the commercial utility of LORAN-C with either a "simple" LORAN A/C converter or an "inexpensive" LORAN-C receiver. Within its stringent operating expense budget, the Coast Guard has been able to accomplish only extremely limited development in this area. Unless the United States is able to demonstrate claims of the commercial utility of LORAN-C, the argument of mutual benefit from commercial application cannot be expected to gain entry in certain critical areas where future LORAN-C expansion is planned. Recent evaluation of LORAN A/C converter type receivers indicates that the cost of such a receiver may exceed the cost of a simple or inexpensive LORAN-C receiver.

18. For purposes of radio frequency spectrum allocation planning, it is necessary to consider frequency requirements for satellite systems, LORAN-A, LORAN-C and CHATHA. It appears that:

a. VHF and UHF frequency allocations must be obtained and protected for future implementation and use by Satellite navigation systems.
b. Existing allocations for LORAN-A in the 1.8 to 2.0 Mc/s band must continue to be protected until LORAN-A may be replaced by a suitable system.

c. Allocations for LORAN-C in the 90 to 110 kc/s band must be protected and promoted since LORAN-C appears to be the system most promising for international adoption in the 90-110 kc/s band.

d. The 10 - 11 mc/s band has been allocated internationally for radio-navigation system use. OMEGA or a comparable system should be planned for this frequency band.

19. The necessary massive commitment of Coast Guard technical personnel, both officers and enlisted man, is placing an increasingly serious burden on Coast Guard electronic and other phases of operational maintenance. In order to reduce this burden it appears desirable to increase Host Nation manning of Loran stations where such operation is feasible. In certain areas where U. S. manning is necessary, it may be necessary to employ contract personnel for station manning with a Coast Guard commanding officer. In all cases where either of these alternatives are utilized, the Coast Guard will maintain an essential Officer Liaison to assure that system operating parameters are maintained.

20. If Loran signals are utilized exclusively for purposes other than those defined in Title 14 USC 81 (military or civil navigation service), the Coast Guard could undertake programmed construction and operation of required facilities only on a reimbursable basis. Under this category are stations for time transmissions, alerting, or such other ancillary uses.

21. Department of Defense plans and objectives in the field of long range navigation have a profound effect on policies and planning by other agencies such as the FAA. In order to provide coherent national planning in these areas, the FAA should be made privy to DOD long range navigation plans.

CONCLUSIONS

22. It is concluded that:

a. Enclosure 1 reflects a realistic estimate of Loran implementation to meet DOG requirements.

b. The implementation of the concept of transmission of LORAN-A and LORAN-C signals from the same site as an interim step in replacement of LORAN-A by LORAN-C should be deferred until development of OMEGA and Satellite systems allows a more realistic decision to be made in regard to replacement of LORAN-A. However, when new LORAN-C facilities are being
sited in areas where LORAN-A stations already exist, collocations will be made when significant savings in personnel and logistics costs can be realized without significantly altering either LORAN-A or LORAN-C coverage. Collocations should therefore be made on the basis of economic justification alone, without regard to replacement of LORAN-A by LORAN-C or, at present, any other system.

c. Emphasis on development must be shifted from a suitable A/C converter to an inexpensive LORAN-C receiver, and the Coast Guard should be authorized to undertake this development with DOD funding.

d. The U.S. National policy should be modified to recognize LORAN-C as the most likely candidate to achieve international acceptance in the 90 - 110 kc/s band, and that OMEGA or another comparable system could eventually be accepted in the 10 - 14 kc/s band.

e. The Coast Guard should be authorized to utilize DOD funding for investigation of LORAN-C skywave phenomena and capabilities.

f. The Coast Guard should be authorized to utilize contractor personnel if required for overseas manning of Loran stations.

g. Military requirements for LORAN-A be re-examined with a view to phasing-out LORAN-A in areas of pure military requirements.

RECOMMENDATIONS

23. It is recommended that:

a. The above conclusions be approved.

b. Enclosure 1, "LORAN STUDY 1962" be considered in development of the JCS Loran Installation Plan, 1963.

c. Existing general program policies and procedures regarding responsibility for the LORAN-C program be continued.

d. The Department of Defense provide additional funding for Coast Guard investigation and development of the following:

   (1) Prototypes of inexpensive LORAN-C receivers for general purpose navigation.

   (2) Investigation of LORAN-C skywave phenomena and applicability for general navigation.

   (3) LORAN-C system development for ancillary applications such as timing, communications, attack alarm, and coverage and performance improvement.

   e. The Department of Defense policy be modified to provide for promotion of the Omega, or a comparable system as the U.S. candidate for international acceptance in the 10 - 14 kc/s band.
f. The FAA be furnished with a copy of LORAN STUDY, 1962, and that the FAA be kept current in regard to navigation programs for which DOD funding has been allocated or is planned.

g. A review of overall navigation system requirements be scheduled for the 1964 Review of the Loran Installation Plan.
PHASING TO LORAN-C

Long-baseline LORAN-A (synp by LORAN-C) is no longer firmly held as a practical concept. L/S allocations are planned on the basis of convenience for logistic and economy in personnel, maintenance, support and administration. Elimination of LORAN-A coverage and phasing to LORAN-C must be based on coordination with user groups and cessation of LORAN-A service wherever it can be accepted.

Analytically, it is probable that user demand will dictate the course to be followed. Wherever US civil-maritime commerce is entitled to US Coast Guard navigation services, LORAN-A will continue to serve, as have radiaisons.

It is therefore understood that withdrawal of the US military requirement for LORAN-A will not of itself constitute license to secure LORAN-A service.

LORAN-A is currently the only medium to long range system which is sufficiently deployed and for which sufficient equipment has been produced so that user cost is comparatively minimal. Other survey or radio navigation systems are either still in development or are either range or cost limited. US civil maritime commerce, air carriers, and many foreign civil maritime interests are users of LORAN-A either in whole or in part.

LORAN-C must also be considered not only in the light of the urgent military requirement it serves but also in its other uses. At present, this system is used or planned for use in:

a. Worldwide precise time transmission

b. Ionospheric behavior studies

c. Nuclear detection detection and positioning using LORAN-C timing information

d. Civil Defense alerting

e. Data transmission

f. Navigation in the skywave reception area

g. Oceanographic studies, as a survey tool
The growing awareness of the scientific community is not only the capabilities of LORAN-C but also the spreading network of stations available cause projects to be undertaken which were hitherto impossible. This, of course, constitutes a source of pressure for continued deployment of LORAN-C regardless of the fate of LORAN-A.

A distinct possibility exists that Coast Guard will be operating both LORAN-A and LORAN-C for many years to come, with firm commitments at present for 69 transmitting stations entirely Coast Guard manned, and a possibility of as many as 89 stations.

Since LORAN-C can serve not only scientific and other needs but also certain long-range radio navigation requirements of civil maritime (and air) users in specific areas, phasing-out of LORAN-A in those areas should be investigated. Civil use of LORAN-C can be furthered by:

a. Development of low-cost LORAN-C user equipment, including automatic readout in lat-long and course/distance to go, for specific needs.

b. Thorough investigation of the LORAN-C skywave coverage area for navigation.

Expansion of LORAN-C networks will require:

a. Rate deployment studies, to determine the practical limit to the number of stations that can transmit without mutual interference.

b. Antenna design investigation, to supplant large towers with another configuration, if possible.

c. Short-baseline LORAN-C for coastal use, in low power operation.

d. “Portable” ground stations for Aids to Navigation work offshore.

e. Maritime or emergency service requirements of military and/or civil users.

Tabulated below are various areas with the number of LORAN-A and LORAN-C stations required to provide at least equivalent service.
Fix coverage provided by LORAN-C with the number of stations indicated is almost three times that provided by the enumerated LORAN-A stations.

The impact of other systems such as CHAPPA and TRANSIT on the Loran program should be assessed. On a cursory basis, it appears that there are few if any valid general navigation requirements for high accuracy in broad ocean areas, and that a general coverage system will satisfy such requirements as do exist. It appears that the system to meet general navigation coverage requirements worldwide might be CHAPPA. In other than the purely military application, implementation of LORAN-C should therefore be based on coordinated requirements of not only navigational users but also several other groups interested in and dependent upon the system.

The Loran Study 1962 provides a preliminary basis for orderly planning taking into account insofar as they are known:

a. Navigation routes

b. Military & scientific requirements

c. Time transmission, alerting and data transmission
DISCUSSION OF DIAGRAMS

LOGAN STUDY — 1962

Enclosure (1), Logan Study 1962, provides, in diagram form, certain pertinent facts concerning LOGAN-A and LOGAN-C. No mention is made of LOGAN-B, since the system is not under current review and is available for specific applications only. Further development of LOGAN-B may be attempted if a valid requirement is stated for a short range high-precision survey system of this type. Although there are several newer navigation systems in various stages of development, none of these new systems has been evaluated in sufficient detail to allow reliable estimate to be made of their impact on the future of Logan navigation systems. These systems, therefore, have not been included in this discussion.

Sheet 1: Depicts the basic technique of obtaining a position with a hyperbolic navigation system.

Sheet 2: Shows and explains briefly the time-difference measurement technique employed in the three Loran systems.

Sheet 3: Shows in tabular form approximate system parameters for LOGAN-A and LOGAN-C. Note particularly not only greater baseline lengths of LOGAN-C but also more constant day and night coverage and higher accuracy.

Sheet 4: Depicts in generalised form attenuation characteristics and coverage realized in LOGAN-A and LOGAN-C. No radiated powers are indicated since this is a generalised presentation.

Sheet 5: Indicates also in generalised form electromagnetic noise areas of the world. These noise areas are important in Loran planning since high noise will make shorter baselines necessary for reliable user service. Man-made electromagnetic noise is also an extremely important consideration in Loran Coverage Planning. Generalized diagrammatic presentation of man-made noise is extremely difficult and therefore no such diagram has been included. As a practical matter, frequency allocation and management are the subjects of separate study for each individual station.

Sheet 6: Shows major air and sea routes of civil commerce. As a civil aid, Loran must be sited to cover these routes. If LOGAN-C supplants LOGAN-A, emphasis must be given to major traffic routes, and coordination must be comprehensive in order to give users ample opportunity to change to new equipment without excessive difficulty and cost.

Sheet 7: Shows ground wave fix coverage from existing LOGAN-A stations. The two standby NATO chains in the UK, France and Spain are not presently available for peacetime commercial use.
Sheet 9: Shows the LOHAN-A system as planned for FY 1964.
Transmission of LOHAN-A and LOHAN-C from the same site has been dis-
continued as a general concept since fix coverage available on the
extended LOHAN-A baselines is not considered to be worth the cost of
additional equipment required by this technique. Collection of
LOHAN-A and C stations will be continued where it represents a saving
in construction and operating costs, and where there is no degradation
of service either the A or the C systems. Note the Azores NATO CHAIN,
which is expected to be operational for peacetime use. Note also
disestablishment of Junan, Korea, and establishment of the Okinawa-
Kikai Jima sites to fill most of the coverage lost. French Frigate
Shanks is shown as being disestablished, but will be continued in service.

Also shown is the relocation of Spruce Cape to Sitkinak (Alaska).
This collection will not be made, being impractical and uneconomical.
Extension on the West Coast, USA, at Camp Pendleton (San Mateo Point)
is shown, but addition of a station in Mexico (Cabo de los Angeles or
Ensenada, California) is not. Complete US West Coast LOHAN-A fix coverage
cannot be obtained without such a site.

Additional stations are also shown in the Caribbean and Gulf of
Mexico. The trial covering the eastern Panama Canal approaches is
part of a JSS Loran A/C 1966 requirement. In addition, the Gulf of
Mexico complex has been a civil maritime requirement for several years.
If implemented, coverage would be as shown. A common station between
East and West Gulf chains is considered feasible, therefore the existing
Miami station will be disestablished, and a new station in the western
Louisiana Delta area will be built for operation in both the West Gulf
and East Gulf chains.

Not shown are such projects as the possible relocation of Folly
Island due to beach erosion or the rehabilitation of stations made
mandatory by the needs of time and technological necessity.

Sheet 10: Shows LOHAN-C ground and airborne single rate fix
coverage now either available or actually in the implementation phase.
This sheet depicts coverage available by mid-1964. All stations shown
are expected to be operational by 1 January 1965, except for Yap. In
this coverage, 11 stations are LOHAN A/C stations, 20 are Coast Guard
named. Of the 20 Coast Guard named stations, one (1) at Sylt, Germany
and one (1) at Tokechibito, Okinawa may eventually be host-nation
operated.

Sheet 11: Depicts single rate ground wave LOHAN-C fix coverage
which would be available from 65 stations. Solid baselines represent
film JSS planning. While hopefully some of the 7 additional stations
that are firmly planned might be host nation operated, present planning envisions Coast Guard manning. Of the seven, three might be manned by Portugal and one by Canada.

Indian Ocean coverage is shown since a Navy requirement may develop.

Philippine stations (Taruypiteo and Catanduanes) are shown in the event a now-cancelled Navy requirement is restated.

Southward extension of the Hawaiian Chain (Howland) and westward linking of Hawaiian and Northwest Pacific chains (Wake, Eniwetak or Kwajalein) may be required by the Pacific Missile Range (PMR) for positioning of range vessels and accurate time distribution. Manning would hopefully be by PMR or a contractor, with Coast Guard technical liaison and guidance only.

The chains down the West Coast of North America from Sitkisanak, Alaska to Guadalupe (via Sitka area, Pacific NW, California (inland)), represent a feasible configuration to provide LORAN-C coverage to US civil users where LORAN-A service is now given. Of the four sites, three could probably be A/C stations. This would have to be a Coast Guard project, on a phased basis. Canada might man the Pacific Northwest station.

Mid-continent US stations (Colorado, Kentucky) reflect a pending USAF requirement for timing and/or a Defense Communication Agency and Office of Civil Defense requirement for communication and civil defense alerting. If implemented, manning could be USCG or USAF (contractor). Stations could be linked at either Brownsville, Texas or to the Louisiana Delta station to provide CONUS LORAN-C navigation coverage. Legs from the California station to Colorado and Cape Fear, N.C., to Kentucky complete CONUS coverage.

Gulf of Mexico coverage can be provided by a triad from Brownsville via Delta to Jupiter (or Cape San Blas). This would also be a Coast Guard project unless a DOD requirement develops.

The series of stations from Puerto Rico along Northwestern South America and into the Atlantic represents a part of a possible Atlantic Missile Range timing and positioning network (9 stations of 18 probably required are shown) which would be, as in the Pacific for PMR, contractor operated with Coast Guard technical liaison and guidance only.

Links between Nantucket and Newfoundland and the southward extension of the Azores chain would likely be CHG operational requirements (2 additional stations), and while one (1) might be host-nation operated (Canada) the others would probably be US manned.
The three Arctic stations might be required by SAC, and would probably be Coast Guard manned or contract manned with USCG control.

In summary, the 65 station plan breaks down as follows:

a. 25 stations operational or under construction, of these, 11 are A/C, a maximum of 7 may be host nation operated.

b. Of the remaining 40 stations, 18 would be Coast Guard manned, 19 would be manned by other services, contractor or host nation and 12 are A/C stations.

Sheet 12: Shows dual rate (requiring two receivers or a special two rate receiver) and skywave fix coverage from 62 LORAN-C stations.

Sheet 13: Shows Arctic coverage if Polar stations are built for SAC.

Sheet 14: Provides a key to station names and skeletal planning.