F 2578

HEADQUARTERS
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
LAURENCE G. HANSCOM FIELD BEDFORD, MASSACHUSETTS

REPLY TO ATTN OF: ESSH/271-3729

25 September 1962

SUBJECT: Mid-Continent LORAN "C" Installation

TO: Commandant (EEE)
U.S. Coast Guard
Washington 25, D. C.

1. In performing our function as the System Program Office (ESD) for the USAF 477L (Nuclear Detonation Detection and Reporting System), we are investigating the implementation of a nationwide time synchronization system which has time simultaneity capabilities of better than 5 microseconds. This synchronization accuracy is necessary to enable our system to locate, with the required accuracy, a nuclear event occurring within the Continental United States utilizing inverse LORAN techniques.

2. Investigations conducted by USAF and MITRE Corporation personnel have indicated that the LORAN "C" system is ideal for accurate time dissemination if synchronized signals can be provided to the Western part of the 477L coverage area. In discussions with U.S.C.G. and N.B.S. personnel the necessity for establishing an experimental mid-continent LORAN "C" timing station to verify coverage versus position and radiated power, to obtain data on the sky wave from the East Coast chain, to obtain time synchronization data, etc., has become clear. The basis for this experimental station would be as outlined below.

3. The station is to be locked in time and frequency to the received ground wave from the East Coast chain and is to be operated on a 40-hour week basis as required by the experimental program; is to be on the air as an experimental timing station for one year; is to use commercial telephone service for communications, and is to use commercial power. It is desired that the station site be on land presently owned by the government and have a high probability of being both a satisfactory site for an operational mid-continent station and for a station that may be put to navigational or other uses.

4. To proceed further with our planning, we would like to request information from the Coast Guard on the following points regarding the experimental timing station:

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a. Can the Coast Guard loan USAF new equipment for this station, the equipment to be either replaced or returned at the end of the experimental period, depending on whether or not an operational station is to be put in?

b. What equipment, in addition to that covered in a, above, is necessary to put the timing station on the air?

c. Can the Coast Guard supervise and manage planning and construction of the station including such items as contractor selections, frequency registration, site location?

d. Can the Coast Guard man the station during the experimental period?

e. What are the estimated costs which will be incurred in putting the station on the air (in view of answers to questions a & b?) This question is intended to include construction, antenna erection, ground plane installation, calibration, etc.

f. Can the problem of working the timing station pulse train into the East Coast chain repetition rate be solved?

g. What are the estimated operating costs for this station?

h. What experiments would the Coast Guard wish to include in the experimental program and to what extent would the Coast Guard wish to participate in the experimental program?

i. Would the following schedule, based on a 1 December 1962 go-ahead, be satisfactory for this project?

(1) Experimental station on the air - 1 May 1963 (target)

(2) Experimental period - 1 May 1963 - 1 May 1964

(3) Initial Planning final station - 1 Jan 1964

(4) Final station go ahead - 1 May 1964

(5) Final station operational - 1 Jan 1965 (target)

(Experimental station to be retrofitted and altered as necessary 1 May 1964 to 1 Jan 1965).

5. We appreciate very much the assistance you have already given us and are looking forward to working closely with you in the future.

ELMER D JONES, Jr, Col, USAF
System Program Director, 477L SPO
Deputy for Systems Management

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XEE-4
Serial No. 04482XEE
15 OCT 1962

CONFIDENTIAL

From: Commandant
To: Headquarters
Electronic Systems Division
Air Force Systems Command
United States Air Force
Bedford, Massachusetts

Subj: Mid-Continent Loran-C Installation

Ref: (a) Headquarters, Electronic Systems Division ltr of 25 Sept. 1962

1. Reference (a) states that time signal dissemination is desired from subject station, and indicates that the station can provide signals over the Western Part of the 4TTL coverage area.

2. From preliminary discussions with MITRE Corporation and the National Bureau of Standards, it was understood that coverage was desired over the Western Portion of the United States. Current planning in response to reference (a) is being accomplished on the basis of an experimental single low power mid-continental installation.

3. In order to coordinate present and anticipated requirements, it is requested that your overall coverage requirements for time dissemination be furnished.

COMMUNICATIONS								
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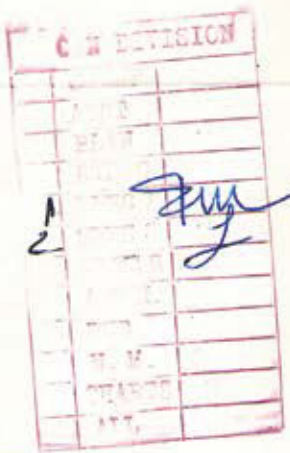
PROPOSED 477L SENSOR SITES

P-46	Blaine, Washington
P-33	Klamath, California
P-2	Cambria, California
P-76	Mt. Laguna, California
P-47	Hutchinson, Kansas
P-79B	Van Vleck, Texas
P-19	Antigo, Wisconsin
P-70	Bellville, Illinois
P-56	Cape Charles, Virginia
P-30	Benton, Pennsylvania
M-93	Winslow, Arizona
M-99	Gettysburg, S. Dakota
M-125	England, Louisiana
M-114	Jacksonville, Florida
M-113C	Parris Island, South Carolina
SM-149	Baker, Oregon
TM-179	Kalispell, Montana
TM-186	Pyote, Texas
TM-191C	Delmita, Texas
TM-199	Eufaula, Alabama
Z-224	Lovell, Wyoming
Z-216	Cedar City, Utah
Z-222	Trinidad, Colorado
Z-210B	Long Key, Florida
C-51	Yorkton, Sask.
C-14	Pagwa, Ontario
C-7	Parent, Quebec
C-5	St. Margarets, New Brunswick
C-34	Sydney, Nova Scotia
C-23	Stephenville, Newfoundland
Build	Owingsville, Kentucky

LIP Review



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477L SENSOR SITES

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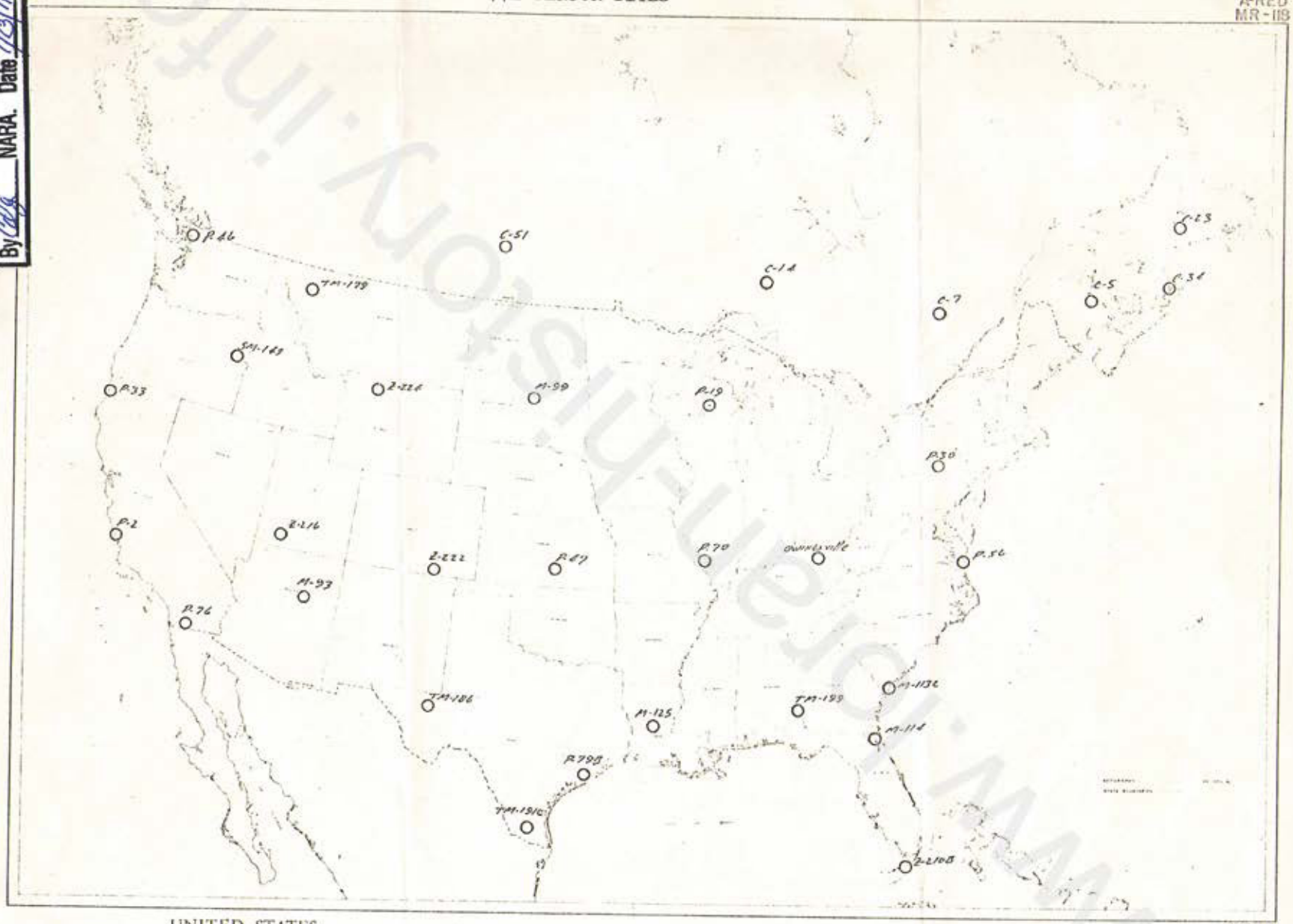
MR-118



UNITED STATES

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A-RED

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ATCH #2
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NODETS

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4 DEC 1962

Ser: 0982

CONFIDENTIAL

From: Commandant
To : Director, Communications-Electronics (J-6), Joint Chiefs of Staff

Subj: Mid-Continent Experimental LORAN-C Timing Station

1. The U. S. Coast Guard was asked by the U. S. Air Force, Headquarters Electronics Systems Division (letter of 25 September 1962) on the feasibility of installing a low power, experimental LORAN-C timing station in the mid-continent U.S. Our answer is enclosed and is forwarded for your information and retention. The assumption of this additional workload will not interfere with implementation of the Loran Installation Plan.

J. A. ALGER, JR.
Rear Admiral, U. S. Coast Guard
Chief of Staff

Encl: (1) Comdt ltr to U.S. Air Force, Headquarters Electronics Systems Division dtd 15 November 1962 (CONFIDENTIAL)

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Serial No.

15 NOV 1962

CONFIDENTIAL

From: Commandant, U. S. Coast Guard
To : Headquarters, Electronics Systems Division
Air Force Systems Command
U. S. Air Force
Bedford, Massachusetts

Subj: Mid-Continent Experimental Timing Station

Ref : (a) Headquarters Electronics Systems Division letter of 28 Sept 1962

1. Reference (a) outlined the general requirements for subject installation and asked specific questions relative to Coast Guard capabilities for implementation of this installation.

2. It appears feasible to install a low-power, experimental timing station at a location in the general area of Wyoming or Colorado which would provide desired time signal coverage over a large portion of the western United States. Extreme difficulty would be experienced in meeting the proposed target-on-air date of 1 May 1963. This target date is doubtful even if site acquisition and topographical survey were accomplished by 1 December 1962, and if sufficient funds were available to pay excess costs incident to construction under adverse winter weather conditions prevailing during the construction period. Direct synchronization of the mid-continent station with the East Coast system will require equipment modifications.

3. Two methods are available which would provide interim indirect synchronization with the East Coast and time dissemination to the desired degree of accuracy for the forty-hour week proposed. Each method requires an ultra-stable Varian Rubidium (or equivalent) frequency standard.

Method 1. Signals from the East Coast and from the mid-continent station would be monitored by the Bureau of Standards on Ketai Observatory. Corrections thus determined would be applied to the transmitted signal. When signals are not synchronized, as when concurrent monitoring is not feasible, the timing clock would be flywheel to indicate calibration.

Method II. Signals from the East Coast and from the proposed mid-continent station would be monitored by the Coast Guard at an intermediate point. Corrections to synchronization would be furnished as required by the monitoring station. As in the previous mode of operation, blink procedures would be employed to indicate malfunction.

4. The Coast Guard has commitments to the Department of Defense to implement Loran-C installations to meet essential requirements of a program vital to National Defense. Current plans would, in all probability, allow temporary use of operational spare electronic equipment in the timing program. However, should additional Department of Defense requirements be generated, these requirements would have priority for allocation of personnel, equipment, technical assistance or administration. Subject to these limitations, the Coast Guard would be pleased to cooperate with your organization in providing the desired service. Accordingly, answers to specific questions posed by your office in reference (a) are listed in order as asked.

a. The Coast Guard can make available a station set of Loran-C electronic equipment for use as required during the experimental period. If this equipment is returned to stock upon experiment completion, funds for refurbishing (approximately $80,000) would be required on a reimbursable basis. If this equipment is utilized as part of a permanent system, reimbursement (approximately $480,000) will be required to replace Coast Guard stock.

b. Enclosure (1) is a list of additional auxiliary equipment required for an experimental and later operational mid-continent timing station.

c. The Coast Guard will assist in all phases of the mid-continent timing program. In the initial phase, it will be necessary for the Air Force to take prime responsibility for site selection, acquisition of required property, and air space clearance for tower erection. The Coast Guard can assume prime responsibility for station design, building construction, antenna procurement and erection, equipment installation, and permanent station operation. Action necessary to obtain authority for experimental use of the frequency band 90-110 kc for transmission of timing signals will be initiated by the Coast Guard through both civil and military channels; active

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Air Force support in this regard will be expected. As the program develops a more complete delineation of areas of responsibility will be required.

d. In order to accomplish the desired program without severe disturbance to other Coast Guard programs, it will be necessary to contract for technicians required for the initial year of operation of the experimental station. The Coast Guard will provide a Loran-C system trained officer as station commander. A minimum Coast Guard enlisted crew of four technicians can be phased into the program for further operation beyond the first year. To ease the technical personnel situation a site should be selected which is not isolated from populated areas. It will be necessary to provide dependent housing at permanent sites should they materialize after the first year of operation.

e. Preliminary estimates may be broken into three categories: basic equipment cost, auxiliary equipment cost and construction (Civil Engineering) cost. Basic equipment cost is stated in paragraph 4.a. with auxiliary equipment breakdown shown as enclosure (1). The construction costs based on experimental as well as permanent station, are estimated in enclosure (2). Final costs, however, will depend upon the site selected, type of construction required and construction season. Final cost estimates can only be furnished after resolution of these considerations. The relatively small difference in cost between temporary and permanent buildings indicates the desirability of selecting the experimental site such that it may become permanent in the final configuration. Reimbursable accounting as required will be established within the Coast Guard.

f. During the experimental period of operation, a group repetition rate would be selected which would minimize conflict between East Coast and Mid-Continent station operation. It is anticipated that the two facilities would initially operate on different repetition rates. Group timing resolution would be accomplished by transmitting a suitable coded additional single pulse per second from each facility.

g. Enclosure (3) is a breakdown of recurring operating costs on a monthly basis.

h. The Coast Guard has no current requirement to justify construction or operation of these stations for its own use.

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[illegible]

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Details of any Coast Guard utilization of this station, and the extent of Coast Guard participation cannot be specifically defined at this time.

4. Normal construction procedures require a period of six to nine months from site acquisition to on-air testing date, depending upon factors of weather, availability of funds, availability of materials, accessibility of the site, etc. The proposed schedule is highly doubtful even if a site could be selected and acquired by 1 December 1962, and if funds were made available to defray extreme costs incident to winter construction. Transfer of funds to the Coast Guard for initial site survey would be required prior to this time. In view of the excessive costs involved, and the possibility of delays due to weather, tower acquisition and tower erection, the Coast Guard recommends that the initial on-air date of May 1 1963 be reviewed, and a construction schedule established based on a fixed period from date of transfer of construction funds.

5. Enclosure (4) is coverage to be anticipated from the experimental station as well as possible expansion to more than one station if required. An estimate of field strength alone is not a sufficient criterion for determining quality of received signal. Range limitation is imposed by the signal to atmospheric noise or interference ratio at the receiving site. Experience has shown that, with a simple whip antenna, a signal to atmospheric noise ratio of 1 to 3 is adequate for signal acquisition and use. For a signal to atmospheric noise ratio of 1 to 10, signal acquisition is difficult but once lock-on is established, operation is satisfactory. Utilizing published data for conductivities and noise levels experienced in the continental United States, it is possible to predict that, at a range of approximately 750 miles from transmitting sites, a signal to noise ratio of 1 to 3 or better will exist [illegible]% of the 0800-1200 time block. For a twenty-four hour day, a signal to noise ratio of 1 to 10 or better will occur within 750 miles 95% of the time.

6. Predicated on these calculations, the coverage shown in enclosure (4) is in line with the operational requirements of the [illegible] system. Using standard Loran-C reception methods, additional stations denoted will probably be required. These

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COMDT, USCG ltr Serial No. [illegible] to U. S. Air Force Systems Command

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standard techniques include use of whip antennas, continuous phase lock with transmitting stations, and standard Loran-C receivers or clocks. Further data acquired by the experimental station may provide sufficient evaluation of non-standard techniques (i.e., antenna arrays, ultra stable oscillators and modified receiving equipment) to eliminate the need for additional transmitting sites, or at least reduce the number required.

7. It is requested that the Coast Guard be advised of the portions of this program which are classified. Minimal classification allows more expeditious handling of correspondence relating to the system.

J. A. ALGER, JR.
Rear Admiral, U. S. Coast Guard
Chief of Staff

Encl: (1) Additional Auxiliary Equipment
(2) Cost Estimate (Civil Engineering Items)
(3) Recurring Cost Estimates
(4) Chart of anticipated coverage.

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

TREASURY DEPARTMENT
U. S. COAST GUARD
CG-[illegible] (10-54)

DIRECTIVE CLEARANCE SHEET

[illegible]ty: 2p 11-13-62

CERTIFIED FOR: SUBSTANCE TYPING INFORMATION

(Fill in blocks as initialled - do not use for routing)

OFFICE OR DIVISION DESIGNATORS	SEV	E	CAR	SC	O	PE	PO	P	FPA	CUS-[illegible]	CCS	[illegible]	
INITIALS OF RESPONSIBLE OFFICERS	[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7630
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Enclosure (1) COMDT (XEE) ltr to Electronic Systems Division
United States Air Force - CONFIDENTIAL

Additional Auxiliary Equipment

Experimental Station

Recorders	$10,000
Screen Room	5,000
Cable	10,000
Test Equipment	20,000
Isolation transformers	1,000
1 Rubidium vapor freq. stand.	17,000
1 Pulse per second generator	7,000
	70,000

Operational Station

Comm. gear	20,000
2 Rubidium vapor freq. stand	34,000
	54,000

Monitor Station (if required)

Loran-C monitor receivers (2 ea.)	100,000
Recorders (2 ea.)	10,000
Oscillators, high stability (2 ea.)	34,000
Test equipment	3,000
Misc Eqpt (antenna, cable)	3,000
	150,000

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Enclosure (2) to CONBT (SES) ltr to Electronic Systems Division, United States Air Force

MID-CONTINENT LORAN PROJECT
COST ESTIMATE
(Civil Engineering Items)

Signal Building	$ 65,000
Transmitter Building	80,000
Tower Foundations and ground system	25,000
Procure and Erect Tower 625'	95,000
Road and outside utilities	20,000
Install electronics (move in only)	8,000
Air conditioning, heating and cooling	15,000
Fire protection	25,000
Receiving antenna installation	3,000
Power transformers	6,000
Outfitting, general	5,000
Vehicle	2,000
Cable trenching and lay	2,000
Power cables	2,000
Contingencies	20,000
Total construction	$373,000
Administrative	20,000
Experimental station Total cost	393,000
Permanent quarters (five family units)	200,000
Permanent station - total cost	$593,000
Monitor station construction(if required)	80,000
Final cost	$673,000

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

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Enclosure (2) COMET (ESD) ltr to Electronic Systems Division
United States Air Force - CONFIDENTIAL

Recurring Cost Estimates	per month
Personnel	$8600.00
Electronic Maintenance	2800.00
Structure Maintenance	1700.00
Total	$13,900.00