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HANDLE VIA TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

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USIB-D-46.4/33
(COMIREX-D-15.2/17)
12 December 1969
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UNITED STATES INTELLIGENCE BOARD

MEMORANDUM FOR THE UNITED STATES INTELLIGENCE BOARD

SUBJECT : World-wide Positioning Requirements

REFERENCES : a. USIB-D-41.14/295 (COMOR-D-13/65), 13 July 1966
b. USIB-D-46.4/24 (COMIREX-D-15.2/12), 29 October 1968, Limited Distribution and Memorandum for Holders, 20 November 1968, Limited Distribution

1. The attached memorandum on this subject from the Chairman, Committee on Imagery Requirements and Exploitation (COMIREX) is circulated herewith for Board consideration of the two recommendations in paragraph 7. The first recommendation is that USIB, because there will be no adverse affect on intelligence collection activities, advise the NRO that it has no objection to adding doppler beacons to an additional three KH-4B missions for the purpose of meeting current DoD world-wide positioning requirements. The NRO indicates that it needs the agreement of the USIB in order to initiate this action. The second recommendation is that USIB note a newly established additional DoD world-wide positioning requirement in support of long-range missiles to meet a technical objective of 210 feet horizontal and 150 feet vertical by 1974.

2. The current 1970 objective established in 1966 (reference a.) is that the positioning of Soviet bloc targets be accurate to within 450 feet horizontal and that elevations be accurate to within 300 feet vertical, both with 90 per cent assurance relative to the World Geodetic System. In 1968 USIB approved (reference b.) adding doppler beacons to five

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KH-4B systems beginning in the summer of 1969 in order to meet an initial operating capability date of June 1970 and subsequent world-wide requirements. Mr. Inlow's memorandum explains that these missions have now been reduced to four beginning in early 1970 instead of the summer of 1969. NRO indicates that the doppler beacon can be added to the three remaining KH-4B missions for an estimated cost of $300,000, without adverse effect on intelligence collection activities. COMIREX reports that the advantages to DoD far outweigh the cost involved. The memorandum also discusses the basis for tightening of the world-wide positioning objective for long-range missiles, which led to the establishment by DoD of the new 1974 technical objective of 210 feet horizontal and 150 feet vertical.

USIB ACTION REQUESTED

3. Board Members are requested to advise the Secretariat not later than close of business 22 December of their concurrence or other views on the COMIREX recommendations in paragraph 7 of the attachment.

James S. Lay, Jr.
JAMES S. LAY, JR.
Executive Secretary

Attachment

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Attachment
USIB-D-46.4/33
(COMIREX-15.2/17)
12 December 1969
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MEMORANDUM FOR: United States Intelligence Board

SUBJECT: World-wide Positioning Requirements

REFERENCES: a. USIB-D-41.14/295 (COMOR-D-13/65), 13 July 1966

b. USIB-D-46.4/24 (COMIREX-D-15.2/12), 29 October 1968, Limited Distribution, and Memorandum for Holders, 20 November 1968, Limited Distribution

1. This memorandum:

a. Addresses a request for doppler beacons to be placed on three additional KH-4B missions in conjunction with DoD needs for improved geodetic positioning accuracies; and,

b. Provides a statement of new positioning accuracies to meet DoD targeting objectives by 1974.

Recommendations are contained in paragraph 7.

2. Reference a. stated that long-range missile systems to be added to the U.S. inventory would require that the positioning of Sino-Soviet bloc targets be accurate to within 450 feet horizontal and that elevations be accurate to within 300 feet vertical, both with 90 percent assurance relative to the World Geodetic System. To meet the Sino-Soviet bloc requirements with an initial operating capability date of June 1970 and subsequent world-wide requirements, reference b. established USIB agreement that the NRO add doppler beacons to five KH-4B missions, beginning in the summer of 1969. Further COMIREX reviews in January - March 1969 with regard to the urgency of the requirement, and NRO problems of initiating the doppler beacon collection in the summer of 1969, resulted in scheduling four doppler beacon KH-4B missions beginning in March 1970 instead of five missions beginning in the summer of 1969.

3. The NRO now indicates that, for an additional cost currently estimated at approximately $300,000, doppler beacons and antennae can be added to the three remaining KH-4B missions which will carry the DISIC (3-inch frame camera) essential to the use of doppler beacons with the KH-4B system. The NRO, however, needs the agreement of the USIB in order to initiate this action. The NRO has further indicated that the seven missions with the doppler beacons can be operated on a satisfactory schedule to cover required objectives beginning with the first KH-4B mission in calendar year 1970.

4. An increase of three KH-4B doppler missions properly scheduled would have the advantage to DoD of positioning a significant number of additional Priority 1 targets in line with the 450-foot horizontal and 300-foot vertical requirement, increasing the positioning accuracy of other targets and providing needed geodetic control for stereophotogrammetric mapping operations being conducted world-wide in advance of the required KH-9/doppler missions. According to the NRO, the doppler beacon can be added to the KH-4B without adverse effect on intelligence collection activities. The advantages to DoD far outweigh the $300,000 cost involved.

5. The Department of Defense also has indicated a tightening of the world-wide positioning objective for long-range missiles. Extensive research and development has been performed on a continuous basis to advance the capability of weapons systems. Major attention has been given to long-range missiles and supporting activities including those contributing to reducing the geodetic and geophysical error of missile operations. Factors of long lead time for acquisition and data reduction and potential benefit in missile effectiveness in view of the cost involved are the basis for the DoD establishing a technical objective of reducing the positioning of the geodetic and geophysical components of missile operations from the requirement accuracies of 450 feet horizontal and 300 feet vertical needed by June 1970 to 210 feet horizontal and 150 feet vertical by 1974, with all values 90 percent assurance relative to the World Geodetic System.

6. The KH-4 DISIC with doppler beacon will meet the 450-foot horizontal and 300-foot vertical positioning requirement and will almost meet the technical objective of 210 feet horizontal under optimum conditions, i.e., 224 feet, but not the 150-foot vertical. The KH-9 system with the doppler beacon and 12-inch SI camera will facilitate the attainment of these more stringent technical objectives. Recent studies indicate that the accelerometer for the KH-9 program specified in reference b. cannot be justified in support of world-wide positioning.

Recommendations

7. It is recommended that:

a. Because there is no adverse effect on intelligence collection activities, the USIB advise the NRO that there is no objection, for the purpose of meeting current DoD world-wide positioning requirements, to adding doppler beacons to an additional three of the remaining KH-4B missions which include the DISIC (3-inch frame camera).

b. The USIB note a newly established DoD world-wide positioning requirement, in addition to that for 1970, in support of long-range missiles to meet a technical objective of 210 feet horizontal and 150 feet vertical by 1974 with 90 percent assurance relative to the World Geodetic System.

Roland S. Inlow
Chairman
Committee on Imagery Requirements and Exploitation

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DEFENSE INTELLIGENCE AGENCY
WASHINGTON, D.C. 20301

MCGWG-D-10/3

PRO AIF 7

26 November 1969

MEMORANDUM FOR CHAIRMAN, COMIREX

SUBJECT: Worldwide Positioning Requirements

1. Attached as enclosure 1 is a draft memo for USIB, subject as above, forwarded for appropriate action by COMIREX. Attached draft has the conourrence of the members of the COMIREX MCGWG, and MCGWG members will recommend concurrence to pertinent COMIREX members.

2. The question of the need for the accelerometer on the KH-9 system has been the principal problem holding up action on this paper for the past several weeks. In attached draft, the MCGWG indicates that the accelerometer cannot be justified in support of worldwide positioning.

3. In the process of evaluating the potential benefits of the accelerometer to MC&G, other needs for atmospheric drag data and associated collection programs were identified which may be considered in light of the potential benefit of including the accelerometer on these KH-9 missions. DIA is making information concerning these other needs available to DoD COMIREX members for consideration as appropriate.

Lloyd L. Rall

1 Enclosure a/s

LLOYD L. RALL, COLONEL, USA
Chairman
COMIREX MC&G Working Group

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22	CIA COMIREX Member [redacted]
23,24	CR SUBCOM (Mr. Shadegg)
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MCGWG-D-10/3

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MEMORANDUM FOR: United States Intelligence Board

SUBJECT: Worldwide Positioning Requirements

REFERENCES: a. USIB-D-41.14/295 (COMOR-D-13/65), 11 July 1966

b. USIB-D-46.4/24 (COMIREX-D-15.2/12), 29 October 1968, Limited Distribution

Memorandum for Holders of USIB-D-46.4/24, 20 November 1968, Limited Distribution

Background

1. Reference a. stated the DoD worldwide positioning requirements of 450 feet horizontal and 300 feet vertical 90 percent assurance relative to the World Geodetic System in support of long-range missiles. To meet this continuing requirement with an initial operating capability date of June 1970, reference b. established USIB agreement that NRO add the Doppler Beacon to five KH-4B systems beginning in the Summer of 1969, add the Doppler Beacon and accelerometer to the KH-9 system with the same operational readiness as the 12" SI camera, and accomplish these steps without impact on the development and scheduling of the 12" SI system into the KH-9 system.

2. Further COMIREX reviews in January - March 1969 with regard to the urgency of the requirement, and NRO problems of initiating the Doppler Beacon collection in Summer of 1969, resulted in scheduling four Doppler Beacon KH-4B missions beginning in March 1970 instead of five missions beginning in Summer 1969. NRO now indicates that for an

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additional cost of $185,000 for Doppler Beacons and antennae, all six remaining KH-4B DISIC (3" frame camera) missions could be operated with the Doppler Beacon on a satisfactory schedule starting in Feb 70 instead of the four presently established. An increase of two KH-4B Doppler missions properly scheduled would have the advantage to DoD of positioning a significant number of additional Priority I targets in line with the 450 feet horizontal and 300 feet vertical requirement, increasing the positioning accuracy of other targets and providing needed geodetic control for stereophotogrammetric mapping operations being conducted worldwide in advance of the required KH-9/Doppler missions. Even though DISIC photography with Doppler Beacon might be partially cloud covered, photogrammetric control can be established through use of the more precise orbit. This permits control to be transferred to other cloud free photography. The advantages to DoD far outweigh the $185,000 cost involved.

3. Since requirements for target positioning and geodetic control for mapping and charting include Northern latitude areas having limited light in winter months, some of the KH-4B DISIC missions with Doppler Beacon should be operated during summer months.

4. The Department of Defense has indicated a tightening of the worldwide positioning objective for long-range missiles. Extensive research and development has been performed on a continuous basis to advance the capability of weapons systems. Major attention has been given to long-range missiles and supporting activities including those

contributing to reducing the geodetic and geophysical error of missile operations. Factors of long lead time for acquisition and data reduction and potential benefit in missile effectiveness in view of the cost involved are the basis for the DoD establishing a technical objective of reducing the positioning portions of the geodetic and geophysical components of missile operations from 450 feet horizontal and 300 feet vertical to 210 feet horizontal and 150 feet vertical by 1974. (All values 90 percent assurance relative the World Geodetic System).

5. The KH-4 DISIC with Doppler Beacon will meet the 450 feet horizontal and 300 feet vertical positioning requirement and will almost meet the technical objective of 210 feet horizontal, under optimum conditions, i.e., 224 feet, but not the 150 feet vertical. In this regard, recent studies indicate that the accelerometer presently approved for the KH-9 program cannot be justified in support of worldwide positioning.

6. According to the NRO, the Doppler Beacon can be added to the KH-4B, and the Doppler Beacon can be added to the KH-9 systems without any adverse effect on intelligence collection activities.

Recommendations

7. It is recommended that:

a. USIB note the updated DoD worldwide positioning requirement in support of long range missiles as 450 feet horizontal and 300 feet vertical beginning in June 1970 (noted in reference b) and a technical objective of 210 feet horizontal and 150 feet vertical by 1974, all values 90 percent assurance relative the World Geodetic System.

b. Since there is no adverse effect on intelligence collection activities, advise the NRO that there is no objection to meeting DoD worldwide positioning requirements as follows:

(1) Add the Doppler Beacon to six KH-4B DISIC (3" frame camera) systems beginning in March 1970. (Instead of the five systems agreed in reference b.)

(2) Add the Doppler Beacon to the KH-9 system with the same operational readiness as the 12" SI camera.

(3) Accomplish (1) and (2) above without impact on the development and scheduling of the 12" SI System into the KH-9 system. (Same as agreed in reference b.).

Appendix

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DEFENSE INTELLIGENCE AGENCY
WASHINGTON, D. C. 20301

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MEMORANDUM FOR THE DIRECTOR, NATIONAL RECONNAISSANCE OFFICE STAFF

SUBJECT: World-wide Positioning Requirements

1. The COMIREX was advised in July of last year that the DoD requirement for positioning of ICBM targets would not be met through the use of existing satellite data. At the same time, it was requested that studies be accomplished for the purpose of identifying alternate solutions (see enclosure 1). It is recognized that, in response to the early October 1967 request of the Chairman, COMIREX, you are now considering possible approaches for meeting the geodetic requirements prior to FY 71.

2. Since early action is needed to not only acquire new data, but also to accomplish the data reduction and update the missile guidance data, DIAMC has evaluated some of the possible alternatives from the utilization point of view. A summary of our analysis is forwarded herewith for your consideration. The different alternatives that your office may identify for meeting the requirement are a major concern to this office because of their interrelationship with our responsibilities as DoD manager of overt geodetic acquisition capabilities and DoD manager for the data reduction, using both the overt and covert-obtained data. There are decisions that must now be made relating to the calendar year 1968 CIP, that will depend on the alternatives selected for fulfilling the world-wide positioning requirement. For example, if a Doppler transponder is incorporated with the KH-4 system, which this office considers to be one of the best solutions that can be undertaken in the near future, an early implementation decision is needed in order to have adequate tracking capability available.

3. It is recognized that you plan to inform the COMIREX of your proposed solutions in the relatively near future. In the meantime, it is recommended that our staff personnel exchange information on this matter in order that your office can take advantage of our considerations from the overt acquisition-utilization point of view and DIAMC can develop the CIP based on the most up-to-date planning information.

FOR THE DIRECTOR:

ROBERT E HERRICOM, JR.
COLONEL, USAF
ASSIST DIR FOR MAPPING, CHARTING AND GEODESY

2 Enclosures a/s

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DEPARTMENT OF THE NAVY
OCEANOGRAPHER OF THE NAVY
THE MADISON BUILDING
732 N. WASHINGTON STREET
ALEXANDRIA, VA. 22314

IN REPLY REFER TO
OH:js
TCS 207,010/68
10 JUL 1968

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From: Oceanographer of the Navy
To: Director, Defense Intelligence Agency (DIAMC)

Subj: World-wide Positioning Requirements

Ref: (a) DIA ltr TCS 657,371-68 of 14 May 68
(b) NAVOCEANO ltr TCS 645,008-67 of 16 Mar 67
(c) DIA ltr TCS 657,220-68 of 25 Mar 68

Encl: (1) Navy Proposed Actions for Refinement of Satellite Ephemerides

1. The Naval Oceanographic Office and the Naval Weapons Laboratory have reviewed reference (a). We have again re-examined the substance of our original proposals in reference (b) regarding the instrumentation of photographic satellites with doppler transmitters and accelerometers for improvement of the Satellite Ephemerides, drag model, and gravity model.

2. In reference (a) the Defense Intelligence Agency reiterated the immediate requirement for increased horizontal and vertical accuracies. There is an urgent need for determination of the ephemerides for satellites at 100 miles altitude to a high level of accuracy and a probable future requirement for even higher accuracies.

3. The need for timely action with regard to the projected goals was stressed since lead times will probably result in an incompatibility between the date the requirement is firmly established and the date the requirement must be met. The actions outlined in enclosure (1) reflect our updated thoughts (reference (b)) and are proposed to meet the new requirement stated in reference (a).

4. In the interim period we have further reviewed the possibility of obtaining a short term advantage to be gained geodetically by utilizing as an all MC&G event two J-3 missions with the 3" F.L. DISIC system, one at an inclination at 72° at a 90-115 nm altitude to be totally independent of any intelligence collection missions. This mission will provide geodetic ties between South America and the United States. A second geodetic mission should be at an inclination of 83° and provide the necessary short arc ties with Europe-Africa.

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10 JUL 1968

These lower inclinations will provide better photogrammetric short arc solutions when supported by existing ground control data and known datums. One of the major contributing causes in not meeting the 750 ft. accuracy is the failure of having a dense geodetic network that is photo identifiable.

5. In the matter of the New Search developments, reference (c), it is strongly recommended that consideration be given to instrumenting several 12" F.L. system with the doppler transmitters as part of the post-1970 period geodetic satellite program. The availability of approximately 20 geoceivers should be well established and coupled with the retention of the present Tranet System (20)(13 stations augmented, 4 mobile Vans, and 3 SRN/9 receivers) stations provide the means for accurate ephemerides determination and control densification.

6. The TIMATION ranging technique (item g. enclosure (1)), a part of the Advanced Navigation System Analysis, has the advantage of being capable of providing continuous coverage if satellites at synchronous altitudes are employed or it can provide intermittent coverage using a single satellite at low altitude. The development potential of a combined Doppler/Timation system may provide techniques for continuous geodetic, all-weather instantaneous fixes on a world-wide basis.

7. Recommendations and Summary. Proposals (a), (b), (c), and (f) of enclosure (1):

a. Doppler Transmitter in Low Altitude Satellite

b. Accelerometers in Low Altitude Satellites

c. Geoceiver Deployment

f. Satellite Acquired Doppler Observations

should be pursued to assure that the immediate accuracy objectives are met, to provide some possibility that the long range objectives can be met, or to at least provide some source data to assist in meeting these long range objectives. Proposal (e), Improvement in Gravity Field, should be given high priority to provide assurance that long range accuracy requirements are met and that source data for follow-on systems are available. Proposal (f), Satellite Acquired Doppler Observations, should be given the highest priority as a means of achieving an even higher degree of precision than that possible under (e), although in a system subject to accidental or deliberate jamming.

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Proposals (d) and (g):

d. Remote Geocoivers

g. Satellite Acquired Timation Observations

should be reserved in the event that more promising methods fail to meet requirements. Component development of these systems should be pursued and the decision reviewed periodically.

8. The proposals as outlined within the enclosure reflect Navy's engineering concepts which it could further investigate and implement, provided that a valid requirement is established and approval and funding furnished. Within the scope of the proposals there is no intent to bring any of these, which by themselves are at a much lower classification--or may even be unclassified--under the aegis of the Talent-Keyhole System. The Navy's Geophysical Satellite program, basically a navigation system, is now available to U. S. commercial interests. We must reiterate that the techniques described are recommended instrumental means within the R&D concept to achieve the desired world-wide positioning requirements. There is no intent to infringe, nullify or limit the scientific application of any current satellite efforts which may parallel, coincide or complement these proposals if they are investigated in support of objectives of the Talent-Keyhole System.

O. D. WATERS, Jr.

Copy to:
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Air Force (Hq AFSIN)
NRO
CIA (COMIREX)
NPIC
Dir. Naval Lab. (Dr. Johnson)
NAVAIRSYSCOM (Mr. Kay)
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DEPARTMENT OF THE NAVY - PROPOSED ACTIONS

a. Doppler Transmitter in Low Altitude Satellite

This recommendation has been made by the Defense Intelligence Agency and the Air Force Space and Missile Systems Organization. COL Courtney of SAMSO indicated that the Air Force Secretary for R&D has questioned whether the action would provide assurance that the immediate accuracy requirements would be met. The NWL is reviewing available information to determine what degree of assurance can be given, however, the fact that the Doppler system will improve the accuracy of the current system, which has not been able to achieve the accuracy objective, should be sufficient justification for its use.

b. Accelerometers in Low Altitude Satellites

Accelerometers have been flown in engineering models of low altitude satellites with excellent results according to the project personnel. We reiterate our recommendation of two years ago that accelerometers be flown with the Doppler transmitters. The accelerometers not only help directly by reducing errors due to drag and thrust uncertainties, but also indirectly by permitting analysis of longer time spans of data, thus reducing the effects of observational errors and allowing more thorough study of, and subsequent correction for, gravity errors.

c. Geoceiver Deployment

Assuming Doppler transmitters are incorporated in the low altitude payload, all available Geoceivers should be deployed to obtain data from the satellites because the portion of the orbit seen by each observing station is extremely small at low altitudes. The NWL is conducting studies to determine the optimum deployment of Geoceivers which can be directly assigned to the project; coordination with other purchasers of Geoceivers is also recommended.

d. Remote Geoceivers

An obvious method of achieving the long range accuracy, despite the small portion of the orbit of low altitude satellites seen by each observing station, is by large scale deployment of Geoceivers. Surface ships, submarines, and helicopters could be used to deploy Geoceivers with automatic or pre-programmed signal acquisition capability on reefs, the ice cap or as anchored buoys, recovering the data tape one to two weeks later. Although some portion of the equipment would be lost to the elements or to vandalism, the accuracy objective would be achieved by using the high altitude satellite data to determine the position of

the equipment and the low altitude data to determine the desired orbit information. Although the equipment cost for this project would probably be less than that for the proposals which follow, it is not recommended that this course be pursued at any significant level of effort. The investment in personnel, ships, aircraft and the possible confrontation with unfriendly forces, coupled with the poor growth potential, make this approach appear inferior to those below. However, the lead time is smaller than that for those below, and it may therefore prove to be the only alternative for a given time schedule. Similarly, satellite relay of the data acquired by the remote Geoceivers is tentatively ruled out, since the lead time would be increased to the level of that for a more effective system below.

e. Improvement in Gravity Field

The Naval Air Systems Command has submitted a plan for the improvement in the earth's gravity field with the aid of data obtained from five proposed satellite launches, four of which would contain drag compensating thrusters. Accomplishment of this program will provide valuable and possibly vital data for the long range accuracy requirement. The improved gravity field, together with development of the thrust compensation technique, will further provide a unique capability for jam-proof, UE-based, real time orbit determination and prediction for follow-on systems. A high priority should therefore be given to this development proposal.

f. Satellite Acquired Doppler Observations

During the time a ground station observes a satellite at 600 statute miles travel from horizon to horizon, the satellite traverses 60 degrees in central angle (in latitude, for a polar orbit). A 100 mile satellite traverses only 24 degrees, which results in the poor coverage discussed earlier, particularly considering that a larger percentage of these data are subject to large refraction errors. On the other hand, if a 100 mile satellite were observed from a 600 mile satellite, the lower satellite would be in view during 84 degrees of central angle, more or less depending on whether the relative motions were in the same or in opposite directions. On an area basis alone then, tracking data from one 600 mile satellite would be worth

$\frac{(84/2)^2}{(24/2)^2} = 12$ ground stations. This ratio, which in itself would be cost effective if development costs were ignored, is very conservative because the percent gain is greater when refraction effects are considered, because it may be possible to optimize the orbits to increase the effectiveness, and, most particularly, because data could be acquired during portions of the orbit which are otherwise inaccessible. The Naval Weapons Laboratory will

conduct studies to evaluate orbit accuracy for various configurations of tracking satellites. The Naval Air Systems Command should be urged to initiate an urgent project at the Applied Physics Laboratory of Johns Hopkins University to develop a 600 nautical mile satellite equipped with receiver type acquisition and tracking equipment and with a navigation satellite type memory to record the tracking data for read-out at telemetry stations. Capability for tuning the satellite receiver over a reasonable range of satellite off-set frequencies would be required in order to prevent jamming.

g. Satellite Acquired Timation Observations

The possibility of applying the Timation System under development at the Naval Research Laboratory in the mode described in paragraph (f) above for the Doppler system should be borne in mind during the course of the NRL project. The Timation System offers the promise of greater coverage with the use of synchronous satellites and higher potential accuracy since geometric solutions for satellite position can be made with range measurements from three satellites, thus eliminating effects of drag and gravity errors on the low altitude satellite. One disadvantage is the singularity at the equator, which could probably be bridged easily with orbit computations based on dynamic techniques. The principal disadvantage is that the system has not yet been developed to the point of demonstrating a level of accuracy comparable to the Doppler system. Development of the system components should be pursued as a possible alternative to the Doppler system proposed in paragraph (f).