Technical Memorandum 4007-4
February 1966

GEOS A

READINESS TEST EVALUATION REPORT

National Aeronautics and Space Administration
GEOS A Project

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Technical Memorandum 4007-4
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Prepared for
National Aeronautics and Space Administration
GEOS A Project

by

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LIST OF ABBREVIATIONS AND ACRONYMS

ACIC	Aeronautical Chart Information Center
ADCOM	Advanced Communications Research and Development
AD/ECS	General Mills Computer
AFCRL	Air Force Cambridge Research Laboratory
AMS	Army Map Service
APL	Applied Physics Laboratory - Johns Hopkins University
APL/SCC	Applied Physics Laboratory - Satellite Control Center
DOD	Department of Defense
FSK	Frequency Shift Keyer
GEOS	Geodetic Earth Orbiting Satellite
GOCC	Geodetic Satellites Control Center
GSFC	Goddard Space Flight Center
GSS	Geodetic Survey Squadron
IBM	International Business Machines
MOTS	Minitrack Optical Tracking System
ms	millisecond
MVE	Mutual Visibility Event
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NETCON	Goddard Network Control

OAO	Orbiting Astronomical Observatory
PCM/DHE	Pulse Code Modulation/Data Handling Equipment
RARR	Range and Range Rate
RSRS	Radio Space Research Station, Slough, Bucks, England
SAO	Smithsonian Astrophysical Observatory
SECOR	Sequential Correlation of Range
STADAN	Space Tracking and Data Acquisition Network
TELEX	International Teletype Wire Exchange
TTY	Teletype
USAF	United States Air Force
USC&GS	United States Coast and Geodetic Survey
WWV	National Bureau of Standards Time Standards Station

SECTION 1

INTRODUCTION

1.1 OBJECTIVE OF REPORT

The objective of the GEOS A Readiness Test Evaluation Report is to critique and document the performance of the readiness test operations, enumerate and discuss operations that require improvement and to make recommendations for improving the GEOS operations and future readiness tests. This report consists of six sections, one for each of the five tests conducted, and one for the overall summary and recommendations. Each of the five report sections contains an introduction, test objective, test operations, test results and recommendations where applicable.

1.2 OBJECTIVE OF GEOS A

In order to fully appreciate the need for the Readiness Tests some background in the National Geodetic Satellite Program is desirable to help comprehend the magnitude of the system involved. The objectives of the National Geodetic Satellite Program, which are also the objectives of GEOS A, are listed below to provide the reader with the general program concepts.

a. Connect geodetic datums to establish one world datum and adjust all local datums to the common center-of-mass of the earth so that positions of geodetic control stations will have a relative accuracy of ±10 meters or better in an earth center-of-mass coordinate system.

b. Define the structure of the earth's gravitational field to 5 parts in 100,000,000, and refine the locations and magnitudes of large gravity anomalies.

c. Improve positional accuracies of satellite tracking sites, and calibrate tracking equipment.

d. Compare and correlate results obtained from the instrumentation and techniques used in order to determine the most accurate and reliable systems.

e. Make generally available geodetic data obtained, including results of analyses indicating its significance.

The fulfillment of these objectives requires a large complex network of participants on a global basis. These prospective Geodetic Earth Orbiting Satellite (GEOS) participants consist of existing network groups currently operating as independent networks as well as participants on an individual basis.

1.3 OBJECTIVE OF THE READINESS TESTS

The GEOS A Mission will be a highly complex operation involving precise spacecraft scheduling operations and large numbers of ground observers. In order to efficiently carry out the GEOS objectives for this complex operation, the various networks and independent participants require some means of communicating with the operation's focal point at the Geodetic Operations Control Center (GOCC). They also require a general understanding of the GEOS data, as well as their required support as a participant. In addition, the operating centers should have an opportunity to "debug" their operations prior to the operational phase of the geodetic mission, and to firm up the operational aspects of the program.

Therefore, Readiness Tests were conducted before and after launch of the GEOS spacecraft to provide operational experience and evaluation of various mission-related operations and systems. The tests were conducted primarily to check out operating procedures and data formats, and thus to demonstrate the readiness of the control centers and supporting stations to carry out the GEOS Mission. Therefore, the principal objectives of these Readiness Tests were as follows:

a. Checkout the existence and acceptability of communications to each participant.

b. Evaluate the acceptability of GEOS prediction formats to the communications facilities.

c. Provide participants with sample GEOS optical prediction data, Mutual Visibility Events (MVE) Lists and operational and observational report formats.

d. Check optical participants station operations and readiness by providing test operations with the GEOS spacecraft.

e. Operational checkout of the GEOS MVE program.

f. Operational checkout of the Applied Physics Laboratory (APL) injection tape program and spacecraft injection operation.

g. Operational checkout of the GOCC.

h. Checkout and evaluation of the ROSMAN station as a backup injection station.

The Readiness Tests were conducted from the GOCC during the period from approximately 26 September to 23 December, 1965, and consisted essentially of five tests as follows:

a. International Participants Readiness Test

b. Optical Predictions Teletype Simulation

c. Simulated MVE Lists Distribution

d. Optical Operational Readiness Test

e. ROSMAN Backup Injection Station Test

The Readiness Tests, other than those under c and e, were exclusively for optical tracking participants as the GEOS optical system was somewhat unique to most optical tracking participants. The electronic tracking participants, i.e., Doppler, SECOR, Minitrack, and RARR, were not tested since they consisted of existing operational networks that would support GEOS in much the same manner that they supported other spacecraft.

SECTION 2

SUMMARY

2.1 SUMMARY OF RESULTS

The Readiness Tests substantiated the need for pre-operational coordination and proved to be effective in exercising the various communication links, mission related systems and operational procedures. It is not possible to evaluate all the benefits derived from the tests. However, the following were the major accomplishments of the tests:

a. Demonstrated the GOCC operational readiness prior to actual operations and provided a proving ground for operational procedures and personnel training.

b. Verified communications access to each of the participating distribution points, resolved the list of distribution centers and confirmed operational data dissemination procedures.

c. Provided operational checkout of spacecraft flashing light systems and ground station photographic systems by providing flashing light observations for each optical participant.

d. Provided an opportunity to check MVE listings and prediction formats as well as provided principal observers with sample data.

e. Demonstrated satisfactory operation of the spacecraft memory and other subsystems associated with the flashing lights.

f. Demonstrated spacecraft injection capability from the ROSMAN station.

g. Exposed network distribution centers and optical observers to operational conditions prior to actual operations.

2.2 CONCLUSIONS

The Readiness Tests proved particularly beneficial in exercising the complex GEOS support network facilities before actual geodetic operations commenced. It thus provided operational practice and identified and corrected numerous minor conflicts and incompatibilities in data formats and operations.

The most significant single benefit of the tests was the opportunity for final development and testing of the control center operational procedures. The second major benefit was the verification of communications access to each of the participating distribution points and subsequent modification of data formats to be compatible with the various communications facilities used in the program.

2.3 RECOMMENDATIONS

Future geodetic satellite projects should require less readiness testing than GEOS A since the major operational facilities, such as the GOCC and APL/SCC, are now operational. In addition, many of the current GEOS A observers will also support subsequent geodetic satellite projects.

However, new observers brought into the program should be given prelaunch readiness tests. All observers should also be provided with an operational test with the spacecraft immediately after launch, but prior to its being declared operational. The following are recommendations for such readiness testing.

a. Optical observers new to the geodetic program should be given tests similar to those outlined in Sections 3, 4, and 5 of this report.

b. Electronic observers new to the program should also be given readiness tests similar to those in Sections 3, 4, and 5.

c. Prelaunch tests should be initiated at least two months in advance of the launch to allow ample time for clarification of any problem areas.

d. The control centers should revise operational procedures to reflect new program requirements.

e. An operational readiness test utilizing all spacecraft optical and electronic systems and all ground station optical and electronic tracking systems should be performed shortly after launch similar to that test outlined in Section 6. Such testing should include all observers regardless of whether they have a current operational system or not. In addition, such tests should include a section on test operations analysis and show how the test data is to be analyzed and utilized in improving operations.

SECTION 3

READINESS TESTS FOR INTERNATIONAL PARTICIPANTS

3.1 INTRODUCTION

A test was conducted with the International Participants to familiarize them with the various GEOS MVE computer listings, MVE teletype prediction formats, the operational and observational report procedures and to obtain inputs for the MVE program.

3.2 TEST OBJECTIVE

The objective of this test was essentially four-fold:

a. Furnish the International Participants with sample GEOS data and details on the operational and observational report requirements of a GEOS participant for their review to determine their degree of participation.

b. Determine what International Participants could participate in the program.

c. Obtain current information on International Participants tracking systems and station coordinates.

d. Determine data distribution requirements for International Participants.

Appendix A is a copy of the Readiness Test that was distributed to the International Participants listed in Paragraph 3.3.1.

3.3 TEST OPERATIONS

The Readiness Test as given in Appendix A was distributed by the GOCC to each of the International Participants listed in Paragraph 3.3.1. Each participant was requested to review each of the formats to familiarize himself with the data and to evaluate it for his particular operations and needs. Comments and

questions were solicited with queries to be directed to the GOCC. The following paragraphs describe briefly the main contents of the test.

3.3.1 Test Participants

Colonel Kelsey, Directorate of Military Survey, United Kingdom, was contacted and he furnished a list of International Participants he considered to be interested in the geodetic program. The Readiness Test was mailed to each of these participants listed below on September 26 and 27, 1965.

3.3.1.1 International Participants Receiving Readiness Test

a. Acaddimician Y. Vaisala
Turku, Finland

b. Monsieur P. Mueller
Meudon, France

c. Direktor Karminsky
Bochum, Germany

d. Professor Dr. M. Kneisel
Munchen, Germany

e. Direktor Dr. Aing H. Knorr
Frankfort, Germany

f. Professor Dr. Ing Marzahan
Berlin, Germany

g. Dr. Weber
Braunschweig, Germany

h. Direktor Dr. Strohmeier
Bamberg, Germany

i. Dr. G. Veis
Athens, Greece

j. Professor G. Bruins
Delft, Netherlands

k. Professor Dr. Lars Asplund
Fack, Vallingby, Sweden

l. Professor Dr. M. Schurer
Berne, Switzerland

m. Royal Observatory
Edinburgh, Scotland, U.K.

n. J. Hewitt Esq, Royal Radar Establishment
Malvern, Worchester, U.K.

o. Professor P. Melchior
Brussels, Belgium

p. Professor Dr. Einar Anderson
Copenhagen, Denmark

q. Professor T. J. Kukkamaki
Helsinki, Finland

r. Professor A. Marussi
Trieste, Italy

3.3.1.2 List of Additional Recipients

In addition, copies of the Test were also sent to the following for information purposes.

a. General R. C. A. Edge
Chessington, Surrey, U.K.

b. D. E. Smith, Esq.
Radio Space Research Station
Slough, Bucks, U.K.

c. Directorate of Military Survey (Colonel Kelsey)
Feltham, Middlesex, U.K.

3.3.2 Mutual Visibility Event Computer Listings

The Readiness Test for International Participants included samples of each type of data the International Participants would receive on a regularly-scheduled basis (weekly) as a participant in the geodetic program. Electronic data was not included as there was no known or anticipated need for it by these participants. An explanation was provided for each MVE

Computer List explaining each list, the frequency of its delivery, the period covered by the list and, where necessary, an explanation of data contained in the list.

The following sample lists were included in the Test:

a. Mutual Visibility Events List

b. Mutual Visibility Events Condensed List

c. Network Ordered Mutual Visibility Events List

d. History Tape List

e. Tracking Complement List

3.3.3 Flash Schedule Predictions

At the time this Readiness Test was conducted, the Radio Space Research Station, Slough, Bucks, England was to receive GEOS orbital parameters by teletype from the GOCC and generate International Participants' station predictions and transmit them by teletype to the respective stations. On this basis, sample Time Ordered MVE GEOS Predictions were provided in the tests rather than Station-Ordered Predictions. It was indicated, however, that if requested, Station-Ordered Predictions containing azimuth, elevation, local hour angle, and declination could be provided for individual stations.

The following predictions were explained giving the frequency of distribution, period covered, prediction data format, and included a sample teletype formatted prediction:

a. International Participants Operational Mutual Visibility GEOS Prediction (Time Ordered).

b. International Participants Long Range Mutual Visibility GEOS Prediction (Time Ordered).

3.3.4 Operational Reports

The various operational reports were discussed, outlining the participant's responsibility for providing the required data necessary for continuing the GEOS mission in the best interests of all geodetic participants and mission objectives. The means for a participant to request particular periods of mutually visible events, and the report to be published by the GOCC on a monthly basis to inform participants of the mission status were also discussed along with sample formats. The following operational reports were discussed:

a. Weekly Field Station Optical Report

b. Monthly Station Status Report

c. Mutual Visibility Event Request

d. GEOS New Letter Report

3.3.5 Observational Reports

In addition to the various operational reports required, the observational report format for the precision reduced optical data was included. The format for the reduced data was given as well as the frequency (two months from the observation) and the mailing address of the Geodetic Satellites Data Service to which it was to be sent.

3.3.6 Tracking Complement

The Tracking Complement List, the listing of all GEOS participants and equipments, was described. Each participant was requested to review the list and provide corrections if required.

3.4 TEST RESULTS

3.4.1 Anticipated Results

It was desired that each recipient would respond to this Readiness Test and indicate whether he could supply the necessary operational and observational data, what lists he did or did not wish to receive, and provide any necessary corrections to the Tracking Complement List.

3.4.2 Actual Results

In actuality, response from the participants was not as good as expected, so that little additional information was obtained regarding the MVE data distribution. It was considered that some benefit was derived from the exercise, since some of the data was undoubtedly read by the participants, providing them a better understanding of the GEOS mission and of the prediction's data and report requirements. The exercise did, however, produce a small amount of data regarding corrections to the tracking complement.

3.5 TEST FOLLOWUP

After the Readiness Tests were conducted with the International Participants, the type of MVE GEOS predictions for the International Participants was changed from a single time ordered prediction to individual station predictions for each of the supporting International Participants.

The distribution list for International Participants was modified slightly from a new listing provided by Colonel Kelsey of the Radio Space Research Station.

SECTION 4

OPTICAL PREDICTION SIMULATION TEST

4.1 INTRODUCTION

The Optical Prediction Simulation consisted of simulated MVE GEOS teletype predictions prepared by the GSFC Data Systems Division in the proper format for each of the GEOS supporting networks. The predictions, which were on five-level teletype tape, were transmitted to each GEOS participating network served by some form of teletype communications facility.

4.2 TEST OBJECTIVES

The objectives of this test were as follows:

a. Verify the type and effectiveness of communications facilities to each of the distribution centers for optical data.

b. Determine the speed with which the predictions could be disseminated to the participants.

c. Determine if the data formats were acceptable to intra-network unique teletype machine function requirements, and evaluate the formats for suitability and for accurate data transfer.

d. Familiarize the GEOS optical station participants with the GEOS prediction data formats.

e. Provide the GOCC with experience in distributing the data and provide opportunity to develop handling and distribution procedures prior to beginning of actual operations.

4.3 PRE-TEST ACTIVITY

Prior to the actual simulation test a number of preliminary checks on the data were made to assure that the teletype formats were valid for all facilities involved. In running these

preliminary checks a number of format and machine function problems were detected and corrected prior to the actual network tests.

4.4 TEST OPERATIONS

The simulated predictions were prepared on five-level teletype paper tape by the GSFC Data Systems Division. In so doing, the teletype formatting program for preparing the prediction data on teletype tape from magnetic tape was also checked out. A number of minor formatting and unique network teletype machine function problems were detected resulting in modifications to the formatting program.

The GOCC was the focal point of these tests, initiating the test predictions to the participants utilizing all communications facilities available for its use (see Table 4-1).

4.4.1 Type of Predictions

The following types of teletype data were generated for this test:

a. Operation Mutual Visibility Predictions for GEOS

b. Long Range Mutual Visibility Predictions for GEOS

c. APL Light Flash Request (APL only)

It had been planned to also simulate Plate Reduction Predictions but the MVE program for generating the plate reduction data was not completed in time to produce these predictions for the test to be of any significant value.

4.4.2 Test Participants

The APL Light Flash Request was transmitted only to the Applied Physics Laboratory over the private wire teletype facility between the GOCC and the APL/SCC.

TABLE 4-1. GEOS A TTY PREDICTION SIMULATION (Sheet 1 of 2)

ITEM NUMBER	STATION NUMBER	STATION IDENTIFICATION	TYPE PREDICTION			DATE TRANSMITTED	DATE STATION RECEIVED	TRANSMISSION MODE	REMARKS
			OPER.	L.R.	P.R.				
1	1021	1BPOIN	X	X	NONE AVAILABLE	10/11	10/11	NASCOM TTY	
2	1022	1FTMYR	X	X		10/9	10/9	"	
3	1024	1OOMER	X	X		10/9	10/9	"	
4	1025	1QUITO	X	X		10/7	10/7	"	
5	1026	1LIMAP	X	X		10/8	10/8	"	
6	1028	1SATAG	X	X		10/7	10/7	"	
7	1030	1MOJAV	X	X		10/8	10/8	"	
8	1031	1JOBUR	X	X		10/7	10/7	"	
9	1032	1NEWFL	X	X		10/8	10/8	"	
10	1033	1COLEG	X	X		10/9	10/9	"	
11	1034	1GFORK	X	X		10/8	10/8	"	
12	1035	1WNKFL	X	X		10/8	10/8	"	
13	1036	1EDINB	X	X		10/9	10/9	TWX	
14	1037	1COLBA	X	X		10/8	10/8	"	
15	1039	1BERMD	X	X		10/8	10/8	NASCOM TTY	
16	1040	1PURIO	X	X		10/16	10/21	TELEX	Received over Weekend
17	1042	1ROSMA	X	X		10/8	10/8	NASCOM TTY	
18	1043	1GSFCP	X	X		10/10	10/10	COURIER	
19	1050	GODLAS	LASER					"	
20	1045	1DENVR	X	X		10/8	10/8	TWX	
21	1071	1JUM24	X	X		10/13	10/13	"	All
22	1072	1JUM40	X	X		10/13	10/13	"	to
23	1073	1JUPCI	X	X		10/13	10/13	"	Jupiter
24	1074	1JUBC4	X	X		10/13	10/13	"	Florida
25	3020	AFCMBR	LASER		N/A	10/9	10/9	DOD TTY	Hanscom Field Bedford
26	3401	BEDFRD	X	-	N/A	10/9	10/9	"	
27	3400	USAFAC	X	-	N/A	10/9	10/10	"	

Table 4-1. GEOS A TTY PREDICTION SIMULATION (Sheet 2 of 2)

ITEM NUMBER	STATION NUMBER	STATION IDENTIFICATION	TYPE PREDICTION			DATE TRANSMITTED	DATE STATION RECEIVED	TRANSMISSION MODE	REMARKS
			OPER.	L.R.	P.R.				
28	3400	USAFAC	--	X	N/A	10/12	10/14	DOD TTY	All sent
29	3413	SL413X	X		N/A	10/12	10/14	"	to 1381st
30	3417	RB417X	X		N/A	10/12	10/14	"	F. E.
31	3420	SH420X	X		N/A	10/12	10/14	"	Warren
32	3421	HOMEST	X	X	N/A	10/12	10/14	"	AFB.
33	3422	GRNVLE	X	X	N/A	10/12	10/14	"	Some
34	3423	SAVANX	X	X	N/A	10/12	10/14	"	Data
35	3424	COLDLX	X	X	N/A	10/12	10/14	"	Garbled
36		*All SAO Stas	X	-	N/A	10/10 *	10/10 *	NASCOM TTY	All SAO Station Predictions Transmitted to SAO Camb.
37	8001	MUNCHN	X	-	N/A	10/7	10/11	NASCOM TTY to RSRS	Mailed FM RSRS
38	8002	BOCHUM	X	-	N/A	10/7	**	"	No Reply
39	8003	BERLIN	X	-	N/A	10/7	**	"	No Reply
40	8004	BRNSCH	X	-	N/A	10/7	10/14	"	Mailed FM RSRS
41	8005	FKFURT	X	-	N/A	10/7	10/11	"	"
42	8006	BAMBRG	X	-	N/A	10/7	10/18	"	"
43	8007	TUORLA	X	-	N/A	10/7	10/10	"	"
44	8008	UPPALA	X	-	N/A	10/7	**	"	No Reply
45	8009	DELFTH	X	-	N/A	10/7	10/11	"	Mailed FM RSRS
46	8010	ZIMWLD	X	-	N/A	10/7	10/10-17	"	"
47	8011	MALVRN	X	-	N/A	10/7	10/11	"	"
48	8012	MEUDON	X	-	N/A	10/7	10/11	"	"
49	8013	ROYOBS	X	-	N/A	10/7	**	"	No Reply
50	--	TRIEST	X	-	N/A	10/7	10/14	"	Mailed FM RSRS
51	--	SWEDEN	X	-	N/A	10/7	10/14	"	"
52	8014	ATHENS	X	-	N/A	10/7	10/14	"	"

* No data on how SAO transmitted this data to their stations and when received by their stations.

** One operation predict transmitted to RSRS (LCHT) for relaying to International Participants. Have no check that these were sent by RSRS (LCHT).

N/A Not Applicable

The Operational and Long Range Predictions were transmitted to the distribution centers and to individual participants, as shown in Table 4-1. Appendix B is a sample of the GEOS simulation prediction and its directive message that was sent out to the optical participants for this test.

4.4.3 Test Results

The Optical Prediction Simulation Test proved to be very beneficial in preparing those involved for actual operations. There were essentially two types of results gleaned from the tests; namely, primary and secondary. The primary results required immediate resolution to complete the tests and the secondary results indicated a change or need for some additional activity.

4.4.3.1 Primary Results

4.4.3.1.1 Accuracy of Predictions Delivered

With the exception of the USAF stations all predictions were delivered over the available communications links with a minimum of errors. The USAF predictions were received with several garbled sections. This problem was due partly to a broken prediction tape and to an apparent bad communications link at the time of the test as subsequent operational predictions have been made with no problems.

4.4.3.1.2 Prediction Data Formats

The tests clearly indicated the need for two minor changes in the prediction formats which were made shortly after the tests. These were as follows:

a. All data columns require filling in to the left with zeros when numbers are not needed so the recipient can tell if a number is dropped during transmission.

b. An end of prediction designation and line count was required so that the recipient could verify that a complete prediction had been received.

4.4.3.1.3 Prediction Delivery Times

With the exception of a few of the International Participants (see Table 4-1), all other participants received the predictions in an acceptable time period (within six days from the transmitted date) for a normal type operation. Predictions for the International Participants were sent by teletype to the Radio Space Research Station at Datchet, England and were mailed from there. However, lengthy delays were encountered after mailing.

To alleviate the time problem with the International participants, the GOCC is currently mailing the predictions directly to the International Participants as well as transmitting them by teletype to the Radio Space Research Station for mail forwarding. The results of this are not available at this time. Also, the time schedule for generating the predictions is being moved ahead one week which should give the necessary additional time for delivering the predictions via mail from either the GSFC or the Radio Space Research Station.

4.4.3.1.4 APL Light Flash Request Simulation

As a result of the simulation test it was determined that the Light Flash Request could be transmitted to the APL over the private wire teletype circuit without error. As a result, this data is now transmitted over the teletype circuit rather than hand-carried by courier as had been originally planned.

The format for the Light Flash Request was modified slightly to correct a minor error and to add a missing machine function. The data received by the APL was verified and simulated injection tapes produced.

4.4.3.2 Secondary Results - Teletype Distribution Procedures

In distributing the simulated teletype predictions it became apparent that a standard distribution list was needed as a working document for the GOCC to distribute the predictions to the proper agencies and stations on a continuing basis. Appendix C is a revised copy of the "Geodetic Operations Control Center GEOS A Observational Prediction Distribution and Procedures" prepared for this purpose. In addition a prediction log sheet was implemented by the GOCC to record delivery of all predictions.

4.5 RECOMMENDATIONS

With the exception of the delivery to the International Participants, delivery of optical predictions has become a fairly routine operation.

An alternate method of delivery to the International Participants would be arranging for delivery of the data by commercial teletype (TELEX) to those participants that either have or can get TELEX service. The NASA communications switching center at the Electra House in London, England, was contacted and indicated it could handle the GEOS prediction traffic. TELEX rates from the United States are about $3.00 per minute. However, from England the rate is only about $0.20 per minute; thus, the cost would not be too great since full period NASA teletype circuits are available to the Electra House.

It is recommended that if the predictions cannot be mailed early enough to reach these participants, the feasibility of using TELEX from London should be investigated.

The following is a list of TELEX numbers supplied by the Radio Space Research Station for some of the International Participants. They are listed below for future reference:

a.	Observatoire de Meudon (MEUDON)	TELEX 27912 Paris
b.	Haute Provence (HAUTEP)	TELEX 27912 Paris
c.	Sternwarte der Stadt Bochum (BOCHUM)	TELEX 0825694
d.	Braunschweig, Germany (BRNSCH)	TELEX 0952749
e.	Delft, Netherlands (DELFTH)	TELEX 31448 Library Technological University, Delft
f.	Uppsala, Sweden (UPPALA)	TELEX 7424 Geodetiska Ups
g.	Berne, Switzerland (ZIMWLD)	TELEX 32150 Astronomisches Institut

SECTION 5

SIMULATED MVE LIST DISTRIBUTION

5.1 INTRODUCTION

In addition to the teletype distribution test, an initial distribution of the principal MVE lists containing simulated GEOS data was made to the Principal Investigators and to the major distribution centers.

5.2 OBJECTIVE

The principal objective of this test was to provide the principal GEOS participants with an estimate of the amount and type of data they would be receiving during the geodetic mission so they could become familiar with the data and resolve any questions before operations began. Secondary objectives of the test were to provide a "shakedown" check for the MVE program and for the GOCC operation in preparing the data for shipment; for detecting the problems and delays in shipping and delivery; and for obtaining updated information on station coordinates.

5.3 SIMULATED MVE LISTS

The following MVE lists were generated using nominal GEOS parameters and orbital data:

a. List #1 - Mutual Visibility Events List

b. List #2 - Mutual Visibility Events Condensed List

c. List #3.1 - Network Ordered Mutual Visibility Events List

d. List #3.2 - Listing of Teletype Prediction Messages

e. Tracking Complement List

In addition, an enclosure was provided to explain the various lists and their terminology. Recipients were also asked to correct the Tracking Complement List for their respective stations so that operational predictions could be provided as accurately as possible.

5.4 DISTRIBUTION

The simulated MVE lists were generated by the GSFC Data Systems Division and delivered to the GOCC. The GOCC packaged the data and provided the mailing labels, completing the mailing on 18 October 1965. The data was distributed in accordance with the distribution listed in Appendix D, "Dissemination of GEOS A Data," on Page 2 under "Initial Distribution." Appendix D also gives the distribution for the regular weekly distribution of MVE lists.

5.5 RESULTS

As a result of this test distribution, some corrections to the tracking complement were obtained. In addition, an estimate of the length of time for delivery was determined with consequent steps to improve the distribution time.

The distribution list was firmed up for distribution of operational data and procedures were established for packaging the data, confirming receipt of the data, and for handling the data through the GSFC Transportation Office.

SECTION 6

OPTICAL OPERATIONAL READINESS TESTS

6.1 INTRODUCTION

The Optical Operational Readiness Test was conducted to provide operational experience in photographing the spacecraft's flashing lights during the calibration period before the spacraft was declared operational. The test was conducted from 30 November to 6 December 1965.

6.2 OBJECTIVES

The main objectives of the test were to provide all optical participants with a maximum number of flashing light observations, within spacecraft power constraints, during a 1-week period for operating experience; to obtain spacecraft/observer data on the accuracy of predicted data; and to evaluate overall spacecraft/observer operations. In accomplishing these objectives, the test also produced checks on the following:

a. Performance of the spacecraft's memory and flashing light system.

b. Operational checkout of the APL Light Flash Request, APL's subsequent injection tape program and injection station operation.

c. Operation of the GOCC in distributing predictions and coordinating general mission activities.

Although not a scheduled part of this test, operations were scheduled concurrently with GSFC RARR stations and ARMY SECOR stations for RARR and SECOR data, respectively.

Appendix E is the Optical Operational Readiness Test Plan used as a guideline for this test.

6.3 TEST OPERATIONS

The test operation consisted of optical predictions being generated from the MVE program, coordination and distribution of the test predictions by the GOCC, daily injection of the spacecraft to program the designated flashes and subsequent photographic recording of the flashing light events and reporting to the GOCC by the observer.

6.3.1 Predictions Utilized

In order to guarantee that flashes would be provided for each optical participant, the flash times had to be handpicked from the MVE list rather than generated from the MVE program. The test, therefore, did not check out the complete MVE program but did check out the MVE listing, prediction accuracy and the prediction teletype formatting. The total number of flashes programmed were within the optical power constraints provided by APL.

6.3.1.1 APL Light Flash Request

The APL Light Flash Request was generated giving the flash times for the 1-week test period. The data was transmitted over the GOCC-APL/SSC private wire teletype circuit without error. The APL performed the necessary computations producing seven daily injection tapes for the test period.

6.3.1.2 Operational Predictions

Operational MVE GEOS Predictions were prepared in the approved teletype formats for distribution to the approved distribution centers and individual participants. The predictions covered the period of 30 November to 6 December 1965.

Long Range Predictions for the succeeding two weeks of data were not generated since regular operational predictions were being generated for the following week.

6.3.1.3 Plate Reduction Prediction

Plate reduction predictions were generated to cover only the test period and not the past 2-week period since nc operational data was available for that period. Plate reduction predictions were generated for the normal distribution.

6.3.2 Computer Printouts

Since the predictions were handselected from the MVE list to provide all participants with a maximum number of flashes allowable for the spacecraft power limitations, printouts other than the MVE list could not be generated in the normal manner. Therefore, only a limited number of selected printouts were generated and they were not distributed.

6.3.3 GOCC Operations

During the Readiness Test, the GOCC was the focal point of activity, coordinating the test activity as well as performing normal operations such as monitoring spacecraft health and scheduling other spacecraft operations with electronic tracking participants. The test provided the GOCC with an opportunity to train operating personnel and firm up operating procedures.

6.3.4 Distribution of Operational Test Predictions

Prior to distribution of the teletype predictions, each optical participant was notified of the Readiness Test by teletype and in general what would be required of them. Appendix F is a copy of this pre-test message.

All teletype predictions prepared by the GSFC Data Systems Division for the 30 November to 6 December Operational Readiness Test were delivered to the GOCC on 23 and 24 November for transmission to the participants. The following paragraphs list the distribution. Appendices G and H are samples of the Readiness Test's Operational and Plate Reduction Predictions, respectively.

6.3.4.1 STADAN Stations (MOTS)

Operational and Plate Reduction Predictions for STADAN stations were distributed to the stations by NASCOM teletype facilities under the cognizance of the NETCON (STADAN Network Control). No problems were encountered in this operation and predictions were delivered with ample lead time.

6.3.4.2 Participating MOTS (Special Optical Stations)

Operational and Plate Reduction Predictions were delivered over commercial teletype facilities to each of these stations with no problems. For these predictions the GOCC interfaced directly with the Communications Message Center for transmission of the data.

6.3.4.3 International Participants

Operational Predictions were sent by teletype to the Radio Space Research Station for air mailing to the International Participants. Some lengthy delays were encountered and several of the International Participants reported they did not receive the predictions until after the beginning of the test period, thus losing several days of flash events.

6.3.4.4 USAF Stations

Operational Predictions for all USAF stations were transmitted over DOD teletype facilities to the 1381st GSS, F. E. Warren AFB for relay to the participating USAF stations. In addition, station predictions were also transmitted to the USAF Academy and to Hanscom Field in accordance with established distribution procedures. Plate Reduction Predictions for the USAF stations were mailed to the ACIC, St. Louis, Missouri. This was a change from original plans for sending these predictions by teletype but since the predictions for all USAF stations produced a lengthy message and since there is some delay in the ACIC receiving the plates from their stations, mail proved to be quite satisfactory for their operation.

6.3.4.5 SAO Stations

A single time-ordered Operational Prediction for all SAO stations was transmitted by NASCOM teletype to the Smithsonian Astrophysical Observatory at Cambridge, Massachusetts. SAO generates their own station predictions and distributes them to the SAO Baker-Nunn stations. The SAO also prepares their own plate reductions.

6.3.4.6 AMS and USC&GS Stations

AMS and USC&GS were each furnished with printouts rather than teletype messages. Both agencies provided a courier to pick up the prediction data as planned.

6.4 SUMMARY OF OPTICAL EVENTS

6.4.1 Problems Incurred

During the Operational Readiness Test Period, several problems occurred. On the December 1 injection an operator error caused all flash times for the December 2 operation to be late by two hours. All scheduled operations for the affected period, December 2, were cancelled so that no test data was obtained for that date.

On December 4 and 6, a number of flashes were reported by APL telemetry data readouts as not occurring. This problem was attributed to the light assembly #4 generating noise spikes which triggered the 10-count circuit causing premature shutdown of the flashing light sequence. It was theorized that this problem occurred at other times during the period for which telemetry was not taken; therefore, it is difficult to determine the effect on the station's optical observations.

A minor problem existed with the optical reporting procedures. The optical reports had been requested on a daily basis so that as much information as possible, obtained as rapidly as possible, could be obtained for use in evaluating the MVE program. In actuality, however, this was somewhat self-defeating as some stations reporting

daily had no chance to examine the plates prior to reporting. In these cases the number of flashes photographed, if any, could not be determined from the report and results cannot be determined until plate reduction has been accomplished. Therefore, the stations have been requested to prepare the optical reports on a weekly basis, thus allowing more time to examine the plates for flash images.

Table 6-1 presents a summary of the number of flashes programmed, the number of flashes observed, and the number of flashes unobserved. Appendix I, the GOCC Optical Summary, prepared from the individual station optical reports, gives the complete breakdown of the optical reports by station and time.

Delivery of operational predictions to certain International Participants continued to take a longer time than had been anticipated.

6.4.2 Improvements Made

During the course of the tests, directions were given to stations using 038-01 plates to increase their developing time to 18 minutes at 68°F and to double the agitation time. A number of stations previously having difficulty detecting the GEOS flash images on their plates reported the images were much easier to see with the new developing data.

6.5 TEST RESULTS

As can be noted from Table 6-1, the results of the operational readiness test were quite encouraging. The reason most often given for not reporting images on photographs taken was that plates had not been examined. Changing the optical report to a weekly report should give more time to examine the plates, thereby alleviating this problem to some extent. For events not photographed, the weather was the largest contributing factor. Equipment problems, according to the report data, were a very minor problem. Excluding

TABLE 6-1. OPTICAL SUMMARY

DATE	TOTAL MVE'S	(1) TOTAL POSSIBLE FLASH PARTICIPANTS	(2) TOTAL POSSIBLE FLASHES FOR OBSERVER	(3) PHOTO TAKEN; NO IMAGES FOUND			(4) PHOTO TAKEN; IMAGES FOUND		(5) NO PHOTO TAKEN			REMARKS
				PLATE NOT EXAMINED	OTHER	TOTAL		WEATHER	EQUIP	OTHER	TOTAL	
NOV 30	13	77	539	91	35	126	81	196	28	98	322	
DEC 1	8	70	490	91	56	147	106	154	21	62	237	
DEC 2												EVENTS CANCELLED BECAUSE OF LATE INJECTION
DEC 3	16	75	525	63	90	153	82	259	7	28	294	
DEC 4	16	77	539	56	35	91	81	308	0	42	350	
DEC 5	13	80	560	77	42	119	50	252	21	56	329	
DEC 6	22	106	742	84	175	259	91	280	7	98	385	

Note: All Data Taken from Station Optical Reports

(1) Total number of flash events visible to all scheduled participants.

(2) Total possible lamp flashes; i.e., total number visible events X 7 lamps per flash event. (all events had 7 flashes)

(3) Numbers given are the possible flashes for mutual observation; i.e., one event missed by one station gives a 7; one event missed by two stations 14, etc.

(4) Number of images reported.

(5) Number of total possible flashes missed; same as (3)

the day of the injection error, an average of 55 percent of the possible images were found on the plates taken and examined with a low of 23 percent and a high of 70 percent for the week's operation.

Steps are being initiated by the GEOS T&DS Manager to have the MVE lists and predictions generated a week earlier which should ensure the International Participants receiving the predictions on time. In addition, the GOCC is mailing copies of the predictions directly to the International Participants on a trial basis, as well as sending the data through the Radio Space Research Station.

For the most part, the participants completed the operational reports (optical report) in a conscientious manner with a minimum of delay.

The distribution list for teletype predictions has been firmed up with teletype predictions distribution becoming fairly routine.

Teletype prediction formats have been firmed up with the addition of column fill-out zeros and end-of-prediction notations. Some reduction in transmission time could be realized by eliminating some extraneous machine functions in the format, but as long as circuit time is not a problem, this could remain as at present.

The late injection problem does not seem to present any real problem since it is essentially an operational problem that should be minimal in reoccurrences.

The results by the successful stations tend to verify that the prediction data is accurate and that the flash times are accurate within limits required for satisfactory operation. No conclusions regarding the effect of the spacecraft attitude on these results is attempted in this report.

6.6 RECOMMENDATIONS

It is recommended that the APL implement the capability for being able to inject the GEOS spacecraft on a later orbit should injection fail to occur during the scheduled time. Injection

should be executed so that the flash predictions for the remainder of the injection period would be correct.

It is recommended that an effort be made to move the MVE program up one week to allow more time for delivery of MVE lists and Operational Predictions.

The Optical Reporting has already been changed to a weekly occurrence which somewhat resolves the problem of not having time to examine the plates prior to completing the Optical Report. Should stations continue to experience difficulty in getting the plates examined prior to reporting, two possibilities exist, namely:

a. Slip the report due day several days after the report period.

b. Complete the report in the present manner and supplement with a followup report when the plates are examined.

Item (a) appears to offer the more satisfactory arrangement from an operational point of view.

SECTION 7

GEOS BACKUP INJECTION TEST

7.1 INTRODUCTION

One of the principal subsystems of the GEOS spacecraft is the flashing xenon lamps programmed by an onboard memory system. The memory system is loaded periodically (usually every 24 hours) from a ground injection station providing programmed flashing sequences for up to 68 hours (normally programmed for approximately 24 hours). Since this is one of the principal functions of the spacecraft and since only one station (APL) having injection capability was available, it was deemed desirable to have an additional station that could be activated as a backup injection station should the need arise.

7.2 TEST OBJECTIVE

The objective of this test was to evaluate the capability of providing GEOS backup injection from a NASA facility with a minimum of GEOS unique equipment and to demonstrate this capability by performing a memory injection with the spacecraft.

In completing this objective the following had to be performed:

a. Development of a GEOS Injection program for a NASA Data Acquisition Facility (DAF) computer

b. Development of GEOS unique hardware to supplement the station equipment for generating the GEOS command tones

c. Selection of an injection station

d. Preliminary checkout with the prototype spacecraft

e. Injection simulation/monitoring of GEOS A

f. Injection of GEOS A

7.3 GENERAL TEST OPERATIONS

Before attempting an injection with the GEOS A, a number of preliminary tests with the prototype spacecraft had to be performed and evaluated to ensure that an actual injection could be performed satisfactorily and in a manner that would not endanger the spacecraft.

The ROSMAN station was selected as the tentative backup station because of location and availability of equipment. The initial test to "debug" the injection program and verify compatibility of spacecraft and ground station hardware was conducted at the GSFC because of availability of ground station equipment similar to that at ROSMAN and, of course, its closeness to the GSFC and APL personnel who conducted the tests.

Once the injection program for the station computer was developed and verified and the injection capability proven to be feasible, additional tests with the prototype spacecraft were to be conducted at the ROSMAN station. These tests were to "debug" station equipment and assure the injection program compatibility with the actual station hardware. Upon successful completion of these tests, an injection of the GEOS A spacecraft was to be attempted. See Appendix J for the injection test plan.

7.4 PROTOTYPE INJECTION TESTS

7.4.1 GSFC Tests

The GEOS A prototype spacecraft was delivered to the GSFC Test Station in Building #12, GSFC, on December 1, and tests were conducted on December 1, 2, and 4. These tests were conducted to check out the injection program and ground station-spacecraft equipment compatibility.

7.4.1.1 Test Configuration

The prototype GEOS A spacecraft was set up at the GSFC Building #12 test station. The "injection station equipment" i.e.,

AD/ECS computer, GEOS FSK modulator, and PCM DHE (Data Handling Equipment) was located in the OAO Control Center of Building #14. Test injections were initiated from the OAO Control Center over intra-building circuits to the test station setup and thence to the prototype spacecraft. Figure 7-1 shows the basic test system used for this test.

7.4.1.2 Computer Program

The computer program developed for the AD/ECS computer by ADCOM Inc. was used for the injection tests. Only minor changes were required in the program for the successful injection of the prototype spacecraft. Both resynchronizing and synchronous injections were successfully conducted. The resynchronizing injection was somewhat more difficult to perform due to critical time synchronizing.

7.4.1.3 Spacecraft-Computer Timing

The GSFC conducted injection tests were initiated with the resynchronizing injection to set the spacecraft clock with WWV time since it could not be set manually to start. Synchronous injections were then performed as long as the spacecraft time and WWV time were synchronized with resynchronizing injections made to reset the spacecraft clock when necessary. There was some spacecraft clock drift due to the fact that the clock requires several days running to stabilize.

7.4.2 ROSMAN Tests

The GEOS A prototype spacecraft was delivered to the ROSMAN site on December 6 with ensuing tests conducted on December 7 to 10. These tests were conducted to check out the injection program on the ROSMAN AD/ECS computer, to check out the ground station/spacecraft equipment compatibility and to provide training for station personnel.

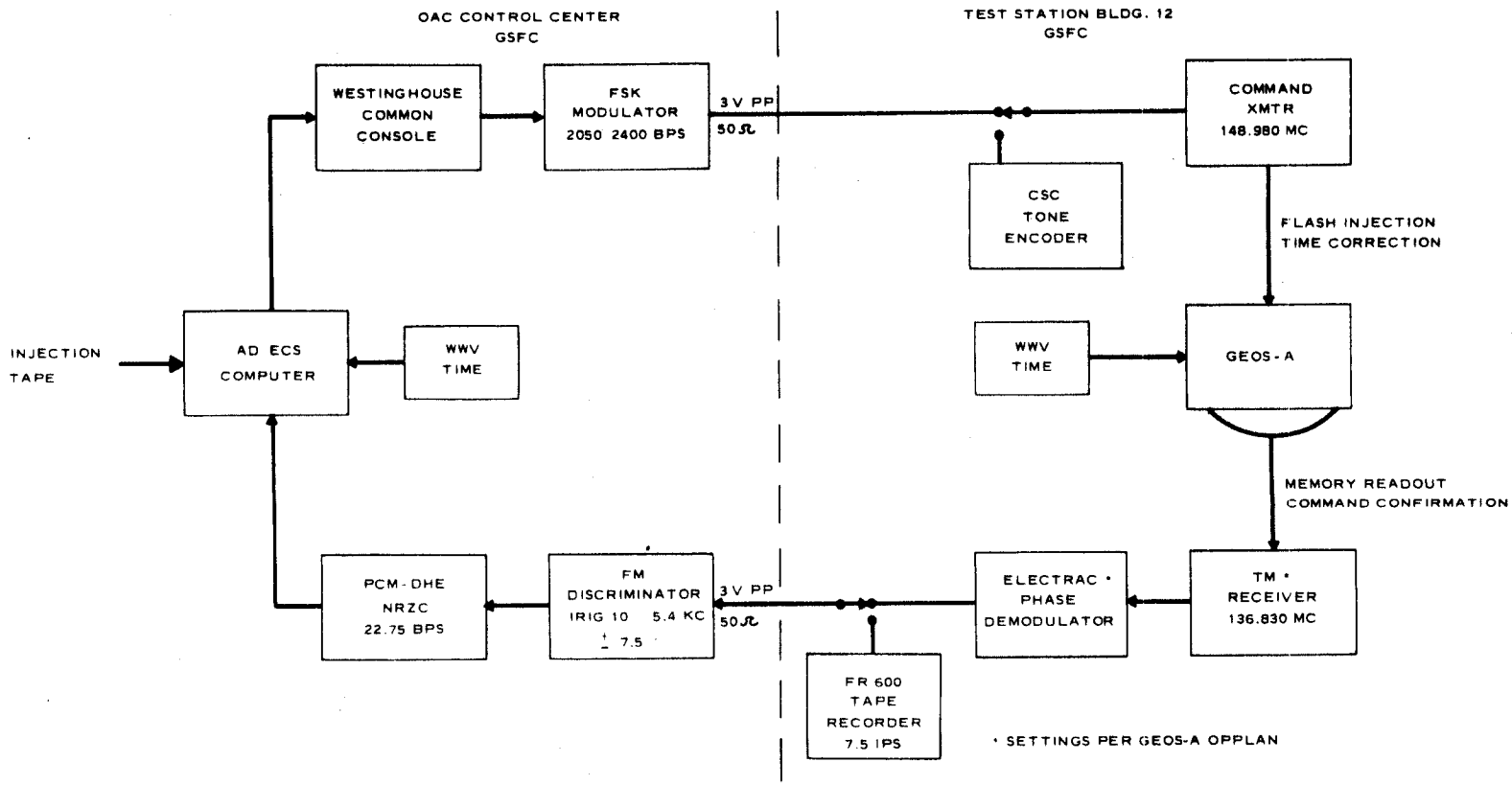


Figure 7-1. GEOS A Prototype Spacecraft Injection Test, GSFC Test

7.4.2.1 Equipment Test Configuration

The ROSMAN test configuration was essentially the same as for the tests at the GSFC, and is shown in Figure 7-2.

7.4.2.2 Test Operations

Since the prototype spacecraft clock had not been synchronized, the resynchronizing injection was conducted first to synchronize the spacecraft time with local station time. In performing the resynchronizing injection, the 22.75-cps data bit rate clock was generated by conversion because the local computer did not have a 22.75-cps clock pulse available. One problem was encountered in performing the resynchronizing injection. A local computer noise problem generated noise spikes when operating a particular internal counting routing for reading in timing, causing spurious "zeros" instead of all "ones," thus preventing proper resynchronizing injection. The program was modified so that it would not read in time during critical injection times, thus permitting successful injection.

Since a GEOS time decoder was not available to decode the spacecraft timing and provide external clock synch to the ground station computer, the time difference between station time and spacecraft time, due to station WWV time error, equipment delay times and half-bit advance times was calculated. This calculated correction, Δt, was applied to the program to ensure computer-spacecraft synchronization within a 22.750-cps clock pulse interval of the spacecraft clock which was required to achieve a successful injection.

7.4.2.3 Injection Tape Transmission

An injection tape covering the period of the ROSMAN prototype spacecraft injection tests was obtained from the APL and transmitted to the ROSMAN station via the NASCOM Digitronics High Speed Paper Tape System. Two problems were encountered in this operation. The first problem was that the Digitronics

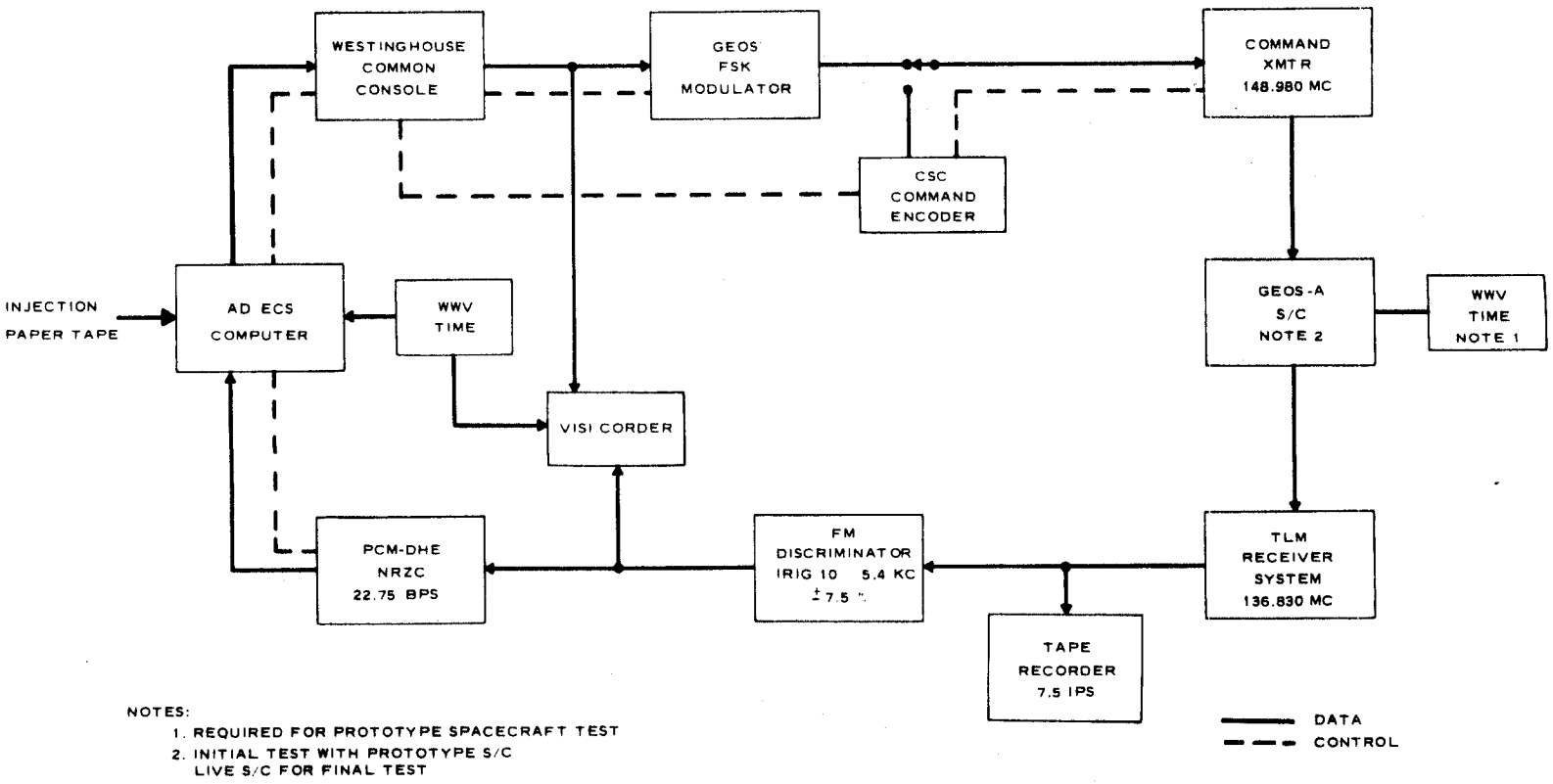


Figure 7-2. ROSMAN Injection Tests, GEOS A Spacecraft

paper tape reader would not accept the tape supplied by APL, for it was thicker and more dense than that normally used. This problem was readily solved by producing a duplicate tape on an acceptable weight tape. The second problem was more serious and makes the use of the Digitronics system unsatisfactory for transmitting the injection tapes except as an emergency procedure. The Injection Tape separates each word by a number of blanks. However, the Digitronics reader does not recognize the blanks, therefore, it strips them out, causing the tape at the receiving terminal to have no blank function separations between words. It was possible for the test personnel to reconstruct a correct tape, but the system would not be acceptable for use during normal operations as it is too difficult to reinsert the blank functions.

7.4.3 Results of Preliminary Test

The tests at the GSFC and the ROSMAN station satisfactorily demonstrated the potential for loading the GEOS A memory from the ROSMAN station. They also demonstrated that potential injection capability was available at the GSFC OAO Control Center, or similarly equipped GSFC control center, for initiating remote injections. This system was not tried over the wideband facility to ROSMAN, but this should present no problem. No further formal tests are planned for the OAO Control Center since the Control Center is commencing readiness checkouts for their own spacecraft operations and because it is felt that the more practical GEOS backup injection capability from an operational, personnel, and equipment standpoint is the ROSMAN station.

The need for a different means of getting the injection tapes to ROSMAN was demonstrated resulting in two possible methods; namely, mail for the normal operation, and OAO Control Center high quality teletype facility for corrections such as daily time updating, et cetera.

Station personnel were indoctrinated into the injection procedures and with some additional practice and firmed operating procedures they should be able to satisfactorily perform GEOS injections on a backup or routine basis.

7.5 ROSMAN GEOS A LIVE INJECTION TESTS

Upon completion of the successful injection tests with the prototype spacecraft, the injection tests were reviewed and the determination made that an injection could be made safely with the orbiting spacecraft.

The test team of Mr. Foxe, Code 514, GSFC, and Mr. Green, a programmer/systems analyst from ADCOM, Inc., were at the ROSMAN station for the injection and the preinjection monitoring. Mr. Kowal of APL was at the APL Injection Station during the injection.

7.5.1 Injection Test Plan

The test plan specified that ROSMAN monitor and simulate injection along with APL's injections on December 22 and 23 (universal time) and then to inject the spacecraft on December 24 at 0107 (universal time).

7.5.2 Injection Simulation/Monitor

ROSMAN was provided with an injection tape transmitted to them over the OAO high quality teletype facility. This facility automatically retransmits a copy back to the originating station for comparison thus assuring an accurate transmitted copy. The ROSMAN station personnel and test personnel setup for the injection simulation, completing the prepass routine in the same manner as for an actual injection. Essentially, the only difference between the injection simulation/monitor and the actual injection was that the injection simulation/monitor "dummied out" the command transmitter so that the initiated commands were not radiated to the spacecraft. The ROSMAN simulation/monitor was conducted at the same time as the

APL injection so that the GEOS A memory readout appeared to the ROSMAN receiving equipment as if ROSMAN had injected.

The simulation/monitor operation was performed on December 23 (universal time) with all indications that a ROSMAN injection would have been completely successful. The following is a summation of the simulation/monitor conducted on December 23, at 0102 universal time, simultaneous with APL's actual injection.

A. Preload (Previous Injection Verification)

Word 61 had a count of 11 greater than the injection tape showed (related to operation of lamp assembly #4). All other 65 words were confirmed correctly. The APL recorded the same information.

B. Injection (measured on visicorder)

B.1 Up data to station time offset - 46 ms early
B.2 Programmed time offset - 50 ms early
B.3 Nominal station to WWV time - 3.6 ms late
B.4 Range delay for spacecraft at 2250 km - 7.5 ms

C. Postlaunch (Injection Verification)

C.1 All 65 words confirmed correct
C.2 GEOS word 1 bit 1 time to station time (minute mark) difference - 8 ms late

7.5.3 ROSMAN Injection

The plan of operation for the ROSMAN injection on December 24 (0107 Z) was for ROSMAN to inject, then for APL to dump the ROSMAN load and inject from the Howard County Station. ROSMAN performed the injection successfully on the first attempt with the APL Injection Station monitoring the injection and the spacecraft performance. The APL station confirmed the successful injection and was satisfied with the operation and therefore did not dump and reinject as planned. The ROSMAN injection, although not a planned part of the test, was the first injection loading the spacecraft for two days of flash times.

The injection effort went smoothly with the station personnel performing the preinjection checkout and injection efficiently. The APL Injection Station monitored the injection and the GOCC, APL and ROSMAN were in voice contact during the exercise.

The results of the ROSMAN injection were as follows:

A. Preload (Previous Injection Verification)

Word 61 had a count of 43 less than injection tape showed (related to problem with lamp assembly #4). All other 65 words confirmed correctly. The same data was also recorded by the APL.

B. Injection

B.1 Programmed offset - 44 ms early
B.1.1 Half Bit advance (fixed constant in program) - 22 ms
B.1.2 Propagation Delay - 7.5 ms nominal
B.1.3 Station Equipment delay - 6.0 ms nominal
B.1.4 Station Time retard from WWV - 3.5 ms nominal
B.1.5 Spacecraft Equipment Delay - 5.0 ms nominal
B.2 Measured offset at Visicorder - 38.5 ms

C. Postload (Injection Verification)

C.1 All 65 words confirmed correctly
C.2 The leading edge of bit 1, word 1, which occurs on the spacecraft minute, was received 7 ms after the minute as expected.

7.5.4 Results

The injection from ROSMAN definitely demonstrated that ROSMAN can perform the synchronous injection with the required degree of accuracy. Bit and frame synch was obtained with no problem. The timing accuracy with which the synchronous injection can be performed appears to be well within the required limit of one 22.750-cps spacecraft clock pulse interval (±22 ms from center of pulse).

The programmed backup synchronous injection was not attempted since the first attempt was successful. This part of the program was previously checked out with simulation tapes and the prototype spacecraft. The resynchronizing test was not attempted since there was no need to reset the spacecraft clock. The tests with the prototype spacecraft indicate that ROSMAN could also successfully perform a resynchronizing injection with the GEOS A spacecraft.

7.6 RECOMMENDATIONS

The following recommendations are made in view of the success of these injection tests:

a. ROSMAN could perform backup synchronous injections to the GEOS A. In view of the success achieved in performing resynchronizing injections with the prototype spacecraft, ROSMAN could also probably perform successful resynchronizing injections with GEOS A.

b. The ROSMAN station should attempt a resynchronizing injection with GEOS A in the near future to demonstrate this capability. It is recommended, however, that due to the critical nature of resynchronizing injections, the APL should perform the resynchronizing injections when they are required if at all possible.

c. If ROSMAN is required to perform injections, either the APL or GSFC should monitor and evaluate the spacecraft timing accuracy and prepare fine time clock correction bits for the succeeding injection tapes.

d. The injection procedures used for the ROSMAN injection should be documented for future reference and established in the GOCC and ROSMAN files.

e. ROSMAN station personnel should continue to simulate and monitor a number of injections until each station crew becomes proficient in the operation.

f. Although injections could be initiated from the OAO Control Center or an equivalent control center at the GSFC, the

ROSMAN station offers advantages in the ease of scheduling for nonconflicting operations and availability of trained personnel for 24-hour operation. It should therefore be the facility used for backup injections.

g. The GSFC should obtain the APL IBM 7094 program for generating the injection tapes from the Light Flash Request so that NASA would have a station backup injection capability, and the capability to prepare injection tapes for fine time adjustments for synchronous injections and clock corrections for resynchronous injections.

h. A GEOS time decoder should be provided at the ROSMAN station for accurately synchronizing injections with the spacecraft clock. It would be desirable, although not absolutely necessary, to use the decoder to externally clock the ground station computer, thus assuring ground station time and spacecraft time synchronization. At minimum the ground station computer should be provided with a crystal controlled clock to reduce the time runout during the injection to less than a millisecond. However, this method would not compensate for any drift in the spacecraft clock.

REFERENCES

1. Special Report on GEOS Command System, Contract NAS 5-9705, by Edward P. Greene, ADCOM, Inc., Cambridge, Massachusetts, September 15, 1965.

2. Results of GEOS Memory Injection Simulation/Monitor - 651223 0102Z, Teletype Message GROS to GOCC 23/1802 Z.

3. Results of GEOS Memory Injection 651224 0107Z, Teletype Message GROS to GOCC 24/0327 Z.

4. NASA-GSFC Memorandum From Mr. Foxe to Mr. Segal dated November 22, 1965 entitled "GEOS A Memory Injection Compatibility Tests."

5. SSC Memorandum from Mr. D. E. Pratt to Record dated December 22, 1965 entitled "NASA ROSMAN Data Acquisition Facility Trip Report Contract NASW-1238."

6. Mailing Adresses of International Participants, Teletype Message LCHT 001 to GOCC DTG 24/1130 Z, from D. Smith to Mr. J. Zegalia.

7. NASA-GSFC Memorandum from Mr. M. Foxe to Mr. C. Looney, dated January 10, 1966, entitled "Initial GEOS Memory Injection."

8. SSC Memorandum from Mr. D. E. Pratt to Record, dated January 20, 1966, entitled "Computer Clock Synchronization and Spacecraft Fine Time Adjustment Capability at ROSMAN DAF."

9. GEOS A Mission Plan, Contract NASW-1238, System Sciences Corp., September 16, 1965.

APPENDIX A

GEOS A OPERATIONAL READINESS TESTS
INTERNATIONAL PARTICIPANTS
PHASE ONE

1.0 GENERAL

This readiness test is intended to familiarize the participants with the operational and observational report formats, the prediction formats, the various computer printouts of flashing light schedules, etc. This supersedes and replaces all instructions and forms in GOCC teletype message dated 29 July 1965, 1334Z. The attached formats are those that will be used by the GSFC in supplying data relative to the mission and those that are to be used by each participant in making operational and observational reports on observations. Completion of these operational and observational reports will be required of each participant to fulfill his obligation as a participant in the GEOS A program. It is requested that each recipient review each format and advise the GOCC of any difficulty in using the data, or in completing the necessary operational and observational forms, and the need for each type of prediction or listing. A format and explanation is provided for each.

This readiness test is divided into three parts, listings and predictions, operational reports and observational data reports.

Any comments or questions on these formats should be addressed as follows:

Geodetic Operations Control Center
Attn: Mr. J. Zegalia
Code 513
Goddard Space Flight Center
Greenbelt, Maryland

2.0 PREDICTIONS AND MUTUAL VISIBILITY EVENT LISTINGS

The GSFC will provide the predictions and computer listings covered in this section to each International Participant in the

GEOS A Program. It is requested that each recipient review the predictions, especially the mutual visibility events lists, to determine if they are adequate for his operations and if he desires to receive all the lists discussed here.

2.1 Mutual Visibility Events List

This is a time ordered list of all Mutual Visibility Events (MVE's) which includes those events that have already been selected for the flash schedule and those that were rejected with an indication of why they were rejected. This list of events is generated weekly covering the operational and long range prediction periods. The list will be mailed to each participant on a weekly basis, one week in advance, covering a 3-week period. The parameters included in this listing are as follows:

1. GMT time of the midpoint of the flash sequence
2. An indication of whether the event was scheduled or not. An asterisk indicates those potential MVE's that are selected.
3. Designation of the stations participating in the event
4. Station number
5. Type of tracking instrument
6. Azimuth
7. Elevation
8. Range
9. Range Rate
10. Local hour angle
11. Declination
12. Right ascension
13. Sub-satellite latitude
14. Sub-satellite longitude
15. Height

16. (Node-GST)

17. $\omega \pm$ (Node-GST)

18. Light angle

19. Sun elevation angle

20. Moon angle

21. Image size

22. Number of lamps in each flash of the sequence (1 to 4)

23. Weight for the event

24. An indication of the non-participation of some stations in a scheduled event. An "F" denotes stations not participating due to moon angle or image size criteria and an "R" is used to denote non-participation because of the camera reloading time requirement.

Figures 1 and 2 are respectively, a sample Mutual Visibility Events List printout and explanation of the format.

2.2 Mutual Visibility Events Condensed List

This list will also be mailed out weekly to each participant, one week in advance, for a 3-week period. This list will be a one-line time-ordered flash event summary or condensed list of the Mutual Visibility Events List for the selected MVE's which are scheduled for flashes. Quantities included in this print-out are as follows:

1. GMT time of the middle flash in the sequence
2. Participation in scheduled events according to:
   - 2.1 Optical stations
   - 2.2 Electronic stations
   - 2.3 Total number of tracking stations
   - 2.4 Baker-Nunn, MOTS, PC-1000 and BC-4 cameras
   - 2.5 SECOR, Doppler, Minitrack, Laser and Range/Range Rate systems
   - 2.6 Total number of networks
   - 2.7 International tracking systems

3. Sub-satellite latitude and longitude

4. Light beacon power information for each scheduled sequence consisting of:

4.1 Flashes available before flashing

4.2 Flashes available after flashing

4.3 Battery level before flashing (percentage)

4.4 Percent of potential MVE's selected for the current day. (Cumulative percentage up to the present time sequence.)

5. Number of lamps flashed in the sequence (1, 2, 3 or 4).

Also associated with this printout will be daily and weekly totals and a total for the operational long-range prediction period for items 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, and 5.

Figure 3 is a sample printout of this list.

2.3 Network Ordered Mutual Visibility Events List

The Network Ordered Mutual Visibility Events List is a listing of station prediction quantities for scheduled flash Mutual Visibility Events. This list will be ordered by network; by station; by the period of coverage of the prediction, operational or long range; and according to time for each station. This list will be generated weekly for a 3-week period, one week in advance, and will be mailed to each participant.

Figure 4 is a sample printout of this list.

2.4 History Tape List

The History Tape List will contain information such as; distributions of observations in (Node-GST); $\omega \pm$ (Node-GST); azimuth, elevation and range per station; telemetry information received from the APL concerning the status of the spacecraft; and information concerning station and network participation in executed flash sequences. This list will be updated weekly and mailed to the individual participants.

Figure 5 is a sample of the type of information contained in this list.

2.5 Tracking Complement List

The Tracking Complement List is a network and station ordered list, listing the type of station (optical, Minitrack, etc.) network affiliation, station number and name, geodetic location, minimum and maximum tracking angle, type of equipment, atmospheric extinction factor for optical stations and weighting factor for each participating station.

It is requested that each International Participant review line items 61 through 73, and advise the GOCC of any required corrections or additions to the data.

Figure 6 is the Tracking Complement List listing GEOS A participants.

2.6 Flash Schedule Predictions

Operational and Long Range Predictions will be updated weekly (Reference Figure 9) for each International Participant. These predictions will be sent by teletype to LCHT (DSIR, Slough, Bucks, England) for relaying to each International Participant by commercial teletype where available, mail where it is not. DSIR will also be provided with orbital elements for use in generating station predictions concurrent with these flash schedule predictions for the International Participants. If requested, station ordered predictions containing azimuth, elevation, local hour angle and declination can also be provided for individual stations.

Orbital elements for the GEOS spacecraft will also be distributed to Fort Belvoir, Virginia, for distribution via the SPACEWARN network to participants of this network.

2.6.1 Time Ordered Predictions

2.6.1.1 Operational Time Ordered Predictions

Operational Time Ordered Predictions will be updated weekly for a one week period one week in advance. These predictions

will list time, longitude, latitude, altitude, number of flashes and number of lamps in the flash for each mutual visibility event in view of an International Participant on a time ordered basis as shown in Figure 7.

2.6.1.2 Long Range Time Ordered Predictions

The Long Range Time Ordered Prediction will be essentially the same as the Operational Predictions except they are for two weeks of data updated weekly. They will consist essentially of the same data except they will not be as accurate as the shorter range Operational Predictions. A sample prediction of this type is shown in Figure 8.

3.0 OPERATIONAL REPORTS

Operational reports are those reports giving information that is necessary in scheduling and improving general mission operations. Each GEOS participant will be requested to provide certain reports so that the GEOS mission can be continued in the best interest of all geodetic participants. These reports are not in lieu of, or a part of, the required analysis and observational reports to be submitted by each participant as his obligation as a participant in the GEOS mission. As operational reports, they will be used as guidelines in the improvement of operations throughout the GEOS mission.

3.1 Weekly Field Station Optical Report

Each participant employing optical tracking facilities is requested to submit a Weekly Field Station Optical Report covering each optical observation, to the GOCC (Geodetic Operations Control Center) at the GSFC, by teletype facilities through the DSIR station at Slough, Bucks, England, or by mail if teletype is not available. This report will indicate the number of flashes, quality of the photographic plate, weather conditions and reasons for no photograph if none was taken.

All optical participants are requested to submit the Weekly Field Station Optical Report immediately following the week's period being reported. The report should include the indicated information for every scheduled pass operation for the reporting station whether an operation was performed or not. These reports are required for planning new flash sequences, for the intercomparison experiments and for determining the distribution of flash events over a geographic location.

Figure 10 shows the report format and gives a sample report message.

3.2 Monthly Station Status Report

Each participating station in the GEOS Program is requested to complete a Monthly Station Status Report at the end of each report month. This report will include the following:

1. Present and planned changes in support capability including additions or deletions of equipment, changes in station operations, and station relocation if a mobile station.

2. Planned or anticipated future additional requirements of the GSFC Geodetic Operations Control Center, Computation Center, or Geodetic Satellite Data Center for such things as additional ephemeris data, changes in operational or observational data reports, etc.

3. A summary report evaluating the operations of the report month; i.e., an evaluation of the optical data acquired for use in the geodetic mission and of the GSFC inputs to the station operation and any general comments for improving the geodetic mission.

This monthly report should be prepared within five days after the end of the report month and should be mailed to the following:

Geodetic Operations Control Center
Code 513
Goddard Space Flight Center
Greenbelt, Maryland, USA

Figure 11 shows the format for this report.

3.3 GEOS News Letter Report

The GOCC will prepare a monthly report called the GEOS News Letter and will mail copies to each GEOS participant. This report will be based on information obtained from each participant's Monthly Station Status Report and other operational data. It will consist essentially of the following:

1. Summary of all participating network operations for the report month including such items as number of participants, evaluation of observational data, etc.

2. Future planning such as new stations to be added or new capabilities being provided, relocation or deletion of participating stations, new geodetic experiments to be performed, etc.

3. A condensation of the monthly reports mentioned in paragraph 3.2 above.

4. A brief spacecraft history including the total number of orbits, total number of light flashes generated, spacecraft health , expected lifetime, etc.

3.4 Mutual Visibility Event Requests

After examining the Mutual Visibility Events List (Figure 1), individual participants or experimenters may desire a particular period of flash sequences for mutual visibility studies of their own with other stations. Flash requests for selected periods of time should be sent by teletype, if possible, to the GOCC at least two weeks in advance of the requested period. Requests for flashes

will be considered along with other established flash criteria, which take into account spacecraft conditions, universal flash distributions, past weather conditions at scheduled stations, degradation of lamps and the best interests of all GEOS participants commensurate with the geodetic mission. GOCC will acknowledge receipt of the requests, however, stations will not normally be notified of the acceptance or rejection of the flash events requested. If flashes are provided, they will be included in the Operational Flash Schedule Predictions.

Figures 12 and 13 show the formats for submitting these requests to the GOCC. Figure 12 is to be used for mail, and Figure 13 for teletype.

4.0 OBSERVATIONAL DATA REPORT

The Observational Data Report is that report which gives specific data on the GEOS observations. Each qualified participant will mail an Observational Data Report to the GSFC in the approved data format as soon as the data are precision reduced and put onto either punched cards or magnetic tape in the prescribed format. This information will be used by the principal investigators and will be archived for use by any of the qu alified scientists for geodetic analyses.

Observational Data Reports should be submitted within two months of the observation. International participants will be individually responsible for submitting their data to the GSFC.

It is important that each qualified participant provide these reports in a conscientious manner as they will be necessary to successfully meet the scientific objectives of the GEOS Mission. They will also be used to "qualify" stations for receiving flash schedules and for requesting mutual visibility events.

The Observational Data Report is to be mailed to the following:

National Space Science Data Center, Code 601
Attn: Geodetic Satellites Data Center
Goddard Space Flight Center
Greenbelt, Maryland

Figure 14 is the format the observational data is to be put onto punched cards or magnetic tape for submittal to the GSFC.

TIME HHMMSS	MVE	STA	NO.	TYPE	AZ (DEG)	EL (DEG)	R (KM)	RDOT (M/S)	LHA (DEG)	DEC (DEG)	RT ASC (DEG)	SUBSATELLITE LAT	LONG (E)	HT (KM)	N-GST	W+ W-G	W- N-G	L A	SUN EL	MOON ANGL	IMGE (MU)	N L	N P	WT
232212												23.70	347.32	1462.9	332	150	206					0		0
		RB417X	3417	OPT	354.33	25.18	2590.9		16.51	7o.47	334.68							47	-72	105	0.	1	R	
		1SPAIN	4004	OPT	205.68	33.49	2240.7		22.09	-16.36	332.73							43	-54	56	....	1	R	
		LASHAM	2106	DOP	202.61	7.47	3803.7	-5313.6	25.63	-28.19	334.37													
232312	*											26.25	349.01	1458.3	331	150	206					1		28
		1SPAIN	4004	OPT	203.41	41.76	1978.4		17.45	-8.90	337.62							37	-55	64	....	1		
		LASHAM	2106	DOP	200.81	11.08	3487.4	-5223.4	-2o.66	-25.17	337.59													
232412												28.77	350.79	1453.2	331	149	206					0		0
		1SPAIN	4004	OPT	199.40	51.83	1752.5		1 .85	-0.39	343.47							30	-55	73	....	1	R	
		LASHAM	2106	DOP	198.56	15.06	3177.8	-5086.5	-19.33	-21.79	341.17													
232512												31.27	352.67	1447.7	331	149	207					1		28
		1SPAIN	4004	OPT	190.79	63.72	1579.5		4.84	10.55	350.73							21	-55	84	....	1		
		LASHAM	2106	DOP	195.69	19.52	2878.3	-4885.0	-15.55	-17.97	345.21													
232612												33.73	354.67	1441.8	331	149	207					0		0
		1SPAIN	4004	OPT	184.15	75.69	1479.0		-4.19	22.63	0.02							11	-55	97	....	1	R	
		ZIMWLD	8010	OPT	221.29	27.41	2455.9		-36.16	-6.89	333.33							46	-46	61	0.	1	R	
		MEUDCN	8012	OPT	203.47	28.00	2430.4		-2o.94	-10.38	343.32							46	-44	68	0.	1	R	
		LASHAM	2106	DOP	191.92	24.53	2593.4	-4592.9	-11.14	-13.56	349.85													
232712	*											36.15	356.81	1435.4	330	149	207					2		32
		1WNKFL	1035	OPT	187.67	29.50	2357.2		-6.75	-8.77	354.83							45	-41	79	54.7	2		
		1SPAIN	4004	OPT	92.81	76.90	1466.5		-15.99	34.74	12.97							11	-55	112	....	1		
		MUNCHN	8001	OPT	227.58	28.75	2388.1		-4o.38	-2.34	332.91							46	-45	62	105.0	1	R	
		BOCHUM	8002	OPT	210.16	26.96	2514.6		-27.15	-8.19	342.33							47	-42	68	90.6	1	R	
		FKFURT	8005	OPT	216.05	27.39	2447.4		-31.71	-6.19	339.09							46	-43	66	98.0	1	R	
		BAMBRG	8006	OPT	222.26	25.66	2528.8		-37.53	-5.66	335.64							47	-43	63	79.3	1		
		DELFTH	8009	OPT	201.83	26.49	2489.9		-19.70	-9.2o	346.94							47	-41	72	93.3	1	R	
		ZIMWLD	8010	OPT	220.75	34.53	2166.2		-3o.54	-0.74	337.21							42	-46	67	111.1	1		
		MALVRN	8011	OPT	183.56	28.10	2417.3		-3.18	-9.70	357.11							46	-41	81	130.0	1		
		MEUDCN	8012	OPT	199.64	34.83	2156.6		-16.17	-4.55	348.44							42	-44	75	124.6	1	R	
		LASHAM	2106	DOP	186.77	30.17	2329.7	-4172.9	-5.92	-8.42	355.34													
232812												38.53	359.11	1428.7	330	149	208					0		0
		1WNKFL	1035	OPT	180.69	35.67	2119.7		3.56	-2.88	1.27							41	-41	87	0.	1	R	
		1SPAIN	4004	OPT	60.65	65.18	1544.3		-31.06	44.82	27.38							20	-55	125	....	1	R	
		MUNCHN	8001	OPT	227.87	36.19	2101.8		-36.88	4.24	336.65							41	-45	69	0.	1	R	
		BOCHUM	8002	OPT	207.16	32.53	2229.3		-22.66	-2.71	347.06							43	-42	75	0.	1	R	
		BERLIN	8003	OPT	221.45	25.54	2525.4		-36.78	-4.02	339.17							47	-40	67	0.	1	R	
		BRNSCH	8004	OPT	214.14	27.70	2425.5		-29.89	-4.36	343.14							46	-40	70	0.	1	R	
		FKFURT	8005	OPT	214.04	34.42	2160.5		-27.50	-0.29	343.55							42	-43	73	0.	1	R	
		HAMBRG	8006	OPT	221.34	32.41	2233.5		-33.89	0.09	339.53							43	-43	69	0.	1	R	
		DELFTH	8009	OPT	197.47	32.96	2217.1		-14.64	-3.76	352.25							43	-41	79	0.	1	R	
		ZIMWLD	8010	OPT	219.82	43.29	1901.8		-29.00	6.80	342.00							36	-46	75	0.	1	R	

MUTUAL VISIBILITY EVENTS LIST

FIGURE #1

TIME ORDERED LIST OF ALL GEOS-A POTENTIAL FLASH MVE's AND ASSOCIATED PARAMETERS

(AN ASTERISK IN THE MVE COLUMN INDICATES SCHEDULED FLASHES)

YEAR	MONTH	DAY	MOON PHASE
1965	10	1	1/4

TIME HHMMSS	MVE	STA	NO	TYPE	AZ (DEG)	EL (DEG)	R (KM)	RDOT (M/S)	LHA (DEG)	DEC (DEG)	RT ASC (DEG)	SUBSATELLITE POINT LAT	LONG	HT	N-GST	W+ N-GST	W- N-GST	LA	SUN EL	MOON ANGLE	IMGE (MU)	NL	WT	NP
030608	*											-14.09	282.40	1123.4	93	273	86					3	70	
		1LIMAP	0026	OPT	190.44	74.14	1160.8		57.51	-27.35	307.21							13	-59	103	49			R
		1QUITO	0025	OPT	175.95	27.47	1974.9		70.55	-62.87	316.89							49	-56	85	18			F
		1QUIPA	0007	OPT	290.34	52.48	1355.8		78.77	-1.25	281.23							31	-63	105	48			
		PANAMA	0999	DOP	175.10	10.04	2984.1	5486.3	74.57	-70.40	322.50													
		LIMAPU	0006	MIN	190.44	74.14	1160.8		57.51	-27.35	307.21													
030712	*											-16.95	284.02	1127.2	93	273	86					2	75	
		1LIMAP	0026	OPT	167.92	57.35	1299.5		56.46	-43.49	319.61							27	-59	96	40			
		1QUIPA	0007	OPT	261.76	62.79	1240.6		73.10	-18.36	287.84							23	-63	101	41			R
		PANAMA	0999	DOP	172.14	6.21	3318.2	5639.0	74.48	-72.95	335.83													
		LIMAPU	0006	MIN	167.92	57.35	1299.5		56.46	-43.49	319.61													

DEFINITION OF SYMBOLS

TIME - GMT TIME OF MIDDLE FLASH IN THE SEQUENCE
(THIS ALSO INDICATES THE NUMBER OF FLASHES IN THE SEQUENCE)

MVE - MUTUAL VISIBILITY EVENT
PRESENCE OR ABSENCE OF AN ASTERISK INDICATES WHETHER THE EVENT WAS SELECTED OR REJECTED FOR THE FLASH SCHEDULE

STA - STATION DESIGNATION

NO. - STATION NUMBER

TYPE - TYPE OF INSTRUMENT

AZ - AZIMUTH (DEGREES)

EL - ELEVATION (DEGREES)

R - RANGE (KILOMETERS)

RDOT - RANGE RATE (METERS/SECOND)

LHA - LOCAL HOUR ANGLE (DEGREES)

DEC - DECLINATION (DEGREES)

RT ASC - RIGHT ASCENSION (DEGREES)

SUBSATELLITE POINT - LATITUDE, LONGITUDE, HEIGHT

(N-GST), W+(N-GST), W-(N-GST) - NODE-GREENWICH SIDERIAL TIME, PERIGEE ±(NODE-GST); USED FOR DISTRIBUTION PURPOSES

LA - LIGHT ANGLE; ANGLE OF LINE OF SIGHT FROM THE CENTER OF THE LIGHT BEAM

SUN EL - SUN ELEVATION ANGLE

MOON ANGLE - ANGLE BETWEEN STATION SATELLITE AND STATION MOON VECTORS

IMGE (MU) - IMAGE SIZE IN MICRONS

NL - NUMBER OF LAMPS FLASHED

WT - PRIORITY SCORE BASED ON 100

NP - AN INDICATION OF THE NON-PARTICIPATION OF SOME OPTICAL STATIONS IN A SCHEDULED EVENT. A LETTER "F" IS USED IF NON-PARTICIPATION WAS ATTRIBUTED TO MOON ANGLE OR IMAGE SIZE CRITERIA AND AN "R" IS USED IF IT WAS DUE TO CAMERA RELOADING TIME REQUIREMENTS

FIGURE #2

YEAR MONTH DAY

1965 10 6

TIME HHMMSS	NO. CPT	NO. ELEC	TOTAL	BAKER NUNN	MOTS	PC-1000	BC-4	SECOR	COPPLR	MINTRK	LASER	R/R	NET WORKS	INTER-NATIONAL	SUBSATELLITE LAT	SUBSATELLITE LONG(E)	FLASHES AVAILABLE BEFORE	PCT	FLASHES AVAILABLE AFTER	PCT	PCT MVES	N L
000612	6	1	7	1	0	0	5	0	1	0	0	0	3	5	40.05	336.07	210.7	97	189.7	92	100	3
001012	2	1	3	1	1	0	0	0	1	0	0	0	3	0	44.53	341.47	189.7	92	182.7	91	67	1
001212	2	1	3	1	1	0	0	0	1	0	0	0	3	0	48.68	347.86	182.7	91	175.7	89	75	1
001412	11	2	13	1	1	0	9	0	2	0	0	0	4	9	52.36	355.43	175.7	89	154.7	84	80	3
013912	3	1	4	1	2	0	0	0	0	1	0	0	2	0	-12.61	275.00	209.3	97	202.3	95	42	1
014112	3	0	3	1	2	0	0	0	0	0	0	0	2	0	-7.36	277.77	203.7	95	189.7	92	46	2
014412	2	3	5	1	1	0	0	0	1	1	0	1	3	0	0.55	281.80	189.7	92	182.7	91	47	1
014612	3	3	6	1	2	0	0	0	2	0	0	1	3	0	5.82	284.48	182.7	91	168.7	87	47	2
014912	5	3	8	2	3	0	0	0	2	0	0	1	3	0	13.69	288.63	168.7	87	154.7	84	50	2
015112	5	3	8	2	3	0	0	0	2	0	0	1	3	0	18.90	291.58	154.7	84	147.7	83	53	1
015412	10	3	13	2	5	3	0	0	2	0	0	1	4	0	26.58	296.45	147.7	83	133.7	80	55	2
015912	7	4	11	0	2	2	3	0	1	1	1	1	4	0	38.82	306.62	133.7	80	119.7	77	52	2
020312	2	5	7	0	1	0	1	0	3	1	0	1	3	0	47.63	317.90	119.7	77	105.7	73	52	2
021212	10	3	13	0	1	0	9	0	2	1	0	0	3	9	58.94	0.87	107.7	74	93.7	71	47	2
034312	4	4	8	2	2	0	0	0	3	0	0	1	3	0	20.12	264.14	148.3	83	134.3	80	44	2
034512	6	5	11	2	4	0	0	0	3	1	0	1	3	0	25.25	267.38	134.3	80	120.3	77	46	2
034712	13	5	18	2	7	4	0	0	3	0	1	1	4	0	30.28	270.96	120.3	77	106.3	74	47	2
APL INJECTION																						
035912	6	5	11	0	1	0	5	0	3	1	0	1	3	0	55.34	307.80	106.3	74	92.3	71	49	2
040812	8	3	11	0	1	0	7	0	2	1	0	0	3	7	56.74	358.66	97.0	72	83.0	68	46	2
053712	1	4	5	1	0	0	0	0	3	0	0	1	3	0	26.45	240.03	134.2	80	127.2	78	44	1
053912	3	5	8	1	2	0	0	0	3	1	0	1	3	0	31.46	243.70	127.2	78	113.2	75	46	2
054112	7	6	13	1	4	2	0	0	4	0	0	2	4	0	36.33	247.86	113.2	75	99.2	72	47	2
054312	6	6	12	1	5	0	0	0	4	0	0	2	3	0	41.02	252.64	99.2	72	85.2	69	48	2
054512	11	7	18	1	5	3	2	0	5	0	0	2	5	0	45.44	258.23	85.2	69	71.2	66	49	2
072612	1	1	2	1	0	0	0	0	1	0	0	0	2	0	19.99	207.73	127.9	78	120.9	77	43	1
072812	1	1	2	1	0	0	0	0	1	0	0	0	2	0	25.12	210.96	120.9	77	113.9	75	44	1
073012	1	4	5	1	0	0	0	0	3	0	0	1	3	0	30.16	214.53	113.9	75	106.9	74	45	1
074412	5	8	13	0	2	0	3	0	5	1	0	2	3	0	57.54	261.49	106.9	74	85.9	69	43	3
075212	5	5	10	0	1	0	4	0	3	1	0	1	3	0	55.57	307.22	91.2	70	77.2	67	43	2
094812	4	6	10	0	2	1	1	0	3	1	1	1	4	0	47.64	297.99	136.6	80	122.6	77	38	2
104712	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-37.03	117.36	162.3	86	148.3	83	38	2
104912	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-32.16	121.61	149.7	83	142.7	82	39	1
105112	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-27.16	125.36	144.0	82	137.0	80	40	1
105412	2	4	6	1	1	0	0	2	1	0	0	1	4	0	-19.47	130.29	139.0	81	132.0	79	40	1
105612	2	7	9	1	1	0	0	4	2	0	0	1	4	0	-14.26	133.27	133.4	80	119.4	77	41	2

MUTUAL VISIBILITY EVENTS CONDENSED LIST

FIGURE #3

PAGE 1 OF 2

YEAR MONTH DAY

1965 10 6

TIME HHMMSS	NO. OPT	NO. ELEC	TOTAL	BAKER NUNN	MOTS	PC-1000	BC-4	SECOR	DOPPLR	MINTRK	LASER	R/R	NET WORKS	INTER-NATIONAL	SUBSATELLITE LAT	SUBSATELLITE LONG(E)	FLASHES AVAILABLE BEFORE	PCT	AFTER	PCT	PCT MVES	N L
111012	1	8	9	1	0	0	0	6	2	0	0	0	3	0	22.43	152.90	121.4	77	114.4	75	42	1
111212	1	7	8	1	0	0	0	6	1	0	0	0	3	0	27.52	156.28	114.4	75	107.4	74	43	1
111412	1	7	8	1	0	0	0	6	1	0	0	0	3	0	32.50	160.04	107.4	74	100.4	72	43	1
112612	1	4	5	0	1	0	0	0	2	1	0	1	2	0	58.27	210.46	101.1	72	94.1	71	43	1
113812	3	8	11	0	1	2	0	0	5	1	0	2	3	0	50.73	264.12	100.8	72	93.8	71	42	1
114012	1	8	9	0	1	0	0	0	4	1	2	1	3	0	46.62	271.44	95.2	71	88.2	70	43	1
130512	1	5	6	1	0	0	0	3	2	0	0	0	3	0	31.21	130.84	136.0	80	129.0	79	43	1
130712	1	5	6	1	0	0	0	3	2	0	0	0	3	0	36.09	134.97	129.0	79	122.0	77	44	1
130912	1	3	4	1	0	0	0	1	2	0	0	0	3	0	40.78	139.71	122.0	77	115.0	76	44	1
131112	1	1	2	1	0	0	0	0	1	0	0	0	2	0	45.22	145.26	115.0	76	108.0	74	45	1
131312	1	2	3	1	0	0	0	0	2	0	0	0	2	0	49.30	151.81	108.0	74	101.0	72	46	1
145112	1	1	2	1	0	0	0	0	1	0	0	0	2	0	17.13	93.39	157.6	85	150.6	83	44	1
145312	1	1	2	1	0	0	0	0	1	0	0	0	2	0	22.30	96.48	150.6	83	143.6	82	45	1
164312	2	0	2	2	0	0	0	0	0	0	0	0	1	0	18.36	65.94	200.3	95	193.3	93	45	1
164512	2	0	2	2	0	0	0	0	0	0	0	0	1	0	23.51	69.09	193.3	93	186.3	91	46	1
181612	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-29.93	10.68	225.0	100	211.0	97	45	2
181812	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-24.88	14.24	212.3	97	205.3	96	45	1
182012	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-19.73	17.47	206.7	96	199.7	94	46	1
182212	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-14.53	20.46	201.0	95	194.0	93	46	1
182412	2	2	4	1	1	0	0	0	1	0	0	1	3	0	-9.28	23.28	195.4	93	181.4	90	47	2
183512	1	0	1	1	0	0	0	0	0	0	0	0	1	0	19.59	38.50	182.7	91	175.7	89	47	1
222312	1	1	2	1	0	0	0	0	1	0	0	0	2	0	32.12	350.74	225.0	100	218.0	98	42	1
222612	1	1	2	1	0	0	0	0	1	0	0	0	2	0	39.33	357.31	218.0	98	211.0	97	42	1
222812	9	1	10	1	1	0	7	0	1	0	0	0	4	7	43.85	2.58	211.0	97	197.0	94	42	2
223012	2	1	3	1	1	0	0	0	1	0	0	0	3	0	48.06	8.79	197.0	94	190.0	92	43	1
234712	1	1	2	1	0	0	0	0	1	0	0	0	2	0	-38.64	278.61	225.0	100	218.0	98	43	1
234912	1	2	3	1	0	0	0	0	1	1	0	0	3	0	-33.84	283.07	219.3	99	212.3	97	43	1
235012	1	1	2	1	0	0	0	0	1	0	0	0	2	0	-31.37	285.08	213.0	97	206.0	96	43	1
235212	2	2	4	2	0	0	0	0	1	1	0	0	3	0	-26.35	288.76	207.4	96	200.4	95	44	1
235412	1	1	2	1	0	0	0	0	1	0	0	0	2	0	-21.22	292.07	201.7	95	194.7	93	44	1
235612	1	1	2	1	0	0	0	0	1	0	0	0	2	0	-16.04	295.12	196.1	94	189.1	92	45	1
235912	1	1	2	1	0	0	0	0	1	0	0	0	2	0	-8.17	299.36	191.1	92	184.1	91	45	1
TOTALS	214	208	422	65	76	17	56	31	117	17	5	38		37					184.1	90	45	96

MUTUAL VISIBILITY EVENTS CONDENSED LIST

FIGURE #3

PAGE 2 OF 2

STATION NAME	STATION NUMBER	STATION TYPE	NETWORK
BAMBRG	8006	OPT	INIPAR

OPERATIONAL PREDICTIONS

TIME YYMMDD	HHMMSS	N P	MOON PHASE	AZ (DEG)	EL (DEG)	R (KM)	RDOT (M/S)	LHA (DEG)	DEC (DEG)	RT ASC (DEG)	SUBSATELLITE LAT	LONG	HT (KM)	N-GST	W+ N-G	W- N-G	L A	SUN EL	MOON ANGL	IMGE (MU)	N L	WT
651001	213712		1/4	121.93	27.71	2419.4		-48.81	3.09	34.40	39.76	28.55	1424.8	358	177	180	46	-39	121	64.8	1	4
651001	232712		1/4	222.26	25.66	2528.8		-37.53	-5.66	335.64	36.15	356.81	1435.4	330	149	207	47	-43	63	79.3	2	32
651001	232912	R	1/4	219.84	40.67	1961.2		-29.32	7.07	344.35	40.86	1.58	1421.6	330	149	208	38	-43	77	85.1	1	30
651001	233212		1/4	189.47	77.03	1427.6		2.65	37.05	11.77	47.39	10.32	1398.0	329	149	210	10	-43	112	81.2	1	35
651002	12612		1/4	288.34	35.24	2064.2		-77.26	37.37	325.74	52.09	351.23	1376.6	300	120	239	42	-35	80	86.0	1	35
651002	234212		1/4	246.20	65.83	1506.4		-27.68	36.25	350.24	47.72	4.69	1399.1	323	143	217	20	-43	87	77.1	1	35
651003	13912		1/4	320.31	43.97	1787.8		-87.03	62.60	320.21	56.64	359.72	1349.3	293	115	247	37	-33	92	90.3	1	33
651003	215612		1/4	165.61	38.34	2042.6		-11.24	-0.87	3.57	38.18	14.61	1433.5	346	166	194	40	-42	67	114.8	2	34
651003	235312		1/4	276.01	61.97	1538.2		-41.34	44.97	340.31	49.99	2.60	1391.7	316	138	224	23	-43	79	76.3	1	35
651004	15012		1/4	325.14	41.26	1842.6		-96.22	64.39	314.77	57.77	359.78	1340.6	287	109	255	39	-32	90	91.6	1	33
651004	34612		1/4	324.66	36.42	1916.6		104.40	61.28	335.67	58.60	357.97	1294.7	257	80	284	42	-15	90	93.2	1	33
651004	220812		1/4	160.94	55.44	1655.4		-11.14	16.52	7.46	43.14	13.98	1420.4	339	161	202	27	-43	68	74.3	1	35
651005	412		1/4	294.45	55.82	1608.9		-55.22	51.49	330.18	52.09	0.94	1384.0	310	133	232	28	-43	76	76.5	1	35
651005	20112		1/4	328.86	39.70	1871.8		103.01	65.90	311.72	58.54	0.20	1331.7	280	104	262	40	-31	88	92.4	1	33
651005	221512	F	1/4	212.98	30.05	2343.5		28.22	-4.87	330.84	36.58	0.75	1441.6	334	156	207	45	-44	16	72.3	1	30
651005	221712	R	1/4	205.67	46.63	1825.3		17.53	9.04	342.03	41.25	5.57	1428.5	333	156	208	34	-44	34	86.0	1	30
651005	221912		1/4	176.79	68.37	1499.5		1.34	28.28	1.41	45.66	11.22	1413.8	333	156	209	17	-44	60	77.5	1	35
651006	1212	R	1/4	274.86	29.45	2313.0		-73.30	25.06	315.10	48.68	347.86	1402.2	304	127	238	46	-43	45	71.5	1	30
651006	1412		1/4	291.12	43.12	1852.5		-70.63	43.80	318.26	52.36	355.43	1385.1	304	127	239	37	-42	63	87.8	1	35
651006	222512	F	FULL	228.00	25.41	2551.3		-42.26	-3.51	320.29	36.97	354.97	1442.5	328	151	214	47	-44	19	56.5	1	28
651006	222712	F	FULL	227.69	40.31	1981.0		-34.86	9.44	328.19	41.62	359.84	1429.4	327	150	215	38	-44	26	84.6	1	29
651006	222912		FULL	225.84	63.14	1550.3		-21.68	28.65	341.88	46.00	5.56	1414.8	327	150	216	22	-44	45	75.5	1	34
651006	223112	R	FULL	72.84	84.67	1403.4		8.13	51.18	12.19	50.00	12.32	1398.7	326	150	217	4	-45	74	82.0	1	30
651007	2412		FULL	290.54	33.20	2147.0		-80.71	37.44	311.68	52.63	349.94	1386.2	298	122	246	43	-42	58	81.6	1	35
651007	2612	R	FULL	313.88	45.41	1778.4		-80.28	59.11	312.60	55.62	358.99	1367.9	297	122	247	35	-42	77	89.3	1	30
651007	223712	R	FULL	242.75	32.53	2231.8		-49.43	9.35	317.12	41.99	354.12	1430.3	321	145	222	43	-45	36	77.9	1	28
651007	223912	R	FULL	249.41	50.74	1728.6		-41.52	26.66	325.53	46.34	359.90	1415.8	320	145	223	31	-45	43	83.1	1	30
651007	224112		FULL	283.79	75.17	1438.7		-23.33	51.13	344.22	50.30	6.76	1399.8	320	145	224	12	-45	62	80.7	1	34

NETWORK ORDERED MUTUAL VISIBILITY EVENTS LIST

FIGURE #4

PAGE 1 OF 2

STATION NAME	STATION NUMBER	STATION TYPE	NETWORK
BAMBRG	8006	OPT	INTPAR

LONG RANGE PREDICTIONS

TIME YYMMDD	HHMMSS	N P	MOON PHASE	AZ (DEG)	EL (DEG)	R (KM)	RDOT (M/S)	LHA (DEG)	DEC (DEG)	RT ASC (DEG)	SUBSATELLITE LAT	SUBSATELLITE LONG	HT (KM)	N- GST	W+ N-G	W- N-G	L A	SUN EL	MOON ANGL	IMGE (MU)	N L	WT
651008	3712		FULL	319.73	42.03	1847.1		-90.25	61.30	306.38	56.98	358.72	1359.5	291	116	254	38	-41	79	89.9	1	33
651008	224812	R	FULL	256.35	31.58	2259.1		-59.32	15.72	310.97	44.56	351.21	1424.2	314	140	230	44	-46	52	76.3	1	30
651008	225112		FULL	281.70	57.97	1597.5		-48.22	45.86	322.82	50.60	1.20	1400.8	314	139	231	26	-46	61	75.1	1	35
651009	4812		FULL	324.20	39.81	1893.6		-98.09	63.01	302.28	58.01	358.87	1350.8	284	111	262	39	-41	81	91.0	1	33
651009	210312		1/4	201.68	34.06	2199.4		17.86	-3.88	327.09	37.01	4.70	1447.5	337	163	207	42	-39	42	79.9	1	34
651009	210612	R	1/4	170.01	59.84	1603.4		5.32	20.02	351.03	43.88	12.31	1428.3	337	162	208	24	-40	27	73.6	1	30
651009	230212		1/4	296.76	52.20	1676.8		-61.43	51.45	313.36	52.64	359.65	1393.4	307	134	239	30	-46	70	81.7	1	35
651010	5912		1/4	327.59	38.67	1913.7		103.63	64.50	300.48	58.68	359.36	1342.0	278	105	269	40	-40	82	91.4	1	33
651012	194112		1/4	167.25	35.60	2153.2		10.36	-3.77	337.72	37.05	14.44	1452.3	347	175	200	41	-30	68	81.4	1	32
651012	213512	R	1/4	248.30	31.31	2288.2		54.01	11.18	301.92	42.75	352.42	1437.7	318	147	229	44	-44	100	75.1	1	30
651012	213712	R	1/4	256.82	48.39	1783.3		47.26	28.31	309.18	47.03	358.35	1424.0	318	146	230	33	-44	88	85.9	1	30
651012	213912		1/4	290.61	70.13	1480.2		31.73	52.78	325.21	50.91	5.38	1408.6	317	146	231	16	-44	72	78.6	1	35
651012	233512		1/4	319.26	40.29	1904.9		-92.92	60.10	293.09	57.29	357.77	1369.4	288	118	261	39	-47	87	89.5	1	33
651013	195112		1/4	188.29	37.11	2105.4		6.61	-2.69	324.24	37.44	8.66	1453.0	341	170	207	40	-32	94	112.5	2	34
651013	195312	R	1/4	165.26	51.86	1738.2		9.26	12.51	340.61	42.05	13.59	1441.4	340	169	208	30	-32	74	78.0	1	30
651013	214612	R	1/4	260.93	30.02	2331.7		63.47	17.14	296.20	45.28	349.59	1431.9	312	141	237	45	-45	112	72.7	1	30
651013	214912		1/4	286.02	54.23	1662.1		-54.59	46.42	305.84	51.20	359.84	1409.6	311	141	238	29	-45	90	76.8	1	35
651013	234612		1/4	323.38	38.52	1942.8		-99.60	61.75	290.16	58.23	358.01	1360.9	281	112	269	40	-47	89	89.9	1	33
651014	200012	R	1/4	211.47	27.91	2459.0		27.72	-7.34	306.37	35.45	0.65	1458.8	335	164	214	46	-33	125	89.2	2	30
651014	200212	R	1/4	204.56	43.21	1928.7		17.72	3.54	316.87	40.15	5.28	1448.2	334	164	215	36	-34	110	83.0	1	30
651014	200412		1/4	181.71	63.63	1567.6		0.83	23.52	334.27	44.61	10.68	1435.9	334	164	215	21	-34	87	74.5	1	35
651014	215712	R	1/4	271.72	28.16	2401.5		-72.15	22.21	291.27	47.69	347.09	1425.8	305	136	244	46	-46	121	66.2	1	30
651014	215912		1/4	285.83	41.64	1921.8		-69.26	39.76	294.66	51.48	354.31	1410.6	305	136	245	38	-46	106	86.2	1	35
651014	235712		1/4	326.41	37.74	1953.9		104.04	63.20	289.46	58.80	358.54	1352.2	275	107	276	41	-47	89	90.1	1	33
651016	202312	R	1/4	241.92	38.38	2055.2		45.39	13.71	296.43	43.14	356.45	1443.9	322	153	229	40	-37	138	83.7	1	30
651016	202512		1/4	250.43	59.36	1612.3		35.03	33.23	307.30	47.39	2.46	1430.9	321	153	230	25	-37	116	73.3	1	35
651016	202712	R	1/4	331.05	80.70	1431.2		8.43	57.76	334.40	51.21	9.57	1416.1	321	153	231	8	-38	86	80.9	1	28
651017	203412	R	1/4	257.18	37.26	2082.1		55.91	20.44	289.66	45.65	353.66	1438.4	315	148	237	40	-39	134	83.7	1	30
651017	203612		1/4	273.55	55.82	1654.7		47.91	40.93	298.16	49.67	0.29	1424.6	315	148	237	27	-39	114	74.2	1	35
651018	204512	R	1/4	270.09	35.08	2145.0		65.70	26.13	283.61	48.04	351.22	1432.6	309	143	244	42	-41	124	82.4	1	30
651018	204712		1/4	289.45	50.81	1730.1		60.41	46.74	289.41	51.78	358.53	1418.1	308	143	245	31	-41	108	83.3	1	35

NETWORK ORDERED MUTUAL VISIBILITY EVENTS LIST

FIGURE #4

PAGE 2 OF 2

GEOS HISTORY PLOTS

DAY IS 1 MONTH IS 9 YEAR IS 65 NUMBER OF STATIONS IS 63 SATELLITE NUMBER IS 999

OPTICAL BEACON POWER DEGRADATION .900000

TRANSPONDER POWER DEGRADATION .950000

LAMP STATUS

LAMP NUMBER	TOTAL LAMP COUNT	INTENSITY DEGRADATION
1	40000	0.750000
2	40001	0.800000
3	40002	0.770000
4	40003	0.780000

NETWORK STATUS

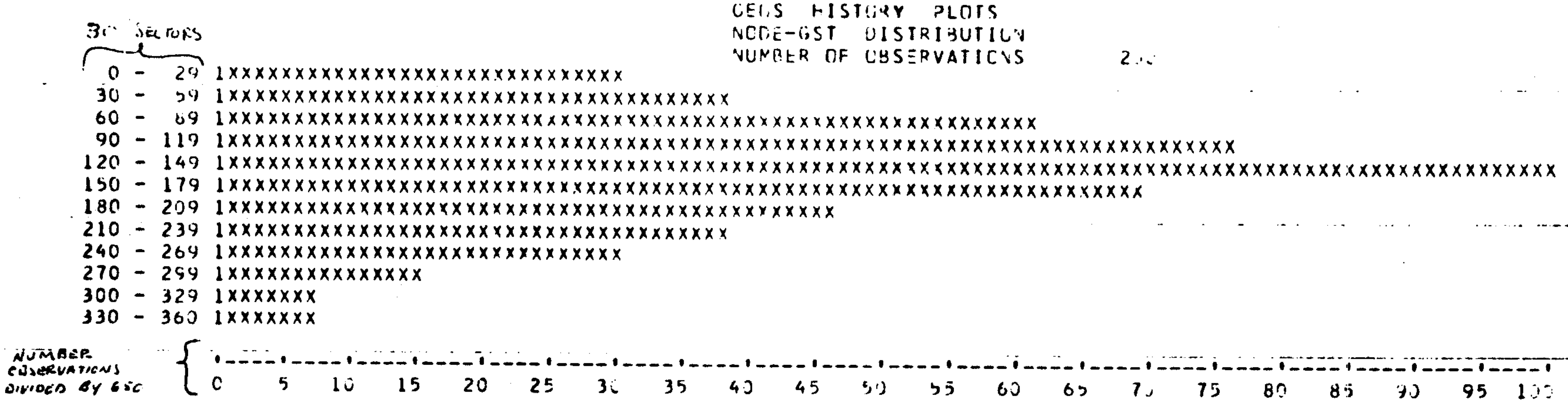
NETWORK	OBSERVATIONS REPORTED	OBSERVATIONS PROVIDED	RATIO(REPORTED/PROVIDED)
STADAN	200	680	0.29412
APL	210	500	0.42000
AFCRL	220	300	0.73333
SAO	230	400	0.57500
AMS	240	350	0.68571
C+GS	250	380	0.65789
NAV OB	260	600	0.43333
INT PT	700	800	0.87500

HISTORY TAPE LIST

FIGURE #5

PAGE 1 OF 5

CEGS HISTORY PLOTS
NODE-GST DISTRIBUTION
NUMBER OF OBSERVATIONS 2..



SCALE FACTOR FOR HORIZONTAL SCALE IS 650

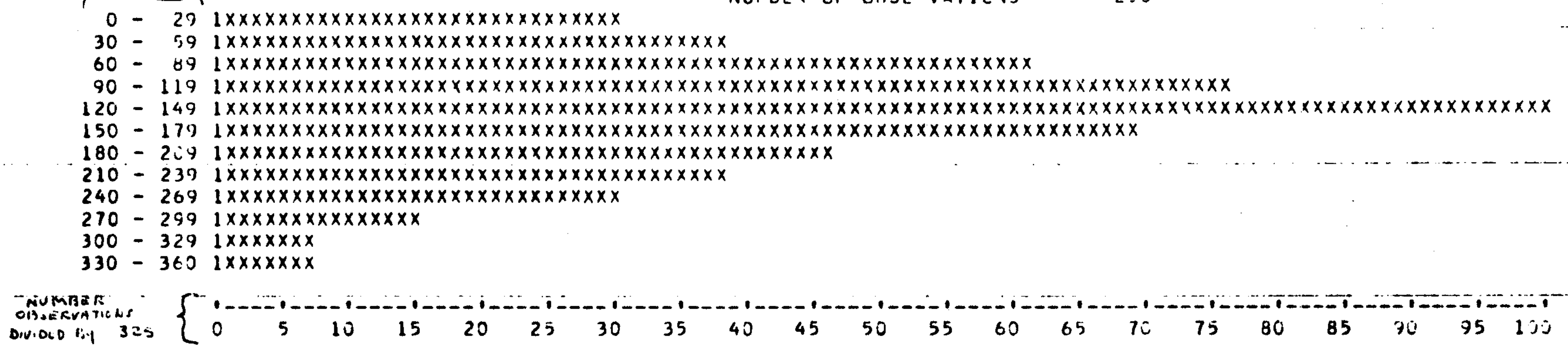
HISTORY TAPE LIST

FIGURE #5

PAGE 2 OF 5

30° Sectors

GEOS HISTORY PLOTS
OMEGA + (NODE-GST) DISTRIBUTION
NUMBER OF OBSERVATIONS 2[illegible]



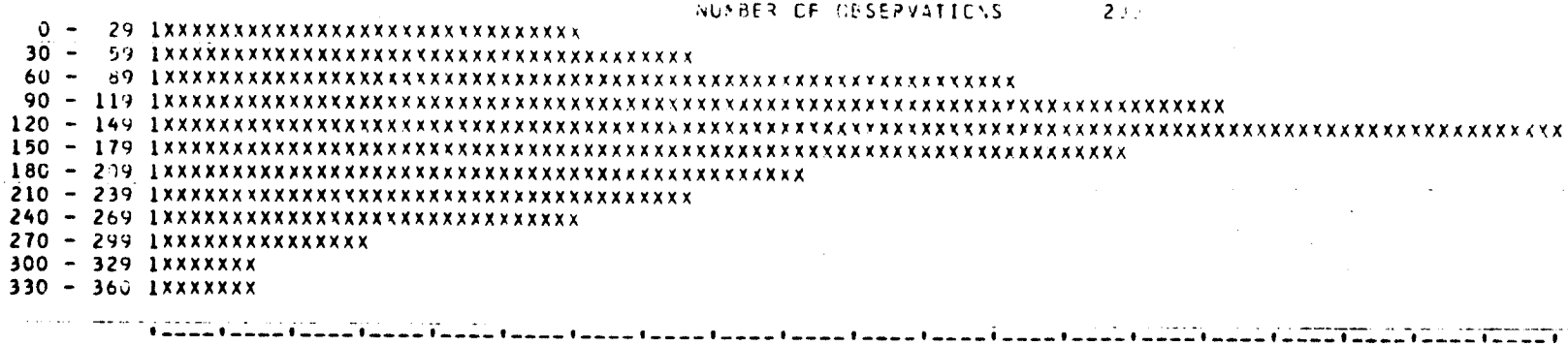
SCALE FACTOR FOR HORIZONTAL SCALE IS 325

HISTORY TAPE LIST

FIGURE #5

PAGE 3 OF 5

GEOS HISTORY PLOTS
OMEGA - (NODE-GST) DISTRIBUTION
NUMBER OF OBSERVATIONS 2..



SCALE FACTOR FOR HORIZONTAL SCALE IS 6500

HISTORY TAPE LIST
FIGURE #5
PAGE 4 OF 5

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                                              GEUS  HISTORY  PLOTS
      TOTAL PROVIDED  OBSERVATIONS       360          OBSERVED  OBSERVATIONS        240          RATIO(OBS/PROV)    0.6667

                  ELEVATION  DISTRIBUTION          STATION  NAME  COMERA          STATION  NUMBER - 1001
  0 -   4 1XXXXXXXXXXXXXXXX
  5 -   9 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 10 -  14 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 15 -  19 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 20 -  29 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 30 -  39 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 40 -  49 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 50 -  59 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 60 -  69 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 70 -  79 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 80 -  90 1XXXXXXXXXXXXXXXX

          !----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!
          0    5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80   85   90   95   100

                            SCALE FACTOR FOR HORIZONTAL SCALE IS         120

                  AZIMUTH    DISTRIBUTION          STATION  NAME  COMERA          STATION  NUMBER - 1001
  0 -  29 1XXXXXXXX
 30 -  59 1XXXXXXXX
 60 -  89 1XXXXXXXXXXXXXXXX
 90 - 119 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
120 - 149 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
150 - 179 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
180 - 209 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
210 - 239 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
240 - 269 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
270 - 299 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
300 - 329 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
330 - 360 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

          !----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!
          0    5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80   85   90   95   100

                            SCALE FACTOR FOR HORIZONTAL SCALE IS         240

                  RANGE      DISTRIBUTION          STATION  NAME  COMERA          STATION  NUMBER - 1001
   0 -  999 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1000 - 1499 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1500 - 1999 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2000 - 2499 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2500 - 2999 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3000 - 3499 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3500 - 3999 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4000 - 4499 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4500 - 4999 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5000 -  --- 1XXXXXXXXXXXXXXXX

          !----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!----!
          0    5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80   85   90   95   100

                            SCALE FACTOR FOR HORIZONTAL SCALE IS         360
```

HISTORY TAPE LIST

FIGURE #5

PAGE 5 OF 5

CAMERA CONSTANTS

TYPE	NO.	LOAD TIME	LENS APERTURE	LENS TRANS	IMAGE SIZE REQUIRED	IMAGE SIZE REQUESTED	FILM TYPE A1	FILM TYPE A2	FILM TYPE A3
BAKER-NUNN	1	1	0.	1.	30.0	30.0	10.5500	-0.1120	0.000835
GEODETIC 30	6	1	0.	0.7000	30.0	30.0	10.5500	-0.1120	0.000835
KETS 40 IN	2	1	2[illegible]	[illegible]	40.	40.	10.5500	-0.1120	0.000835
KETS 24 IN	7	1	10[illegible]	0.7000	40.0	40.0	10.5500	-0.1120	0.000835
KC-135	3	3	200000.	0.6500	30.0	30.0	10.5500	-0.1120	0.000835
KC-4	4	4	117000.	0.7000	30.0	30.0	10.5500	-0.1120	0.000835
SCHMIDT	5	4	40[illegible]	0.7000	30.0	30.0	10.5500	-0.1120	0.000835
SCHMIDT CCC	10	4	600000.	0.7000	30.0	30.0	10.5500	-0.1120	0.000835
SCHMIDT 7	15	7	400000.	0.9000	40.0	40.0	10.5500	-0.1120	0.000835
SCHMIDT 10	20	10	40[illegible]	0.9000	40.0	40.0	10.5500	-0.1120	0.000835
QUESTICN	25	10	4[illegible]	0.9000	40.0	40.0	10.5500	-0.1120	0.000835

TRACKING COMPLEMENT LIST

FIGURE #6

PAGE 1 OF 4

PROG NUM.	TYPE	STATION NETWORK	NO.	NAME	GEODETIC LAT	GEODETIC LONG (E)	SPHEROID HEIGHT	MIN. ELEV	MAX. ELEV	CAMERA TYPE	ATMOSPHERIC EXTINCTION	WEIGHTING FACTORS 1	WEIGHTING FACTORS 2
1	OPTICAL	STADAN	1021	1BPOIN	38 25 49.91	282 54 49.37	5.1	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
2	OPTICAL	STADAN	1022	1FTMYR	26 32 53.78	278 8 4.60	9.1	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
3	OPTICAL	STADAN	1024	1DOMER	-31 23 30.00	136 52 10.99	157.9	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
4	OPTICAL	STADAN	1025	1QUITU	0-37 20.55	281 25 15.62	3584.5	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
5	OPTICAL	STADAN	1026	1LIMAP	-11 46 34.86	282 50 59.14	34.1	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
6	OPTICAL	STADAN	1028	1SATAG	-33 8 56.23	289 19 52.88	580.9	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
7	OPTICAL	STADAN	1030	1MOJAV	35 19 48.56	243 6 0.85	921.7	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
8	OPTICAL	STADAN	1031	1JOBJR	-25 53 0.98	27 42 28.49	1564.5	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
9	OPTICAL	STADAN	1032	1NEWFL	47 44 28.94	307 16 46.71	111.9	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
10	OPTICAL	STADAN	1033	1COLEG	64 52 18.61	212 9 40.15	189.3	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
11	OPTICAL	STADAN	1034	1GFORK	48 1 21.18	262 59 21.05	249.6	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
12	OPTICAL	STADAN	1035	1WNKFL	51 26 45.53	359 18 13.57	87.8	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
13	OPTICAL	STADAN	1036	1EDINX	26 18 0.	261 50 0.	7.0	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
14	OPTICAL	STADAN	1037	1COLBX	38 58 0.	267 40 0.	23.5	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
15	OPTICAL	STADAN	1038	1SUDCX	46 30 0.	278 59 0.	4.2	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
16	OPTICAL	STADAN	1039	1BERMX	32 23 0.	295 19 0.	26.4	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
17	OPTICAL	STADAN	1040	1PURIX	18 25 0.	293 57 0.	10.0	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
18	OPTICAL	STADAN	1041	1JAMAX	18 5 0.	283 12 0.	15.0	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
19	OPTICAL	STADAN	1042	1ROSMN	35 12 0.	277 7 0.	17.2	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
20	OPTICAL	STADAN	1043	1GSFCP	39 1 0.	283 11 0.	10.0	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
21	OPTICAL	STADAN	1044	1CKVLX	38 13 0.	274 12 0.	10.0	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
22	OPTICAL	STADAN	1045	1DENVX	39 30 0.	255 15 0.	1800.0	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
23	OPTICAL	STADAN	1071	1JM24X	27 1 14.80	279 53 13.72	150.8	25.0	90.0	MOTS 24 IN	0.750	4.251E 10	4.251E 10
24	OPTICAL	STADAN	1072	1JM40X	27 1 14.80	279 53 13.72	150.8	25.0	90.0	MOTS 40 IN	0.750	4.251E 10	4.251E 10
25	OPTICAL	STADAN	1073	1JPC1X	27 1 14.80	279 53 13.72	150.8	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
26	OPTICAL	STADAN	1074	1JBC4X	27 1 14.80	279 53 13.72	150.8	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
27	OPTICAL	AFCRL	3001	BEDFRD	42 27 17.80	288 43 35.00	83.8	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
28	OPTICAL	AFCRL	3002	USAFAX	38 50 0.	255 10 0.	1889.8	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
29	OPTICAL	AFCRL	3411	FN411X	-4 0 0.	327 45 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
30	OPTICAL	AFCRL	3412	LO412X	-8 0 0.	325 0 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
31	OPTICAL	AFCRL	3413	SL413X	-12 50 0.	322 [illegible] 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
32	OPTICAL	AFCRL	3414	AS414X	-8 0 0.	345 0 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
33	OPTICAL	AFCRL	3417	RB417X	6 25 0.	349 10 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
34	OPTICAL	AFCRL	3418	TI418X	-20 30 0.	331 0 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
35	OPTICAL	AFCRL	3420	SH420X	-15 45 0.	354 0 0.	2.5	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
36	OPTICAL	AFCRL	3421	HOMESX	25 30 0.	279 37 0.	-0.	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
37	OPTICAL	AFCRL	3422	GREENX	33 23 0.	268 57 0.	-0.	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
38	OPTICAL	AFCRL	3423	SAVANX	32 0 0.	278 30 0.	-0.	25.0	90.0	PC-1000	0.750	4.251E 10	4.251E 10
39	OPTICAL	AFCRL	3424	COLDLX	54 28 0.	249 45 0.	-0.	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
40	OPTICAL	SAO	4001	1ORGAN	32 25 25.50	253 26 50.07	1549.6	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10

TRACKING COMPLEMENT LIST

FIGURE #6

PAGE 2 OF 4

PROG NUM.	TYPE	STATION NETWORK	NO.	NAME	GEODETIC LAT	GEODETIC LONG (E)	SPHEROID HEIGHT	MIN. ELEV	MAX. ELEV	CAMERA TYPE	ATMOSPHERIC EXTINCTION	WEIGHTING FACTORS 1	WEIGHTING FACTORS 2
41	OPTICAL	SAO	4002	1DLFAN	-25 57 35.95	25 14 54.52	1585.6	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
42	OPTICAL	SAO	4023	AJSBAK	-31 23 30.75	136 52 38.98	157.9	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
43	OPTICAL	SAO	4004	1SPAIN	36 27 46.45	353 47 40.55	58.0	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
44	OPTICAL	SAO	4005	1TOKYO	35 40 18.95	139 32 12.69	109.1	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
45	OPTICAL	SAO	4006	1NATAL	29 21 33.37	79 27 28.50	1923.6	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
46	OPTICAL	SAO	4007	1QUIPA	-16 27 54.78	288 30 24.21	2456.7	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
47	OPTICAL	SAO	4008	1SHRAZ	29 38 12.71	52 31 13.54	1630.7	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
48	OPTICAL	SAO	4009	1CURAC	12 5 46.21	291 9 43.97	4.9	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
49	OPTICAL	SAO	4010	1JUPTR	27 1 14.80	279 53 13.72	150.8	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
50	OPTICAL	SAO	4011	1WILDO	-31 56 36.53	294 53 39.82	597.7	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
51	OPTICAL	SAO	4012	1MAUIO	20 42 33.01	203 44 26.84	3021.9	25.0	90.0	BAKER-NUNN	0.750	1.063E 10	1.063E 10
52	OPTICAL	SAO	4017	1JS36X	27 1 14.80	279 53 13.72	150.8	25.0	90.0	GEODETIC 36	0.750	1.063E 10	1.063E 10
53	OPTICAL	C + GS	6107	LL107X	56 51 0.	258 59 0.	5.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
54	OPTICAL	C + GS	6108	CB108X	68 0 0.	243 0 0.	1000.0	25.0	90.0	BC-4	0.750	4.251E 10	4.251E 10
55	OPTICAL	C + GS	6113	MD113X	52 0 0.	278 30 0.	10.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
56	OPTICAL	C + GS	6114	HK114X	44 38 0.	296 25 0.	15.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
57	OPTICAL	C + GS	6115	GB115X	53 15 0.	299 40 0.	20.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
58	OPTICAL	C + GS	6116	FB116X	63 45 0.	291 30 0.	20.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
59	OPTICAL	C + GS	6117	NK117X	60 10 0.	314 55 0.	20.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
60	OPTICAL	C + GS	6121	SJ121X	47 0 0.	307 10 0.	1.0	25.0	90.0	BC-4	0.750	1.063E 10	1.063E 10
61	OPTICAL	INTERN	8001	MUNCHN	47 48 11.00	11 0 37.00	999.7	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
62	OPTICAL	INTERN	8002	BOCHUM	51 25 43.00	7 11 43.00	51.8	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
63	OPTICAL	INTERN	8003	BERLIN	52 28 30.00	13 25 30.00	39.9	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
64	OPTICAL	INTERN	8004	BRNSCH	52 35 10.00	10 30 20.00	74.1	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
65	OPTICAL	INTERN	8005	FKFURT	50 4 44.00	8 31 17.00	1115.8	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
66	OPTICAL	INTERN	8006	HAMBRG	49 53 6.00	10 53 24.00	288.0	25.0	90.0	SCHMIDT	0.750	1.063E 10	1.063E 10
67	OPTICAL	INTERN	8007	TJORLA	60 24 57.50	22 16 37.50	50.9	25.0	90.0	SCHMIDT	0.750	1.063E 10	1.063E 10
68	OPTICAL	INTERN	8008	JPPALA	59 51 56.10	17 35 26.40	29.0	25.0	90.0	SCHMIDT	0.750	1.063E 10	1.063E 10
69	OPTICAL	INTERN	8009	DELFTH	52 0 33.00	4 22 10.00	-0.	25.0	90.0	QUESTION	0.750	1.063E 10	1.063E 10
70	OPTICAL	INTERN	8010	ZIMWLD	46 52 41.00	7 27 57.00	900.0	25.0	90.0	SCHMIDT	0.750	1.063E 10	1.063E 10
71	OPTICAL	INTERN	8011	MALVRN	52 8 34.50	358 0 59.40	0.	25.0	90.0	SCHMIDT 500	0.750	1.063E 10	1.063E 10
72	OPTICAL	INTERN	8012	MEUDON	48 48 18.00	2 13 54.00	152.0	25.0	90.0	SCHMIDT 10	0.750	1.063E 10	1.063E 10
73	OPTICAL	INTERN	8013	ROYOBS	55 55 30.00	356 49 0.	145.0	25.0	90.0	SCHMIDT 7	0.750	1.063E 10	1.063E 10
74	SECOR	AMS	5501	CLKFLD	15 10 33.14	120 32 13.91	110.0	0.				1.000E-02	0.
75	SECOR	AMS	5502	HERNDN	38 59 32.35	282 50 21.25	158.0	0.				1.000E-02	0.
76	SECOR	AMS	5503	TRUKIS	7 27 0.	151 51 0.	5.0	0.				1.000E-02	0.
77	SECOR	AMS	5504	YAPIS_	9 32 48.00	138 0 7.00	24.0	0.				1.000E-02	0.
78	SECOR	AMS	5505	MANUSI	-2 6 0.	147 17 0.	8.0	0.				1.000E-02	0.
79	SECOR	AMS	5506	KOLEAI	7 22 40.00	143 54 35.00	1.0	0.				1.000E-02	0.
80	SECOR	AMS	5507	MARCUS	24 18 0.	153 58 0.	10.0	0.				1.000E-02	0.

TRACKING COMPLEMENT LIST

FIGURE #6

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PROG NUM.	TYPE	STATION NETWORK	NO.	NAME	GEODETIC LAT	GEODETIC LONG (E)	SPHEROID HEIGHT	MIN. ELEV	MAX. ELEV	CAMERA TYPE	ATMOSPHERIC EXTINCTION	WEIGHTING FACTORS
81	SECOR	AMS	5508	GUAMPO	13 26 0.	144 38 0.	37.0	0.				1.000E-02 0.
82	SECOR	AMS	5509	MAUIHA	20 42 35.00	203 44 23.00	3052.0	0.				1.000E-02 0.
83	SECOR	AMS	5510	KAUIHA	22 0 5.00	200 38 15.00	183.0	0.				1.000E-02 0.
84	SECOR	AMS	5511	LARSON	47 11 8.00	241 [illegible] 0.	355.0	0.				1.000E-02 0.
85	SECOR	AMS	5512	SANDIG	32 48 40.34	242 51 31.84	425.0	0.				
86	SECOR	AMS	5513	FORORD	36 36 0.	239 [illegible] 0.	30.0	0.				1.000E-02 0.
87	DOPPLER	APL	2003	LACRES	32 16 54.00	253 14 56.00	1157.3	-0.				4.000E 02 -0.
88	DOPPLER	APL	2008	SANMES	-23 13 16.00	314 7 27.00	508.1	-0.				4.000E 02 -0.
89	DOPPLER	APL	2010	HAWAII	18 56 5.00	204 19 8.00	93.0	-0.				4.000E 02 -0.
90	DOPPLER	APL	2011	PHILIP	14 59 21.00	120 4 15.00	7.6	-0.				4.000E 02 -0.
91	DOPPLER	APL	2012	SMTHFD	-34 39 43.00	138 38 30.00	22.9	-0.				4.000E 02 -0.
92	DOPPLER	APL	2013	MISAWA	40 42 59.00	141 23 12.00	12.2	-0.				4.000E 02 -0.
93	DOPPLER	APL	2014	ANCHOR	61 17 2.00	210 16 38.00	55.8	-0.				4.000E 02 -0.
94	DOPPLER	APL	2017	TAFUNA	-14 19 50.00	189 17 12.00	33.5	-0.				4.000E 02 -0.
95	DOPPLER	APL	2018	THULEG	76 32 14.00	291 15 58.00	24.4	-0.				4.000E 02 -0.
96	DOPPLER	APL	2019	MCMRDO	-77 57 0.	166 40 0.	30.5	-0.				4.000E 02 -0.
97	DOPPLER	APL	2092	AUSTIN	30 17 19.00	262 16 4.00	212.7	-0.				4.000E 02 -0.
98	DOPPLER	APL	2106	LASHAM	51 11 9.00	358 58 28.00	130.5	-0.				4.000E 02 -0.
99	DOPPLER	APL	2111	APLMND	39 9 49.00	283 6 11.00	145.1	0.				4.000E 02 -0.
100	DOPPLER	APL	2115	PRETOR	-25 56 46.00	28 20 53.00	1580.1	-0.				4.000E 02 -0.
101	MINITRACK	STADAN	1001	BPOINT	38 25 49.91	282 54 49.37	5.1	-0.				1.000E 08 1.000E 08
102	MINITRACK	STADAN	1003	FTMYRS	26 32 53.78	278 8 4.60	9.1	-0.				1.000E 08 1.000E 08
103	MINITRACK	STADAN	1005	QUITOE	-0-37 20.55	281 25 15.62	3577.1	-0.				1.000E 08 1.000E 08
104	MINITRACK	STADAN	1006	LIMAPU	-11 46 34.86	282 50 59.14	54.1	-0.				1.000E 08 1.000E 08
105	MINITRACK	STADAN	1008	SNTAGO	-33 8 56.23	289 19 52.88	580.9	-0.				1.000E 08 1.000E 08
106	MINITRACK	STADAN	1012	NEWFLD	47 44 28.94	307 16 46.71	112.9	-0.				1.000E 08 1.000E 08
107	MINITRACK	STADAN	1013	COLEGE	64 52 18.61	212 9 40.15	199.3	-0.				1.000E 08 1.000E 08
108	MINITRACK	STADAN	1014	GFORCS	48 1 21.18	262 59 21.05	249.6	-0.				1.000E 08 1.000E 08
109	MINITRACK	STADAN	1015	WNKFLD	51 26 45.43	359 18 13.57	87.8	-0.				1.000E 08 1.000E 08
110	MINITRACK	STADAN	1016	JOBURG	-25 53 0.98	27 42 28.49	1564.5	-0.				1.000E 08 1.000E 08
111	MINITRACK	STADAN	1017	MOJAVE	35 19 48.56	243 6 0.85	921.7	-0.				1.000E 08 1.000E 08
112	MINITRACK	STADAN	1018	CDMERA	-31 23 30.00	135 52 10.99	157.9	-0.				1.000E 08 1.000E 08
113	LASER	STADAN	1050	GODLAS	39 1 11.48	283 10 26.71	51.8	30.0				1.000E-02 -0.
114	LASER	AFCRL	3020	AFCMBR	42 27 17.80	288 43 35.00	88.9	30.0				1.000E-02 -0.
115	R/RDOT	STADAN	1022	MADGAR	-19 1 43.00	47 18 10.00	1401.5	-0.				1.000E-02 -0.
116	R/RDOT	STADAN	1026	ROSRAN	35 11 45.05	277 7 26.23	873.2	-0.				1.000E-02 -0.
117	R/RDOT	STADAN	1052	CARVON	-24 54 14.69	113 42 55.01	37.2	-0.				1.000E-02 -0.

TRACKING COMPLEMENT LIST

FIGURE #6

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FIGURE 7

OPERATIONAL PREDICTION FORMAT FOR INTERNATIONAL PARTICIPANTS

(Time Ordered)

	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
Row 1	INTERNL PARTICIPANTS OPERATIONAL MUTUAL VISIBILITY GEOS PREDICTIONS
Row 2	99999
Row 3	YYMMDD HHMMSS LONG LAT HT NF NL
Row 4	650601 103000 32621 39410 50600 7 3

KEY TO ABOVE FORMAT:

Row 1: Identification

Row 2: Satellite Number

Row 3: Column Identifications

Row 4: Col. 1-6 year, month, day
Col. 9-14 hour, minute, second
Col. 17-21 longitude (degrees to nearest hundredth) of SSP
Col. 24-27 latitude (degrees to nearest hundredth) of SSP
(Minus sign will appear in col. 23 for Southern latitude)
Col. 30-34 altitude (to nearest kilometer)
Col. 38 number of flashes (5 or 7)
Col. 42 number of lamps in flash (1, 2, 3 or 4)

Row 5, 6, 7, etc. Repeat format of Row 4 for each scheduled pass for the one week prediction.

Note: In addition to these predictions the DSIR (by TTY to LCHT) will receive updated orbital elements from GSFC for use in station prediction programs for the international participants.

INTERNL PARTICIPANTS OPERATIONAL MUTUAL VISIBILITY GEOS PREDICTIONS
65100

YYMMDD	HHMMSS	LONG	LAT	HT	NF	NL
651001	213712	2855	3976	1425	7	1
651001	232712	35681	3615	1435	7	2
651001	233212	1032	4739	1398	7	1
651002	12612	35123	5209	1377	7	1
651002	234212	469	4772	1399	7	1
651003	13912	35972	5644	1349	7	1

INTERNATIONAL PARTICIPANTS
TIME ORDERED OPERATIONAL
MUTUAL VISIBILITY PREDICTIONS

FIGURE #7

Page 2 OF 2

FIGURE 8

LONG RANGE PREDICTION FORMAT FOR INTERNATIONAL PREDICTIONS

(Time Ordered)

Page 1 of 2

Row 1	INTERNL PARTICIPANTS LONG RANGE MUTUAL VISIBILITY GEOS PREDICTIONS
Row 2	99999
Row 3	YYMMDD HHMMSS LONG LAT HT NF NL
Row 4	650601 103000 32621 3941 05060 7 3

KEY TO ABOVE FORMAT:

Row 1: Identification

Row 2: Satellite Number

Row 3: Column Identifications

Row 4: Col. 1-6 year, month, day

Col. 9-14 hour, minute, second

Col.17-21 longitude (degrees to nearest hundredth) of SSP

Col.24-27 latitude (degrees to nearest hundredth) of SSP
(Minus sign will appear in col. 23 for Southern latitude)

Col.30-34 altitude (to nearest kilometer)

Col.38 number of flashes (5 or 7)

Col.42 number of lamps in flash (1, 2, 3, or 4)

Row 5, 6, 7,etc. Repeat format of Row 4 for each scheduled MVE for a two-week period.

Note: In addition to these predictions the DSIR (by TTY to LCHT) will receive updated orbital elements from GSFC for use in station prediction programs for the international participants.

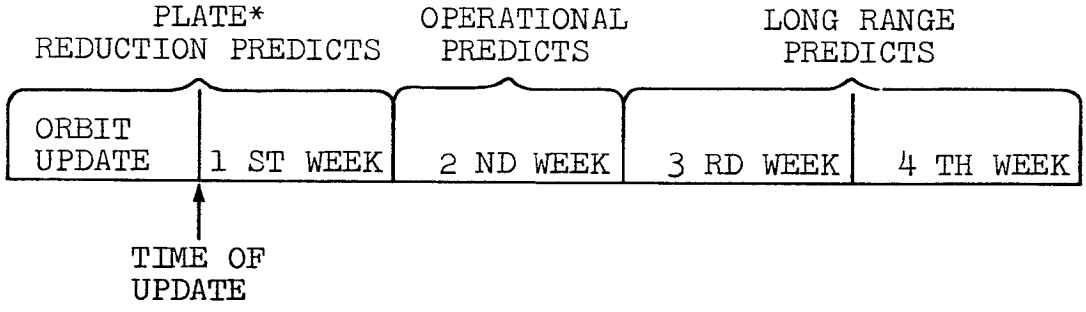
INTERNL PARTICIPANTS LONG RANGE MUTUAL VISIBILITY GEOS PREDICTIONS
65100

YYMMDD	HHMMSS	LONG	LAT	HT	NF	NL
651008	3712	35872	5698	1359	7	1
651008	43112	205	5183	1246	7	1
651008	224612	34580	4008	1438	7	1
651008	225112	120	5060	1401	7	1
651009	4812	35887	5801	1351	7	1
651009	44212	46	4965	1237	7	1
651009	210312	470	3701	1448	7	1
651009	210612	1231	4388	1428	7	1

INTERNATIONAL PARTICIPANTS
TIME ORDERED LONG RANGE
MUTUAL VISIBILITY PREDICTIONS

FIGURE #8

PAGE 2 OF 2



* Plate Reduction Predicts can be provided to International Participants upon request.

PREDICTION COVERAGE DIAGRAM

FIGURE #9

FIGURE 10

WEEKLY FIELD STATION OPTICAL REPORT

The report format shall be as follows:

Station (6 letter designations)

REF 65991

AAAAAA

BBBB (3 Spaces) CDEFG (1 space) CDEFG (1 space) CDEFG

AAAAAA

BBBB (3 spaces) CDEFG (1 space) CDEFG (1 space) CDEFG

Station need appear only once per message with date, predicted time and flash data reported for each predicted flash sequence of the report period. Each pass shall be recorded three times because of possible errors in transmission.

Code:

REF 65991 = Satellite Identification

AAAAAA = Year, month, day Zulu

BBBB = Predicted Flash Time in hours, minutes zulu

C: 1 = Photograph taken

9 = No photograph taken

D: Weather conditions:

0 = No photograph taken

1 = Clear; can see 5th magnitude and beyond

2 = Light haze; can see no fainter than 4th mag.

3 = Moderate haze; can see no fainter than 3rd mag.

4 = Heavy haze; can see no fainter than 2nd mag.

E: 0 = No photograph taken
If photograph taken indicate number of flashes observed by the numbers 1 through 7

8 = Plate not yet examined

9 = Photograph taken but no flashes found on plate

F: 0 = No photograph taken

Photo taken: 1 = Excellent plate quality
2 = Average plate quality
3 = Poor plate quality (explain)

G: Photograph taken = 0

Reason no photograph taken:

1 = Weather

2 = Equipment failure

3 = Operator error

4 = Miscellaneous (Explain below)

Example of typical report as prepared for teletype transmission:

```
RR GOCC GOPS
DE LCHT 001
08/0010Z

BOCHUM
REF 65991
650901
1135   11720 11720 11720   (7 FLASHES AVG PLATE,WEATHER CLEAR)
1400   90002 90002 90002   (NO PHOTO EQUIPMENT FAILURE)
650904
1115   90004 90004 90004   (MISCELLANEOUS NO SUPPORT)
FLAT TIRE COULD NOT GET TO SITE IN TIME
650907
1605   12930 12930 12930   (NO FLASHES FOUND ON PLATE, LIGHT HAZE)
OPERATOR ERROR IN PLATE DEVELOPMENT

08/0040Z SEP LCHT
```

NOTE: Information in parentheses is for explanation herein only and will not be a part of an actual report.

FIGURE 11

GEODETIC PARTICIPANTS

MONTHLY STATION STATUS REPORT

DATE_____

REPORT NR_____ REPORT PERIOD FM_____ TO_____

STATION/PARTICIPANT NAME_____ DESIGNATION_____

SATELLITE IDENTIFICATION_____ TRACKING EQUIP_____

TYPE STATION: FIXED_____ MOBILE_____

1. Describe any change in equipment for the report period.

_____

_____

_____

2. Describe any change in station operation or procedures._____

_____

_____

3. Mobile stations:

3.1. Anticipated length of stay at present location_____

3.2. If relocating, coordinates and elevation of new location

(Indicate Datum)_____

If relocating, deactivation date at present location_____

Reactivation date at new location_____

4. Flash Schedules:

4.1. Are Flash Schedule Predicts adequate? Yes_____ No_____

4.2. If not, state what additional data are required._____

_____

MONTHLY STATION STATUS REPORT
(continued)

5. Do you wish to continue receiving:

5.1. Mutual Visibility Lists? Yes_____ No_____

5.2 GEOS News Letter Report? Yes_____ No_____

6. Are any changes required in the procedures for Predictions or other GSFC supplied data: Yes_____ No_____

6.1. If answer to 6 is yes, explain_____

_____

_____

7. Suggestion or recommendations for improving the GEOS Mission:

_____

_____

_____

8. General Comments _____

_____

_____

_____

_____

FIGURE 12

GEODETIC PARTICIPANTS

MUTUAL VISIBILITY EVENT REQUEST

DATE _____

REQUEST NR_____ MUTUAL VISIBILITY LIST REFERENCED_____

STATION/PARTICIPANT NAME_____DESIGNATION_____

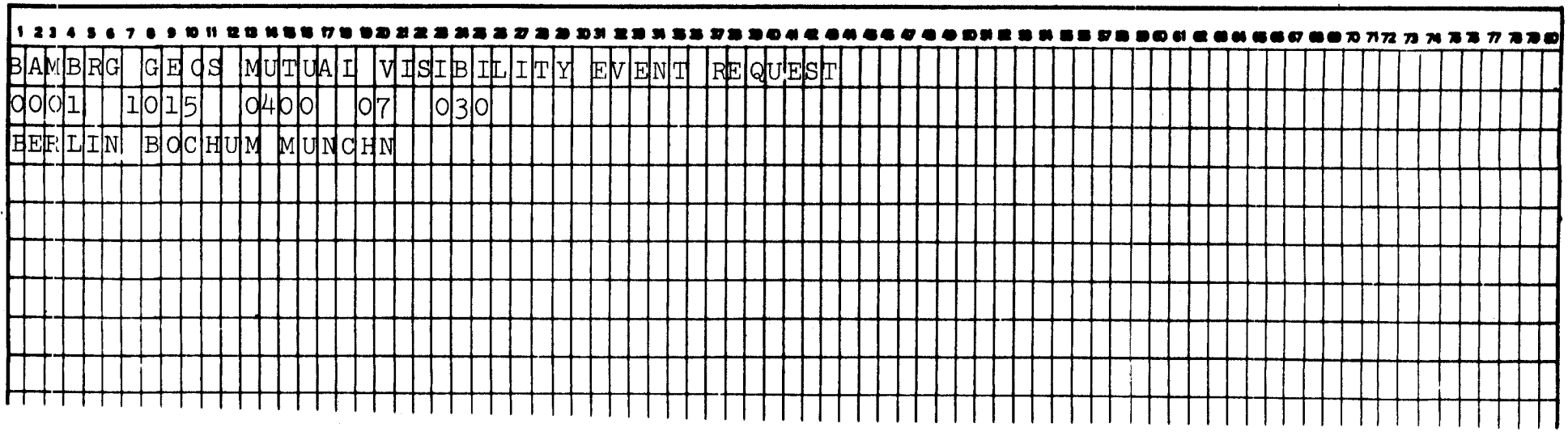
ITEM NR	MVE REQUESTED PERIOD			SYNERGETIC STATIONS	NUMBER FLASHES REQUESTED (5 or 7)	REQUESTED IMAGE SIZE (Microns)	REMARKS	GSFC DISPOSITION
	MO	DAY	HR					

Page _____of_____ Pages

FIGURE 13

GEOS PARTICIPANTS MUTUAL VISIBILITY EVENT REQUEST

(TTY FORMAT)



KEY TO FORMAT:

row 1: Col. 1-6 Station Designation (Requesting Station)
8-43 Identification

row 2: Col. 1-4 Request Nr. (consecutive Nr for each requested event)
6-10 Month, day of requested event
13-16 Hour of requested event in Zulu
19-20 Number flashes requested, 5 or 7 (if applicable)
23-25 Requested image size diameter in microns (if applicable)

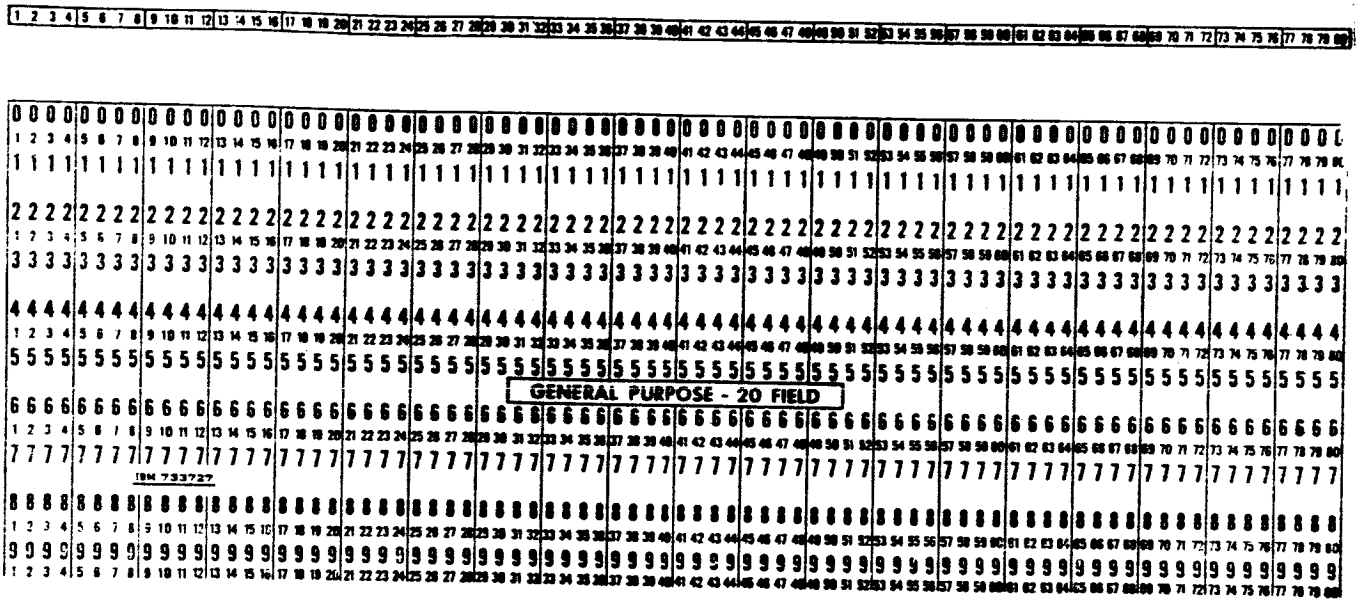
row 3: Col. 1-69 (as needed) Station designation of requested synergetic stations

row 4, 5, 6, 7, etc.: Repeat rows 2 and 3 for each Flash Request Period.

FORMAT

FOR

NGSP OPTICAL OBSERVATIONS



Field	Cols.	Description
1.	1 - 6	Satellite Identification*
	1 - 2	Year of Launch
		64 = 1964
		65 = 1965
		66 = 1966
		etc.
	3 - 5	Order of Launch

*As per COSPAR numbering system

Field	Cols.	Description
	6	Component Identifier
		1 = a
		2 = b
		3 = c
		4 = d
		etc.
2.	7	Type of Coordinates
		1 = Right Ascension and Declination
		2 = Range
		3 = Range Rate
		4 = Frequency Shift
		5 = Direction Cosines
		6 = X, Y Angle
		7 = Azimuth and Elevation Angle
3.	8	Observation Identifier
		0 = Active (Observation on beacon)
		1 = Passive (Chopping Shutter)
		2 = Camera in conjunction with Laser
		3 = Laser Angular data
4.	9 - 11	Timing Standard Deviation
	9	Milliseconds
	10 - 11	.01 Milliseconds

Field	Cols.	Description
5.	12 - 13	Time Identifier
		00 = UT-0 determined at observing station
		01 = UT-1 determined at observing station
		02 = UT-2 determined at observing station
		03 = UT-C determined at observing station
		04 = A.1 determined at observing station
		05 through 49 Other Systems*
		50 = UT-0 Satellite time
		51 = UT-1 Satellite time
		52 = UT-2 Satellite time
		53 = UT-C Satellite time
		54 = A.1 Satellite time
		55 through 99 Other Systems*
6.	14 - 18	Station Number
	14	System Designator
		0 = COSPAR
		1 = AFCRL
		2 = SAO
		3 = STADAN
		4 = TRANET DOPPLER
		5 = AMS

*As described in the associated preprocessing report; number assigned at NSSDC before transmitting data to various investigators.

Field	Cols.	Description
		6 = USC+GS
		7 = Naval Observatory
		8 = International Participants
	15 - 18	Station Number
7.	19 - 34	GMT of Observation
	19 - 20	Year of Observation
		64 = 1964
		65 = 1965
		66 = 1966
		etc.
	21 - 22	Month of Observation
	23 - 24	Day of Observation
	25 - 26	Hour of Observation
	27 - 28	Minute of Observation
	29 - 30	Second of Observation
	31 - 34	.0001 Second of Observation
8.	35 - 53	Observation Data
	35 - 37	R.A. (hours)/Azimuth degrees (arc), 0°North/ X angle (degrees arc). Sign of X angle appears in Col. 35
	38 - 39	R. A. minutes (of time)/Azimuth minutes (arc) /X angle .01 degrees (arc)

Field	Cols.	Description
	40 - 41	R. A. seconds (time)/Azimuth seconds (arc)
	42 - 44	R. A. .001 seconds (time)/Azimuth .001 seconds (arc)
	45	Sign of declination/Y angle (+) (-)
	46 - 47	Declination, degrees (arc)/Elevation angle degrees (arc)/ Y angle degrees (arc)
	48 - 49	Declination minutes (arc)/Elevation angle minutes (arc)/Y angle .01 degrees (arc)
	50 - 51	Declination, seconds (arc)/Elevation angle, seconds (arc)
	52 - 53	Declination, .01 seconds (arc)/Elevation angle, .01 seconds (arc)
9.	54 - 59	Date of Plate Reduction
	54 - 55	Year of Reduction 64 = 1964 65 = 1965 66 = 1966 etc.
	56 - 57	Month of Reduction
	58 - 59	Day of Reduction

Field	Cols.	Description
10.	60 - 71	Coded Information
	60 - 61	Supplementary Documentation
		03 = SAO Reduction Precedure Report
		04 = MOTS Plate Reduction Procedure Report
		05 = ACIC Plate Reduction Procedure Report
		06 = USC and GS Plate Reduction Procedure Report
		07 = NASA Goddard R and R Preprocessing Report
		09 = NASA Goddard Laser Preprocessing Report
		10 = AFCRL LASER Reduction Procedure Report
		11 = International Preprocessing Reports
		12 = AMS Plate Reduction Report
		. (additional numbers will be assigned by NSSDC as required)
		.
		.
		n
	62 - 63	Equator Designation
		01 = Mean Standard Equator

Field	Cols.	Description
		02 = Mean Equator at Jan 0.0 of Year of observation
		03 = Mean Equator at instant of observation
		04 = Mean Equator at arbitrary time (arbitrary system to be defined in associated preprocessing report)
		11 = True Standard Equator
		12 = True Equator at Jan 0.0 of year of observation
		13 = True Equator at instant of observation
		14 = True Equator at arbitrary time (arbitrary system to be defined in preprocessing report)
	64 - 65	Equinox Designation
		01 = Mean Standard Equinox
		02 = Mean Equinox at Jan 0.0 of year of observation
		03 = Mean Equinox at instant of observation
		04 = Mean Equinox at arbitrary time (arbitrary system to be defined in associated preprocessing report)
		11 = True Standard Equinox
		12 = True Equinox at Jan 0.0 of year of observation

Field	Cols.	Description
		13 = True Equinox at instant of Observation
		14 = True Equinox at arbitrary time
		(arbitrary system to be defined in associated preprocessing report)
	66 - 67	Instrumentation Type
		00 = PC - 1000 MOD-1
		01 = PC - 1000 MOD-2
		02 = BC - 4 450 mm
		03 = BC - 4 300 mm
		04 = BC - 4 210 mm
		05 = Baker Nunn SAO
		06 = Baker Nunn - Military
		07 = MOTS
		08 = 1200 mm Ballistic Camera
		09 = 600 mm Ballistic Camera
		10 = MOTS 24"
		11 = International Types
	68 - 69	Catalog Identification
		01 = BOSS
		02 = SAO Combined
		03 = FK-4
		04 = NASA Combined

Field	Cols.	Description
		05 = AGK-2
		06 = AMS Combined
		07 = Cape Zone, Volume 1
		08 = Yale, Volume 1
		09 = Others (to be defined in the associated preprocessing reports). Code number to be assigned by NSSDC.
	70 - 71	Catalog Epoch
		01 = 1855.0
		02 = 1875.0
		03 = 1900.0 .
		04 = 1950.0
		05 = 1965.0
		06 = Others (to be defined in the preprocessing reports); code numbers to be assigned by NSSDC
11.	72 - 80	Description of Random Error
	72	Standard deviation in R.A. (seconds of arc) multiplied by the cosine of the declination/ standard deviation in Az (seconds of arc)/ standard deviation in X angle (degrees of arc)
	73 - 74	Standard deviation R.A. (.01 seconds of arc) multiplied by the cosine of the declination/

Field	Cols.	Description
		standard deviation in Az (.01 seconds of arc)/standard deviation in X angle (.01 degrees of arc)
	75	Standard deviation in declination (seconds of arc)/standard deviation in elevation angle (seconds of arc)/standard deviation in Y angle (degrees of arc)
	76 - 77	Standard deviation in declination (.01 seconds of arc)/standard deviation in elevation angle (.01 seconds of arc)/standard deviation in Y angle (.01 degrees of arc)
	78 - 80	Covariance; sign in col 78 (+), (-), decimal assumed between col 79 and 80.

Figure B-7. Format for NGSP Optical Observations (Sheet 10 of 10)

APPENDIX B

GEOS A PREDICTION SIMULATION TEST
SAMPLE TELETYPE MESSAGE

RR GOCC
FM: GOCC
TO:
SUBJ: GEOS A PREDICTION SIMULATION TESTS

THE FOLLOWING NOMINAL GEOS A PREDICTIONS ARE REPRESENTATIVE OF THE PREDICTIONS YOUR STATION WILL BE RECEIVING AS PART OF THE GEOS PROGRAM. THIS SIMULATION IS INTENDED TO VERIFY EXISTENCE OF TELETYPE FACILITES, DETERMINE IF ANY PROBLEMS ARE ENCOUNTERED IN TRANSMISSION OF THIS DATA, AND DETERMINE THE EXPEDIENCY WITH WHICH DATA CAN BE DISSEMINATED. IT IS NOT INTENDED TO BE A CHECK ON THE PROGRAMMING ACCURACY OF THE GEOS DATA ALTHOUGH THE DATA IS BASED ON NOMINAL GEOS PARAMETERS.
IT IS IMPORTANT THAT THE RECIPIENTS OF THIS TEST DO THE FOLLOWING:

1. IMMEDIATELY TRANSMIT BY TELETYPE TO THE SENDING STATION, ATTENTION GOCC, THE PREDICTION IDENTIFICATION LINE, THE SATELLITE AND STATION IDENTIFICATION LINE, THE PREDICTION ELEMENTS IDENTIFICATION LINE, THE FIRST TWO ROWS OF DATA AND THE LAST TWO ROWS OF DATA, EXACTLY AS RECEIVED IN THE TEST AND THE TIME AND DATE THE TEST WAS RECEIVED.
2. IMMEDIATELY MARK THE TIME AND DATE OF RECEIPT ON THE RECEIVED MESSAGE AND MAIL A COPY TO THE FOLLOWING:
   GODDARD SPACE FLIGHT CENTER
   ATTENTION: GEODETIC OPERATIONS CONTROL CENTER
   CODE 513
   GREENBELT, MARYLAND U.S.A.
3. REVIEW FORMAT OF THE TEST DATA AND SUBMIT ANY COMMENTS OR QUESTIONS WITH ITEM 2 OR BY SEPARATE MAIL TO THE SAME ADDRESS AS FOR 2.

TEST PREDICTION

INTERNL PARTICIPANTS OPERATIONAL MUTUAL VISIBILITY GEOS PREDICTIONS
65100

YYMMDD	HHMMSS	LONG	LAT	HT	NF	NL
651029	43112	36000	3974	1442	7	1
651029	43612	1518	5032	1407	7	1
651030	44012	35184	3778	1449	7	1
651030	44312	35964	4458	1430	7	1
651031	10312	3429	2856	1468	7	1
651031	25812	1314	3705	1452	7	2
651031	45512	42	4903	1416	7	1
651101	11612	3446	3631	1455	7	1
651101	30412	35933	2765	1471	7	1
651101	31012	1229	4205	1441	7	1
651101	50612	35855	5120	1410	7	1
651102	32112	938	4461	1436	7	1
651102	51612	35302	5148	1411	7	1
651103	32912	35824	4053	1449	7	1
651103	33412	1381	5092	1415	7	1
651103	52512	34368	4995	1419	7	1
651104	14512	1490	3510	1462	7	1
651104	33912	35250	4090	1450	7	1
651104	34412	828	5121	1416	7	1

APPENDIX C

GEODETIC OPERATIONS CONTROL CENTER
GEOS-1 OBSERVATIONAL PREDICTIONS
DISTRIBUTION AND PROCEDURES

1.0 GENERAL

This procedure establishes the distribution procedures that will be implemented for the distribution of teletype formatted observational predictions throughout the GEOS A operations. Since the GOCC is the operational control center and has operational responsibility for the satisfactory completion of the mission objectives, it is very important that it be completely cognizant of all data pertaining to the mission. The GOCC will, therefore, be the central point for distribution and collection of all GEOS data.

2.0 DATA DISSEMINATION

The GOCC will be responsible for all data disseminated to GEOS participants and as such must be informed and cognizant of all information disseminated to participants concerning the GEOS A mission. This will include operational and observational predictions as well as ordinary message data. All message data to any of the GEOS participants will either be routed through the GOCC or will info the GOCC.

The following optical station predictions are to be transmitted weekly through NETCON.

Station Number	Station Identification	NASCOM TTY Ind.	Oper. Pred.	Plate Reduct. Pred.
1021	1BPOIN	GBPT	X	X
1022	1FTMYR	GYRS	X	X
1024	1OOMER	AOOM	X	X
1025	1QUITO	GQUI	X	X
1026	1LIMAP	GAPU	X	X
1028	1SNTAG	GAGO	X	X
1030	1MOJAV	GAVE	X	X
1031	1JOBUR	GBUR	X	X
1032	1NEWFL	GFLD	X	X
1033	1COLEG	GLGE	X	X
1034	1GFORK	GRKS	X	X
1035	1WNKFLD	LWNK	X	X
1042	1ROSMN	GROS	X	X

2.1.2 Minitrack and R&RR Predictions

The Data Systems Division shall also provide the GOCC with computer printouts of scheduled MVE's for Minitrack and R&RR station events. GOCC will interface with NETCON requesting priority coverage by Minitrack and R&RR stations on these passes. NETCON shall include this information in their normal operational predicts and scheduling operations. NETCON shall include GOCC as an addressee on operational predictions and scheduling messages that affect GEOS.

The Data Systems Division shall be responsible for generating the optical predictions, producing 5-level teletype tapes of the predictions, and for delivery of the teletype tapes to the GOCC by start of the working day every Monday, on a continuing basis as discussed below.

2.1 STADAN PREDICTIONS

2.1.1 Optical Predictions

The Data Systems Division shall deliver to the GOCC operational and plate reduction predictions on teletype tape for each of the supporting STADAN MOTS stations. These predictions are to be separated and labeled as to network, station and type of prediction. Long range prediction tapes for STADAN stations will not be required, but printouts of the STADAN stations long range predictions will be required as well as printouts of the operational and plate reduction predictions and shall be delivered on Monday along with the tapes. The printouts will be delivered to NETCON and a copy kept in the GOCC files.

The GOCC will log in each prediction message received from the Data Systems Division, check to insure all required tapes are received, then log the messages out and deliver to NETCON for teletype transmission to the stations. NETCON will be responsible for transmitting the predictions to the STADAN MOTS stations including GOCC as an addressee on each TTY prediction message sent out. The GOCC will log the date and time of transmission of each prediction.

The following STADAN stations are to be scheduled through NETCON, for Electronic MVE's.

Station No.	Station Name	NASCOM TTY Ind.	Minitrack	R&RR
1001	BPOINT	GBPT	X	
1003	FTMYRS	GYRS	X	
1005	QUITOE	GQUI	X	
1006	LIMAPU	GAPU	X	
1008	SNTAGO	GAGO	X	
1012	NEWFLD	GFLD	X	
1013	COLEGE	GLGE	X	
1014	GFORKS	GRKS	X	
1015	WNKFLD	LWNK	X	
1016	JOBURG	GBUR	X	
1017	MOJAVE	GAVE	X	
1018	OOMERA	AOOM	X	
1022	MADGAR	LTAN		X
1026	ROSMAN	GROS		X
1052	CARVON	ACRO		X

2.2 USAF PREDICTIONS

The Data Systems Division shall deliver operation and long range predictions on teletype punched paper tape to the GOCC for the supporting USAF distribution centers. In this case, tapes should not be segregated by station but by the USAF distribution centers as listed below. Each tape shall be labeled as to the type of prediction, i.e., operational or long range, and the USAF distribution center to which it is to be transmitted. These tapes will be logged in by the GOCC,

checked to insure all required tapes are received, then logged out and delivered to the NASA Communications message center in Building #3. Th Communications message center will transmit to the appropriate distribution center via teletype in accordance with the following. The GOCC will log the date and time of the transmitted data.

2.2.1 USAF Stations and TTY Distribution Centers for Operational and Long Range Predictions

USAF Dist. Center	TTY Commo.	Station Number	Sta. Ident.	Oper. Pred.	Long Range Pred.
USAF ACADEMY Colorado Spgs ATTN: Capt. Hallisey	Via DOD	3400	USAFAC	X	
*138 1st GSS F.E. Warren AFB ATTN: Stellar Camera	Via DOD	3400	USAFAC	X	X
		3401	BEDFRD	X	X
		3402	SEMMES	X	X
		3407	TRNDAD	X	X
		3106	ANTIGA	X	X
		3406	CURACO	X	X
		3405	GRDTRK	X	X
		3404	SWANIS	X	X
		3648	HUNTER	X	X
		3647	DAUPHN	X	X
		3333	GRNVLE	X	X
		3657	ABERDN	X	X
		3861	HOMEST	X	X
*ACIC St. Louis, Mo. ATTN: J. Johnson (Same predict as for F. E. Warren)					
710-326-0595 L. G. Hanscom Field Bedford, Mass. ATTN: Hadigeorge	Via TWX	3401	BEDFRD	X	

* Multiaddress Msg Requiring only one GSTS Transmission.

2.2.2 USAF Plate Reduction Predictions

The Data Systems Division will produce computer printouts of the USAF stations plate reduction predictions rather than TTY paper tape (regular printouts, not TTY prediction printouts). The GOCC will mail the plate reduction prediction printouts along with the normal weekly mail distribution to Headquarters ACIC (ACOC), Second and Arsenal Streets, St. Louis, Mo. Plate reduction predictions will be provided for each of the stations listed under Paragraph 2.2.1.

2.3 SPECIAL OPTICAL STATION PREDICTIONS

The Data Systems Division shall deliver operational, long range and plate reduction predictions on teletype paper tape to the GOCC for the special optical stations supporting Mr. J. Berbert. Individual tapes should be provided for each station, one tape for operational and long range combined with a second tape for plate reduction. Tapes will be logged into the GOCC, checked to insure all predicts are received, then logged out and delivered to the NASA Communications Message Center in Building #3. The Communications Center shall transmit via TWX or other appropriate teletype facilities to the following points. The GOCC shall record the date time group of the transmitted data.

2.3.1 Special Optical Stations Distribution

TTY Distribution	Station Number	Sta. Ident.	Oper. Pred.	Long Range Pred.	Plate Reduc. Pred.
TWX 910-870-1560 Pan Am. College Edinburg, Texas ATTN: Prof. Engle	(4036) 1036	1EDINB	X	X	X
TWX 910-760-1442 U. of Missouri Columbia, Mo. ATTN: Dr. L.V. Holroyd	(4037) 1037	1COLBA	X	X	X
NOT CONFIRMED	(4038) 1038	1SUDCX	---	---	---
GBDA(NASCOM) MOTS Site ATTN: R. Gillihan	(4039) 1039	1BERMD	X	X	X
ITT TELEX 3450-418 U. of Puerto Rico Rio Piedra, Puerto Rico ATTN: Prof. R. Arce	(4040) 1040	1PURIO	X	X	X
NOT CONFIRMED	(4041) 1041	1JAMAX	---	---	---
TWX 910-931-2639 U. of Denver Denver, Colo. ATTN: Dr. D. Murcray	(4045) 1045	1DENVR	X	X	X
TELEPHONE Mr. S. Genatt 982-5300	(4043) 1043 (4050) 1050	1GSFCP GODLAS	X	X LASER PREDICT	X
NOT CONFIRMED	(4044) 1044	1CKVLE	X	X	X
HOBE Sound	(4071) 1071	1JUM24	X	X	X
Jupiter, Fla.	(4072) 1072	1JUM40	X	X	X
ATTN: L. Guerrero	(4073) 1073	1JUPC1	X	X	X
TWX 305-546-5301	(4074) 1074	1JUBC4	X	X	X

2.4 SAO STATIONS

The Data Systems Division shall deliver a single, time ordered teletype operational prediction tape including all SAO supporting stations. This prediction will be logged in by GOCC, checked for completeness, then logged out and delivered to the message center for teletype transmission to SAO over a NASCOM teletype circuit (GSAO). GOCC will log the date/time group of the transmitted message.

Distribution Center	Sta. No.	Sta. Name	Oper. Pred.
Smithsonian	9001	1ORGAN	X
Astrophysical	9002	1OLFAN	X
Observatory	9023	AUSBAK	X
TTY: GSAO (NASCOM)	9004	1SPAIN	X
ATTN: R. Martin	9005	1TOKYO	X
	9006	1NATOL	X
	9007	1QUIPA	X
	9008	1SHRAZ	X
	9009	1CURAC	X
	9010	1JUPTR	X
	9011	1VILDO	X
	9012	1MAUIO	X
	9024	COLDLK	X

2.5 INTERNATIONAL PARTICIPANTS

The Data Systems Division shall deliver a single station-ordered operational and long range teletype prediction tape of scheduled MVE's for the International Participants. This list will include flash times for each of the International Participants. These

two tapes will be logged in by the GOCC, checked for completeness, and logged out to Communications. The tapes will be hand-carried to the Communications Center for teletype transmission to the following. GOCC will log the date/time group of the transmitted message.

Distribution Center	TTY Commo	Sta. No.	Sta. Ident.	Oper. Pred	L.R. Pred
International Participants	LCHT	8001	MUNCHN	X	X
		8002	BOCHUM	X	X
ATTN: Col Kelsey/ D. Smith		8004	BRNSCH	X	X
		8005	FKFURT	X	X
		8006	BAMBRG	X	X
		8007	TUROLA	X	X
		8008	UPPALA	X	X
		8009	DELFTH	X	X
		8010	ZIMWLD	X	X
		8011	MALVRN	X	X
		8012	MEUDON	X	X
		8013	ROYORS	X	X
		8014	ATHENS	X	X
		8015	HAUTEP	X	X

2.6 USC&GS

The Data Systems Division shall deliver predictions in computer printout form to the GOCC for the USC&GS. GOCC will notify USC&G who will send a courier to pick up the data. GOCC will keep records of the transaction in log form.

Station Number	Station Identification
6107	LYNNLK
6108	CMBDGE
6113	TIMINS
6114	HALFAX

Station Number	Station Identification
6115	GOOSEB
6116	FROBAY
6002	BELTVL
6121	STJOHN

2.7 AMS

AMS computer printouts will be handled in the same manner as USG&GS.

Station Number	Station Identification
5861	HOMEFL
5333	GREENV
5648	FTWART
5001	HERNDN

2.8 APL

APL will not receive MVE teletype predictions from the GOCC as they will generate their own from the APL Light Flash Request.

The Data Systems Division will generate the APL Light Flash Request for seven days of flash times. The Data Systems Division shall deliver the teletype paper tape of the seven days of flash times to the GOCC, one week in advance of the scheduled times.

The GOCC will transmit the APL Light Flash Request tape to APL on the APL-GOCC direct circuit in accordance with the established teletype message handling procedures, keeping record of the receipt and transmission in the GOCC log.

APPENDIX D

GEOS DATA DISTRIBUTION

October 1, 1965

MEMORANDUM

TO: DISTRIBUTION

FM: J. B. Zegalia
T&DS Manager, Geodetic Satellites

SUBJ: Dissemination of GEOS A Data

This memorandum describes the GEOS A data, delineates responsibilities and defines the procedures to be followed in handling and distributing GEOS A data to the various Principal Investigators and Participants.

1.0 GENERAL

The GEOS A data will be generated on a weekly basis by the DSD and sent out to each designated participant under the guidance and direction of the GOCC. Initially, approximately 20 sets of optical data will be prepared, each "data package" approximating six inches in height, consisting of five sets of computer printouts. As the program gets underway, the electronic mutual visibility event data and history data will be generated in addition to that for optical observations and will probably increase the size of the "data package" from the initial size of 6 inches to approximately 18 inches of computer printouts. In addition, data will have to be provided for International Participants as well as for electronic network distribution centers increasing the number of "data packages" by approximately 20 plus 4 respectively, thereby, bringing the total to about 44 sets each containing a stack of bound printouts approximately 18 inches.

2.0 RESPONSIBILITIES AND PROCEDURES

The DSD under the direction of the GEOS OCE will be responsible for generating the GEOS A data on a weekly basis. The DSD will also be responsible for seeing the data through the bursting and binding operation; for ensuring that space is provided for storing the data in the EAM Room until it can be picked up by the mail room; for ensuring that the bound data volumes are properly stacked on shelves and segregated in stacks according to type of

data; and for ensuring that the data are bound and stacked by the proper time.

The Information Dissemination Group will be responsible for packaging or binding the data in accordance with the distribution list to be provided by the GOCC and for providing the proper labels for shipment. They will also be responsible for seeing that the mail room picks up the data in time for shipment, requesting special mail pickup when required.

The GOCC will be responsible for providing the mailing list and list of contents for each data package to the Information Dissemination Group and for advising the DSD of the proper number of copies to produce. GOCC will coordinate on an overall basis to ensure that the data gets produced, collated, packaged, and shipped on time, in the correct quantities and to the proper participants. The GOCC will also be responsible for ensuring that each recipient acknowledges receipt of the "data package" by teletype message and for keeping a log of data sent by network and station, the date sent, date received, and acknowledged and a list of the printouts contained in the "data package." For the initial distributions, GOCC will provide special assistance to the Information Dissemination Group to help in getting the data ready for distribution.

3.0 INITIAL DISTRIBUTION

The initial distribution list will consist of the following printout lists:

List #1	Mutual Visibility Events List
List #2	Mutual Visibility Events Condensed List
List #3.1	Network Ordered Mutual Visibility Events List
List #3.2	Listing of all teletype prediction messages
	Tracking Complement List

The initial distributions will consist of the above data distributed to the following participants:

1. Mr. John S. McCall — 1 Set
   Geodesy Branch, Engineering Office
   Chief of Engineers
   Department of Army
   Washington, D. C.

2. Lt/Cdr. C. J. Limerick, Jr. — 1 Set
   Bureau of Naval Weapons
   Code RTMS-3
   Department of Navy
   Washington, D. C.

3. Capt. Lawrence Swanson — 1 Set
Building #1
Washington Science Center
Coast and Geodetic Survey
Rockville, Maryland

4. Mr. O. W. Williams — 1 Set
Air Force Cambridge Laboratories
OAR CRJ L. G. Hanscom Field
Bedford, Massachusetts

5. Mr. John Berbert — 1 Set
Code 536
Goddard Space Flight Center
Greenbelt, Maryland

6. Dr. Ivan I. Mueller — 1 Set
The Ohio State University
Department of Geodetic Science
164 West 19th Avenue
Columbus, Ohio - 43210

7. Dr. Charles Lundquist — 1 Set
Smithsonian Astrophysical Observatory
60 Garden Street
Cambridge, Massachusetts

8. Mr. William M. Kaula — 1 Set
Institute of Geophysics and Planetary Physics
University of California
Los Angeles, California

9. Headquarters ACIC (ACOC) — 1 Set
Second and Arsenal Streets
St. Louis, Missouri

10. 1381st Geodetic Survey Squadron — 1 Set
F. E. Warren Air Force Base
Wyoming, 82003
Attention: Stellar Camera

11. Col. J. Kelsey — 1 Set
Directorate of Military Survey
Survey 6,
Elmwood Avenue
Feltham, Middlesex
United Kingdom

12. Mr. J. Rosenberg — 2 Sets
Code SG
NASA Headquarters

13. Geodetic Operations Control Center (GOCC) 2 Sets
Code 513
GSFC

14. F. E. Lerch 3 Sets
Data Systems Division
Code 547
GSFC

15. Dr. Siry 1 Set
Code 547
GSFC

16. D. Quiry 1 Set
Code 537
NETCON
GSFC

4.0 REGULAR DISTRIBUTION

As the program progresses, additional lists will be generated increasing the size of the "data package." The lists generated by the DSD will consist of the following:

List #1	Mutual Visibility Events List
List #2	Mutual Visibility Events Condensed List
List #3.1	Network Ordered Mutual Visibility Events List
List #3.2	List of Teletype Prediction Messages
List #4	Time Ordered List of Potential Radio MVE's
List #5	Condensed List of Potential Electronic MVE's
List #6	History Tape Listing
List #7	Histogram of Station Participation
	Tracking Complement List

The following distribution will receive Lists 1, 2, 3.1, 3.2, 4, 5, 6, 7, and the Tracking Complement List.

1. Mr. John S. McCall 1 Set
Geodesy Branch, Engineering Office
Chief of Engineers
Department of Army
Washington, D. C.

2. Lt/Cdr. C. J. Limerick, Jr. 1 Set
Bureau of Naval Weapons
Code RTMS-3
Department of Navy
Washington, D. C.

3. Capt. Lawrence Swanson — 1 Set
Building #1
Washington Science Center
Coast and Geodetic Survey
Rockville, Maryland

4. Mr. O. W. Williams — 1 Set
Air Force Cambridge Research Laboratories
OAR CRJ L. C. Hanscom Field
Bedford, Massachusetts

5. Mr. John Berbert — 1 Set
Code 536
Goddard Space Flight Center
Greenbelt, Maryland

6. Dr. Ivan I. Mueller — 1 Set
The Ohio State University
Department of Geodetic Science
164 West 19th Avenue
Columbus, Ohio 43210

7. Dr. Charles Lundquist — 1 Set
Smithsonian Astrophysical Observatory
60 Garden Street
Cambridge, Massachusetts

8. Mr. William M. Kaula — 1 Set
Institute of Geophysics and Planetary Physics
University of California
Los Angeles, California

9. Headquarters ACIC (ACOC) — 1 Set
Second and Arsenal Streets
St. Louis, Missouri
Attention: Mr. Johnson

10. 1381st Geodetic Survey Squadron — 1 Set
F. E. Warren Air Force Base
Wyoming, 82033
Attention: Stellar Camera

11. Col. J. Kelsey — 1 Set
Directorate of Military Survey
Survey 6
Elmwood Avenue
Feltham, Middlesex
United Kingdom

12. Mr. J. Rosenberg — 2 Sets
Code SG
NASA Headquarters

13. Geodetic Operations Control Center (GOCC) — 2 Sets
Code 513
GSFC

14. F. E. Lerch — 3 Sets
Data Systems Division
Code 547
GSFC

15. Dr. Siry — 1 Set
Code 547
GSFC

16. NETCON — 1 Set
Code 537
GSFC

17. Mr. Robert Frazer — 2 Sets
Applied Physics Laboratory
Johns Hopkins University
Howard County Laboratory
Scaggsville, Maryland

18. Army Map Service — 2 Sets
SECOR Division
Herndon, Virginia

The International Participants will receive lists 1, 2, 3.1, 3.2, 6, and the Tracking Complement List in accordance with the following distribution.

19. Acaddimician Y. Vaisala — 1 Set
Puolalanpuisto 1,
Turku, Finland

20. Monsieur P. Muller — 1 Set
Observatoire De Meudon
Seine-Et-Dise, France

21. Direktor Karminsky — 1 Set
Sternwarte DDR Stadt Bochum
4630 Bochum
Blankensteiner Strasse 200A
Germany

22. Professor Dr. M. Kneissl — 1 Set
B. Akademie Der Wissenschaften
8 Munchen 22
Marstallplatz 8, Germany

23. Direktor Dr. Aing H. Knorr — 1 Set
Institut Fur Angewandte Geodasie
Frankfurt/Main
Kennedy-Allee 151, Germany

24. Professor Dr. Aing Marzahn — 1 Set
Technische Universitat Berlin
Berlin - Charlottenburg
Hardenbergstrasse, Germany

25. Dr. Weber — 1 Set
Deutsche Forschungsanstatt Fur Luftfahrt
Braunschweig Flughafen, Germany

26. Direktor Dr. Strohmeier — 1 Set
Remeis - Sternwarte
Bamberg, Germany

27. Dr. G. Veis — 1 Set
National Technical University of Athens
Athens, Greece

28. Professor G. Bruins — 1 Set
Technical University
Delft, Holland

29. Professor Dr. Lars Asplund — 1 Set
Rickets Allmanna Kartverk
Fack,
Vallingby 1, Sweden

30. Professor Dr. M. Schurer — 1 Set
Astronomical Institute
Berne, Switzerland

31. Satellite Tracking Section — 1 Set
Royal Observatory
Edinburgh 9, U. K.

32. J. Hewitt Esq. — 1 Set
Optics Division
Royal Radar Establishment
Malvern, Worcs., U. K.

33. General R. C. A. Edge — 1 Set
Ordnance Survey
Leatherhead Road
Chessington, Surrey, U. K.

34. D. E. Smith Esq. — 1 Set
Radio and Space Research Station
Detton Park
Slough, Bucks, U. K.

35. Directorate of Military Survey — 1 Set
Survey 6
Elmwood Avenue
Feltham, Middx., U. K.

John B. Zegalia
T&DS Manager, Geodetic Satellites

hgg/bjs

cc: Mr. E. Murphy - GOCC
Mr. E. Doll - DSD
Mr. F. Lerch - DSD
Mr. R. Adams - Info. Dissem. Group
Mr. J. Rosenberg - NASA Hq.

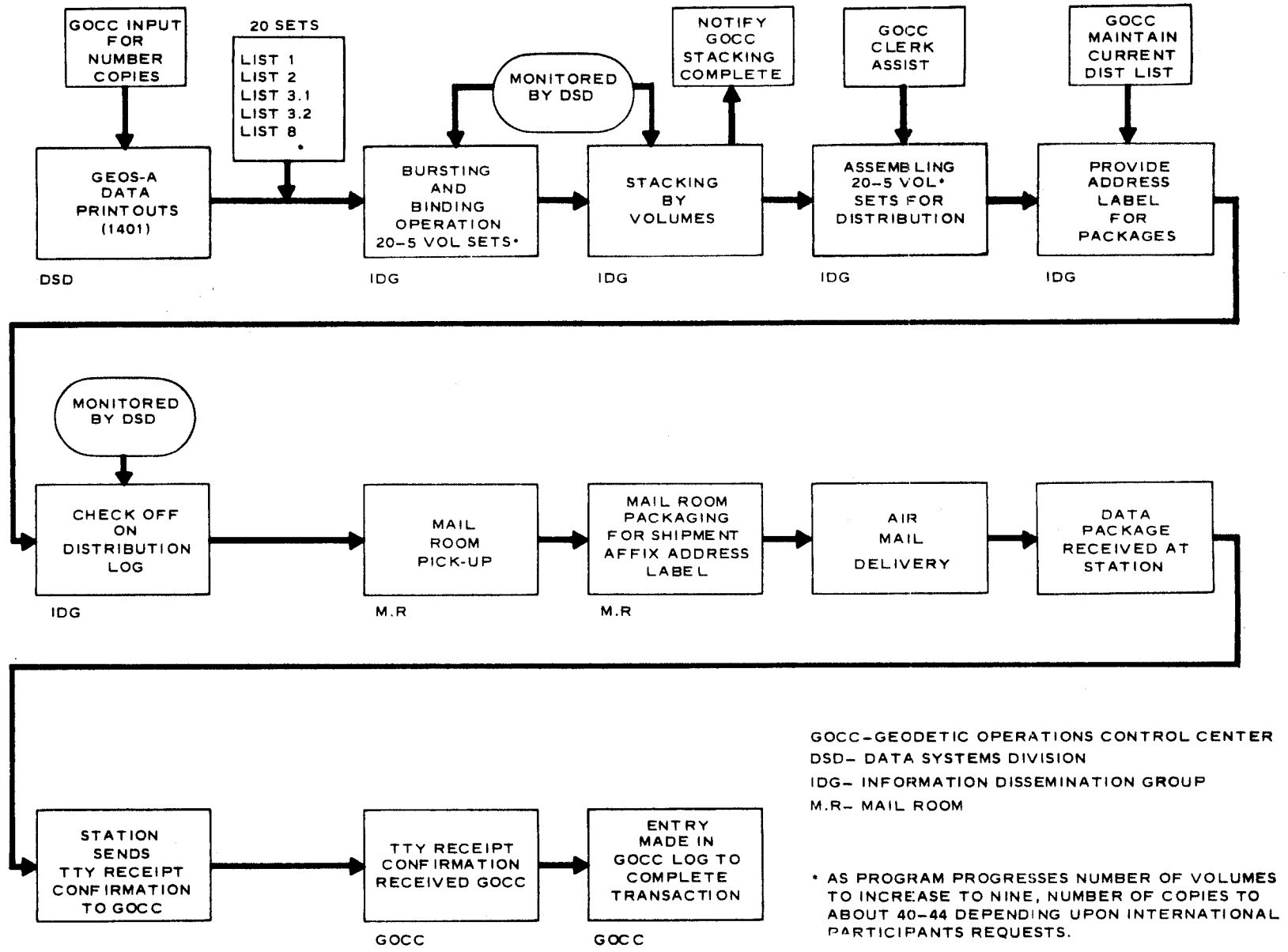


Figure D-1. GEOS A Data Initial Distribution

APPENDIX E

GEOS A OPERATIONAL READINESS TEST

PHASE TWO

OPTICAL PARTICIPANTS

1.0 GENERAL

Phase one of the GEOS A Readiness Tests was intended only to familiarize the International Participants with the observational prediction formats, operational and observational report formats, and various computer listings of flashing light data, etc.

This phase, phase two, is intended to check out the following:

a. Operation of the spacecraft's memory and flashing light subsystem.

b. Optical Participants station operations in interpreting GEOS predictions, performing optical tracking of the GEOS A spacecraft, and preparation of operational reports.

c. Operational checkout of the GSFC GEOS computer programs for observational prediction generation and flashing light schedules generation.

d. Operational checkout of APL injection tape programs and the injection stations operation.

e. Operation of the GOCC for handling observational data in an expeditiously and accurate manner.

2.0 TEST OUTLINE

This test will provide GEOS A flash schedule predictions to the GEOS Optical Participants and flashing light sequences for a 1-week period during the spacecraft's calibration period.

The DSD shall generate teletype formatted operational predictions and plate reduction predictions for each of the participating optical stations. International Participants will require the operational station ordered predictions, rather than the operational time ordered predictions. A minimum of seven flashing light sequences shall be scheduled for each optical station in the 1-week period. Predictions shall be prepared one week in advance of the test period. The DSD shall also provide the APL Light Flash Request for generation of the injection tapes.

The GOCC shall transmit the predictions to the stations in the normal manner and shall transmit the APL Light Flash Request to the APL/SCC.

APL will be responsible for preparing the injection tape in the established manner and for affecting the spacecraft injection for the requested flash events.

Each participant should try to observe a minimum of three of the seven scheduled sequences during the weeks period. Each participant shall complete the Weekly Field Station Optical Report at the end of the test period and submit to the GSFC Geodetic Operations Control Center in the prescribed manner. The observational data shall be submitted to the GSFC-Geodetic Satellite Data Center as soon as possible, in the prescribed manner.

GEOS A Readiness Test Sequence of Events

ITEM NR	TEST EVENT	PROCEDURE OR ACTION	COMPLETION DATE
1	Inform test participants	GOCC advise all optical participants of the Readiness Test, when it will commence and what they will be requested to do. Advise by TTY.	11/18
2	Prepare station predictions	DSD prepare operational and plate reduction predictions for the optical participants for a minimum of seven flash sequences for each optical participant, for the test week, Nov. 30 to Dec. 6. DSD judiciously choose the MVE's for the various participants.	11/22
3	Prepare APL Light Flash Request	DSD prepare APL Light Flash request Tape for Item No. 2, in the prescribed manner, for the week Nov. 30 to Dec. 6.	11/22
4	Transmit Test Predictions	GOCC transmit Test Predicts to all J. Berbert Support Stations.	11/23
		GOCC transmit Test Predicts to all AFCRL centers.	11/23
		GOCC transmit Test Predicts for all International Participants to LCHT.	11/23
		GOCC transmit APL Light Flash Request to APL/SCC.	11/23

ITEM NR	TEST EVENT	PROCEDURE OR ACTION	COMPLETION DATE
		GOCC transmit Test Predicts (Thru NETCON) to all STADAN MOTS Stations.	11/24
5	Prepare S/C Injection Tape	APL produce daily injection tapes for the week's flash events.	11/29
6	Spacecraft Memory Injection	APL inject spacecraft memory for the flash scheduled events -- continuing throughout the test period.	11/29 Continuing daily throughout the test period
7	Test operation	Each optical participant having a scheduled event record events on photographic plate. Record a minimum of three events (more may be taken if desired by station).	11/30 - 12/6
8	Operational report	Each participant complete and submit the Weekly Field Station Optical Report to the GOCC in accordance with established procedures.	12/7
9	GOCC review operational reports	GOCC review reports for content and procedural errors. Provide copies of the reports to J. Berbert.	12/8 (12/13 mailed reports)

ITEM NR	TEST EVENT	PROCEDURE OR ACTION	COMPLETION DATE
10	J. Berbert review operational report	J. Berbert review reports and analyze data. Prepare report to GOCC.	12/14 (12/17 mailed reports)
11	Operational report	GOCC prepare report on Test Operation advising participants of any required change in operations.	12/21
12	Observational data	Each participant complete and submit optical observational data to the GSFC Geodetic Satellite Data Center in the prescribed formats.	1/7
13	Report on observational data	Geodetic Satellite Data Center review observational data. Prepare final report to GOCC.	1/21

APPENDIX F

GEOS A READINESS TEST
OPTICAL STATION TELETYPE MESSAGE

TO: (ALL GEOS-OPTICAL PARTICIPANTS)
FROM: GEODETIC OPERATIONS CONTROL CENTER
SUBJECT: GEOS A READINESS TESTS (OPTICAL)

A GEOS A READINESS TEST IS TENTATIVELY SCHEDULED FOR THE WEEK OF NOVEMBER 30 THROUGH DECEMBER 6 INVOLVING ALL VISIBLE OPTICAL PARTICIPANTS. THE GOCC WILL PROVIDE OPERATIONAL AND PLATE REDUCTION PREDICTS FOR THE SCHEDULED FLASHING LIGHT EVENTS TO THE INDIVIDUAL OPTICAL PARTICIPANTS OR NETWORK DISTRIBUTION CENTER IN ACCORDANCE ESTABLISHED DISTRIBUTION PROCEDURES. OPERATIONAL PREDICTS FOR THIS TEST ARE TENTATIVELY SCHEDULED TO BE DISTRIBUTED NOVEMBER 23. PLATE REDUCTIONS WILL BE DISTRIBUTED SEVERAL DAYS LATER.

EACH VISIBLE OPTICAL PARTICIPANT WILL BE REQUESTED TO RECORD SEVERAL EVENTS OUT OF THE SCHEDULED EVENTS FOR THE WEEK. EACH PARTICIPANT IS REQUESTED TO COMPLETE AND SUBMIT THE WEEKLY FIELD STATION OPTICAL REPORT TO THE GOCC, BY TELETYPE WHERE POSSIBLE, AT THE END OF THE TEST PERIOD.*

THE OPTICAL OBSERVATION DATA IS TO BE SUBMITTED, BY MAIL, TO THE GSFC - GEODETIC SATELLITE DATA CENTER IN ACCORDANCE WITH ESTABLISHED FORMATS. IT IS DESIRED TO OBTAIN THIS DATA AS SOON AS POSSIBLE.

* MODIFIED BY FOLLOW-UP MESSAGE TO REPORT DAILY.

APPENDIX G

TYPICAL OPERATIONAL READINESS TEST (PHASE 2)
TELETYPE OPERATIONAL MUTUAL VISIBILITY PREDICTION

#
GOCØØ7A
RR GOCC
DE GSTS Ø51
23/2128Z
FM GEODETIC OPERATIONS CONTROL CENTER
TO DLD/UNIV OF PUERTO RICO ATTN PROF. R ARCE
INFO GOCC

SUBJECT - GEOS A READINESS TEST PREDICTIONS

MOTS OPERATIONAL MUTUAL VISIBILITY PREDICTIONS FOR GEOS
65891 1PURIO 1Ø4Ø

YYMMDD	HHMMSS	AZ	EL	LHA	DEC	NL
651131Ø	Ø33212	14415	8278	-ØØ432	Ø1237	3
6512Ø1	Ø33512	23169	7198	ØØ1415	ØØ666	3
6512Ø2	Ø34412	35544	5579	ØØØ419	Ø5232	3
6512Ø3	Ø13612	14419	3Ø55	-Ø3568	-3Ø26	2
6512Ø3	Ø34412	27715	5534	ØØ3663	Ø1897	4
6512Ø3	Ø34812	33843	5Ø94	ØØ227Ø	Ø5311	3
6512Ø4	Ø13812	16411	2893	-Ø1834	-4Ø37	4
6512Ø4	Ø14712	Ø8691	4Ø36	-Ø5165	Ø14Ø1	4
6512Ø4	Ø35412	34519	3716	ØØ3154	Ø67Ø7	3
6512Ø5	Ø14412	16473	4Ø51	-Ø133Ø	-2953	2
6512Ø5	Ø35912	34381	2984	ØØ4884	Ø7126	3
6512Ø6	Ø14712	183Ø3	3837	ØØØ284	-333Ø	3
6512Ø6	Ø4Ø212	33ØØ2	286Ø	ØØ6377	Ø6Ø72	3

24/ØØ32Z NOV GSTS

APPENDIX H

TYPICAL OPERATIONAL READINESS TEST (PHASE 2)

TELETYPE PLATE REDUCTION PREDICTION

```
[illegible]10/[illegible]-4911
[illegible]B17"Z
[illegible]S GSFC GREENBELT GEODETIC OPERATIONS CONTROL CENTER
[illegible] OF PUERTO RICL ITT TELEX 3450-418

[illegible]/ PROF R. ARCE INFO COPY BLVD 7000
[illegible]/ PLATE REDUCTION PREDICTS 6589A.

[illegible] PLATE REDUCTION MUTUAL VISIBILITY PREDICTIONS FOR GEOS
[illegible]: 1PURIO      1040
```

YYMMDD	HHMMSS	RT ASC	DECL	EQUINOX
651130	033200	035057	10301	1855
651130	033204	035190	10886	1855
651130	033208	035323	11472	1855
651130	033212	035456	12059	1855
651130	033216	035593	12646	1855
651130	033220	035729	13234	1855
651130	033224	035867	13822	1855
651201	033500	024470	04517	1855
651201	033504	024577	05077	1855
651201	033508	024684	05640	1855
651201	033512	024792	06206	1855
651201	033516	024901	06774	1855
[illegible]01	033520	025010	07345	1855
[illegible]01	033524	025120	07919	1855
651202	034400	033292	50426	1855
651202	034404	033440	50947	1855
651202	034408	033582	51465	1855
651202	034412	033[illegible]26	51974	1855
651202	034416	034024	52487	1855
651202	034420	034224	52992	1855
651202	034424	034429	53492	1855
651203	013600	041550	-31535	1875
651203	013604	041636	-31182	1875
651203	013608	041722	-30829	1875
651203	013612	041808	-30476	1875
651203	013616	041895	-30116	1875
651203	013620	041981	-29757	1875
651203	013624	042067	-29397	1875
651203	034400	013256	16783	1855
651203	034404	013330	17313	1855
651203	034408	013402	17861	1855
651203	034412	013474	18411	1855
651203	034416	013547	18963	1855
651203	034420	013621	19517	1855
651203	034424	013695	20074	1855
651203	034800	022863	51013	1855
651203	034804	022909	51559	1855
651203	034808	023135	52103	1855

```
851203  034812  023272   52643  1855
851203  034816  023412   53181  1855
851203  034820  023555   53717  1855
851203  034824  023700   54249  1855
851204  013800  031159  -41080  1875
851204  013804  031295  -41014   875
851204  013808  031380  -41006  1875
851204  013812  031486  -40696  1875
851204  013816  031581  -40384  1875
851204  013820  031677  -40070  1875
851204  013824  031772  -39755  1875
851204  014700  053059   12782  1855
851204  014704  053130   13139  1855
851204  014708  053301   13544  1855
851204  014712  053423   13947  1855
851204  014716  053545   14343  1855
851204  014720  053668   14747  1855
851204  014724  053791   15144  1855
851204  035400  020219   65103  1855
851204  035404  020349   65611  1855
851204  035408  020486   66087  1855
851204  035412  020620   66560  1855
851204  035416  020761   67060  1855
851204  035420  020906   67467  1855
851204  035424  021055   67961  1855
851205  014400  030115  -30995  1875
851205  014404  030217  -30628  1875
851205  014408  030320  -30254  1875
851205  014412  030423  -29880  1875
851205  014416  030525  -29504  1875
851205  014420  030629  -29129  1875
851205  014424  030733  -28744  1875
851205  035900  010359   69327  1855
851205  035904  010509   69778  1855
851205  035908  010646   70228  1855
851205  035912  010783   70678  1855
851205  035916  010920   71128  1855
851205  035920  011058   71587  1855
851205  035924  011216   72009  1855
851206  014700  020640  -34714  1875
851206  014704  020742  -34385  1875
851206  014708  020844  -34054  1875
851206  014712  020946  -33721  1875
851206  014716  021049  -33385  1875
851206  014720  021151  -33046  1875
851206  014724  021254  -32705  1875
851206  040200  001647   58751  1855
851206  040204  001734   59205  1855
851206  040208  001820   59659  1855
851206  040212  001905   60111  1855
851206  040216  001949   60563  1855
851206  040220  001972   61013  1855
851206  040224  001953   61463  1855
END OF PREDICTION DATA      81 LINES OUTPUT
NCD/J D ZEGALIA/GEODETIC OPERATIO NS CONTROL CENTER

30/1235Z NOV GSTS
```

APPENDIX I

GEOS A OPERATIONAL READINESS TEST (PHASE 2)

FROM: GOCC, GSFC STATION OPTICAL REPORT SUMMARY

TO: J. Rosenberg, F. Lerch, J. Berbert, API Frazer, WOLF/Finegar

SUBJ: Station Optical Report Summary

The following is a summary of station reports from MVE conducted on 30 November, 1965.

1. Scheduled Times (Z)

30/0321	30/0928
30/0332	30/1307
30/0543	30/1556
30/0556	30/1731
30/0744	30/1943
30/0750	
30/1921	
30/2345	

2. Reports

	FLASH TIMES (Z)			
STATION	SKED	ACTUAL	RESULTS	REMARKS
1GSFCP	30/0543	30/0543	11820	none
1PURIO	30/0332	30/0332	11320	none
BLDVLE	30/0543	30/0543	11810	none
LYNNLK	30/0744	30/0744	90001	none
	30/0950	30/0950	90001	
TIMINS	30/0543	30/0543	90001	none
	30/0744	30/0744	90001	
GOOSEB	30/0543	30/0543	90001	none
STJOHN	30/0543	30/0543	90001	none
HOMEST	30/0332	30/0332	128X0	none
	30/0543	30/0543	128X0	
HALFAX	30/0543	30/0543	90001	none
GRNVLE	30/0543	30/0543	138X0	none
ABERDN	30/0543	30/0543	118X0	none
DAUPHN	30/0543	30/0543	148X0	none
SEMMES	30/0543	30/0543	90002	none
HUNTER	30/0543	30/0543	940001	(as sent)
1FTMYR	30/0332	30/0332	90000	none
	30/0543	30/0543	90000	
1WNKFL	30/0556	30/0556	93003	none
	30/2345	30/2345	94001	
1BPOIN	30/0543	30/0543	11910	none
1ROSMA	30/0543	30/0543	11710	none
	30/0744	30/0744	11920	
1DENVR	30/0543	30/0543	11820	none
	30/0744	03/0744	11820	none
	30/0950	30/0950	11820	none
1QUITO	30/0321	30/0321	94001	none
	30/0332	30/0332	94001	none
1JUP24	30/0332	30/0332	90001	none
	30/0543	30/0543	90001	none

NOTE: Reference Appendix A, Figure 10, for Interpretation of Results.

STATION	SKED	ACTUAL	RESULTS	REMARKS
1JUP40	30/0332	30/0332	90001	none
	30/0543	30/0543	90001	none
1JUBC4	30/0332	30/0332	90001	none
	30/0543	30/0543	90001	none
1JUPC1	30/0332	30/0332	90001	none
	30/0543	30/0543	90001	none
1EDINB	30/0744	30/0744	11710	first plate using 18 mins. developing time & 3 lamp flashes are easily seen.
1JOBUR	30/1921	30/1921	90003	none
1BERMD	30/0332	30/0332	13820	none
	30/0543	30/0543	13820	
1MOJAV	30/0744	30/0740	12920	photo taken at wrong LHA due to operators error.
	30/0950	30/0950	12520	displacement very small and difficult to determine stars from flashes.
1LIMAP	30/0321	30/0321	94001	none
1GFORK	30/0543	30/0543	14930	none
	30/0744	30/0744	14930	none
	30/0950	30/0950	90001	none
1NEWFL	30/0543	30/0543	90001	none
1OOMER		30/1104	94001	none
1ORGAN	30/0744	30/0744	13630	none
	30/0950	30/0950	90002	none
1OLFAN	30/1921	30/1921		report not yet received
1SPAIN	30/2345	30/2345		report not yet received
1TOKYO	30/1536	30/1536	90004	no predict, elevation too low.
1NATOL	30/1731	30/1731	90004	none
	30/1943	30/1943	90004	none
1QUIPA	30/0321	30/0321	90002	none
1SHRAZ	30/1943	30/1943	13830	none
1CURAC	30/0321	30/0321	90004	none
	30/0332	30/0332	11710	none
1JUPTR	30/0332	30/0332	14720	none
	30/0543	30/0543	13710	none
	30/0744	30/0744	90001	none
1VILDO	30/0321	30/0321	90001	none
1MAUIO	30/0928	30/0928	12710	none
AUSBAK	30/1307	30/1307	90004	none

FROM: GOCC, GSFC

TO: J. Rosenberg, F. Lerch, J. Berbert, APL/Frazer, WOLF/Finegar

SUBJ: Station Optical Report Summary

The following is a summary of station reports from MVE conducted on 1 December, 1965.

1. Scheduled times (Z)
   - 01/0152
   - 01/0321
   - 01/0335
   - 01/0546
   - 01/0739
   - 01/1109
   - 01/0757
   - 01/1912

2. Reports

STATION	FLASH TIMES (Z) SKED	ACTUAL	RESULTS	REMARKS
1GSFCP	01/0546	01/0543	11820	none
	01/0757	01/0757	13820	
1PURIO	01/0335	01/0335	11710	none
1NEWFL	01/0757	01/0757	11910	Further scrutinizing of plate reveals two light sou ces at following cardinals: 1st 02.36.40 R.A. 45 deg 50.4 mins Dec. 2nd 02.23.48 R.A. 49 deg 31.1 mins Dec.
1MOJAV	01/0739	01/0739	11510	none
BEDFRD	01/0546	01/0546	11810	Photo taken. Plate not yet examined
	01/0757	01/0757	90004	No photo. Sight limitation.
1GFORK	01/0546	01/0546	90001	
	01/0757	01/0757	90001	
BLTVLE	01/0546	01/0546	11810	none
	01/0757	01/0757	11810	none
LYNNLK	01/0757	01/0757	90001	none
	01/1200	01/1200	90001	none
GOOSEB	01/0757	01/0757	13820	none
TIMINS	01/0546	01/0546	90001	none
	01/0757	01/0757	90001	none
STJOHN	01/0757	01/0757	14830	none
FROBAY	01/0757	01/0757	13820	none
1EDINB	01/0546	01/0546	90001	none
1WNKFL	01/0152	01/0152	11110	none
1JUP24	01/0335	01/0335	11920	none
	01/0546	01/0546	11720	none

STATION	SKED	ACTUAL	RESULTS	REMARKS
1JUP40	01/0335	01/0335	90003	none
	01/0546	01/0546	11720	none
1JUPC1	01/0335	01/0335	11920	none
	01/0546	01/0546	11220	none
1JUBC4	01/0335	01/0335	11920	none
	01/0546	01/0546	11920	none
1BPOIN	01/0546	01/0546	90004	Photo taken. Plate broken when removed from plate holder.
1OOMER	01/1109	01/1109	91004	Unable to take photo due to shack limits. Camera limits reached at -60°
1QUITO	01/0321	01/0321	94001	
	01/0335	01/0335	94001	
1ROSMA	01/0546	01/0546	11910	none
1JOBUR	01/1914	01/1914	12920	none
1COLBA	01/0546	01/0546	11710	none
HOMEST	01/0335	01/0335	94001	none
	01/0546	01/0546	94001	none
ABERDN	01/0546	01/0546	94001	none
GRNVLE	01/0546	01/0546	128X0	none
HUNTER	01/0335	01/0335	93002	none
	01/0546	01/0546	93002	none
SEMMES	01/0546	01/0546	128X0	none
DAUPHN	01/0546	01/0546	128X0	none
1PURIO	01/0335	01/0335	11710	none
1FTMYR	01/0335	01/0335	11710	none
	01/0546	01/0546	11710	none
1BERMD	01/0335	01/0335	90001	none
	01/0546	01/0546	90001	none
1LIMAP	01/0321	01/0321	94001	none
CMBDGE	01/0757	01/0757	90001	none
	01/1200	01/1200	90001	none
HALFAX	01/0546	01/0546	13820	none
	01/0757	01/0757	90001	none
1SATAG	01/0321	01/0321	12120	none
1ORGAN	01/0546	01/0546	14720	
	01/0739	01/0739	90001	
1OLFAN		01/1914		no event
1SPAIN	01/0152	01/0152	11710	
1TOKYO		01/1344		no event
1NATOL		01/1737		no event
		01/1948		no event
1QUIPA	01/0321	01/0321	90001	
1SHRAZ		01/1737		no event
		01/1948		no event
1CURAC		01/0335	90004	power failure
1JUPTR	01/0335	01/0335	11710	
	01/0546	01/0546	11710	
1VILDO		01/0321		report not yet received
1MAUIO		01/0944	90002	
AUSBAK	01/1109	01/1109	11710	

STATION	SKED	ACTUAL	RESULTS	REMARKS
	LATE RECEIPT OF RESULTS FOR 30 NOVEMBER 1965			
1OLFAN	30/1921	30/1921	11710	
1SPAIN	30/2345	30/2345	11110	
1COLBA	30/0543	30/0543	11710	
	30/0744	30/0744	11320	

FROM: GOCC, GSFC

TO: J. ROSENBERG, F. LERCH, J. BERBERT, WOLF/FINEGAR, APL/FRAZER

SUBJ: STATION OPTICAL REPORT SUMMARY

The following is a summary of station reports from MVE conducted on 2 December, 1965

1. Scheduled Times (Z)

*02/0113	*02/0600
*02/0155	*02/0750
*02/0331	*02/1124
*02/0344	*02/1206
*02/0404	02/1403
*02/0545	02/1921

NOTE: *Injection for indicated times was two hours late. Participating stations were informed of the two hour late memory injection by message, and were informed, "All participating optical stations are relieved of any responsibility for observing the flashing light events for this period."

2. Reports

	FLASH TIMES (Z)			
STATION	SKED	ACTUAL	RESULTS	REMARKS
1BERMX		02/0344	90001	
1JOBUR	02/1929	02/1929	14920	
1OOMER		02/1124	91004	Cancelled GOPS 01/2022Z
1JUP14		02/0344	90001	
		02/0545	90004	
1JUP40		02/0344	90001	
		02/0545	90004	
1JUPC1		02/0344	90001	
		02/0545	90004	
1JUBC4		02/0344	90001	
		02/0545	90004	
1QUITO		02/0331	94001	
1BPOIN		02/0344	90004	
		02/0545	90004	Cancelled by GOPS 01/2002Z
C&GS				All station - Events on Day 651202 not taken due to error in flash time.
1CSPCP		02/0344	92004	Cancelled by GOPS
		02/0545	92004	01/2001Z
[illegible]DN		02/0344	128X0	
[illegible]STD		02/0344	128X0	
GRNVLE		02/0545	94001	
HUNTER		02/0344	118X0	
		02/0545	118X0	
SERRES		02/0344	118X0	
		02/0545	94001	
DAUPHN		02/0344	118X0	
		02/0545	94001	

STATION	SKED	ACTUAL	RESULTS	REMARKS
USAFAC		02/0545	91004	
1ORGAN		02/0545		no event
		02/0750	11510	
1OLFAN		02/1929	12710	
1SPAIN		02/0155		no event
		02/2146	11710	
1TOKYO		02/1352	90001	
1NATOL		02/1741	90004	unclassified trouble
1QUIPA		02/0113	90004	no predict - elevation too low
		02/0331		no event
1SHRAZ		02/1741	11710	
		02/1942	11710	
1CURAC		02/0331		no event
		02/0344		no event
1JUPTR		02/0344		no event
		02/0544	13710	
		02/0545		no event
1VILDO		02/0113	12910	
1MAUIO		02/0948		no event
AUSBAK		02/1124		no event

FROM: GOCC, GSFC

TO: J. Rosenberg, F. Lerch, J. Berbert, WOLF/Finegar, APL/Frazer

SUBJ: Station Optical Summary Report

The following is a summary of station reports from MVE conducted on 3 December, 1965.

1. Scheduled Times (Z)

03/0116	03/0344	03/0759	03/1407
03/0132	03/0348	03/0811	03/1614
03/0136	03/0545	03/1117	03/1923
03/0159	03/0602	03/1209	03/1934

2. Reports

STATION	FLASH TIMES (Z) SKED	ACTUAL	RESULTS	REMARKS
BEDFRD	03/0348	03/0348	13820	Photo taken-Plate not developed
	03/0602	03/0602	90004	No photo sight limitation
1LIMAP	03/0132	03/0132	94001	none
1BERMX	03/0344	03/0344	13820	none
	03/0348	03/0348	13820	none
1GSFCP	03/0344	03/0344	94001	none
	03/0348	03/0348	94001	none
	03/0602	03/0602	94001	none
1MOJAV	03/0545	03/0545	91003	none
	03/0759	03/0759	11710	none
1BPO1N	03/0344	03/0344	94001	none
	03/0348	03/0348	13920	none
	03/0602	03/0602	94001	none
1GFORK	03/0759	03/0759	90001	none
1FTMYR	03/0344	03/0344	90001	no photo-cloud cover
	03/0348	03/0348	90001	no photo-cloud cover
1NEWFL	03/0602	03/0602	11920	none
	03/0811	03/0811	11920	none
1JOBUR	03/1923	03/1923	11720	none
	03/1934	03/1934	90001	none
1OONEE	03/1117	03/1117	92002	no photo, camera focusing underadjustment, also intermittent cloud.
1WHFL	03/0159	03/0159	94001	none
1ROSMA	03/0344	03/0344	90001	none
	03/0348	03/0348	90001	none
1PURIO	03/0136	03/0136	11710	none
	03/0344	03/0344	11710	none
	03/0348	03/0348	11710	none
1DENVR	03/0545	03/0545	12820	none
	03/0759	03/0759	12820	none

STATION	SKED	ACTUAL	RESULTS	REMARKS
1QUITO	03/0132	03/0132	94001	none
	03/0344	03/0344	94001	none
1JUP24	03/0344	03/0344	13920	none
	03/0348	03/0348	13920	none
1JUP40	03/0344	03/0344	13720	none
	03/0348	03/0348	13720	none
1JUPC1	03/0344	03/0344	13920	none
	03/0348	03/0348	13920	none
1JUBC4	03/0344	03/0344	13920	none
	03/0348	03/0348	13920	none
1EDINB	03/0344	03/0344	90001	none
	03/0545	03/0545	90001	none

FROM: GOCC, GSFC

TO: J. Rosenberg, F. Lerch, J. Berbert, WOLF/Finegar, APL/Frazer

SUBJ: Station Optical Report Summary

The following is a summary of station reports from MVE conducted on 4 December, 1965.

1. Scheduled Times (Z)

04/0120	04/0354	04/0802	04/1401
04/0138	04/0413	04/0809	04/1748
04/0147	04/0557	04/1134	04/1928
04/0340	04/0758	04/1213	04/2154

STATION	SKED	ACTUAL	RESULTS	REMARKS
1NEWFL	04/0354	04/0354	90001	
1BERMD	04/0147	04/0147	12820	
	04/0354	04/0354	13820	
1LIMAP	04/0138	04/0138	94001	
	04/0340	04/0340	94001	
	04/0557	04/0557	11320	
1MOJAV	04/0802	04/0802	11710	
1BPOIN	04/0354	04/0354	94001	
	04/0557	04/0557	94001	
1GFORK	04/0802	04/0802	90001	
	04/0809	04/0809	90001	
1FTMYR	04/0354	04/0354	90001	
		04/0357	90001	
1EDINB	04/0557	04/0557	90001	
1JOBUR	04/1928	04/1928	11920	
1QUITO	04/0138	04/0138	94001	
	04/0340	04/0340	94001	
1WNKFL	04/0413	04/0413	94001	
1OOMER	04/1134	04/1134	12924	Predictions Misinterpretated
1JUP14	04/0354	04/0354	90001	
	04/0557	04/0557	90001	
1JUP40	04/0354	04/0354	90001	
	04/0557	04/0557	90001	
1JUPC1	04/0354	04/0354	90001	
	04/0557	04/0557	90001	
1JUBC4	04/0354	04/0354	90001	
	04/0557	04/0557	90001	
1ROSMA	04/0354	04/0354	90001	
	04/0557	04/0557	12910	
1SNTAG	04/0120	04/0120	11220	
1PURIO	04/0138	04/0138	11620	
	04/0147	04/0147	11710	
	04/0354	04/0354	11320	
1GSFCP	04/0354	04/0354	94001	none
	04/0557	04/0557	94001	none

STATION	SKED	ACTUAL	RESULTS	REMARKS
1DENVR	04/0557	04/0557	12920	
	04/0802	04/0802	12920	
1COLBA	04/0354	04/0354	90001	none
	04/0557	04/0557	90001	none
	04/0802	04/0802	11710	none
ABERDN	04/0354	04/0354	94001	none
	04/0557	04/0557	94001	none
GRNVLE	04/0354	04/0354	128X0	none
	04/0557	04/0557	138X0	none
DAUPHN	04/0354	04/0354	94001	none
	04/0557	04/0557	94001	none
HOMEST	04/0354	04/0354	118X0	none
HUNTER	04/0354	04/0354	94001	none
	04/0557	04/0557	94001	none
SEMMES	04/0354	04/0354	94001	none
	04/0557	04/0557	94001	none
USAFAC		04/0447	118X0	none
COLEGE	04/1213	04/1213	91004	Camera undergoing modification
1CURAC	04/0147	04/0147	14520	
	04/0340	04/0340	report not yet received.	
	04/0354	04/0354	unclassified troubles.	
1JUPTR	04/0354	04/0354	90001	
	04/0557	04/0557	90001	
1VILDO	04/0120	04/0120	90001	unclassified troubles
1MAUIO	04/0748	04/0748	11710	
AUSBAK	04/1134	04/1134	14110	
1ORGAN	04/0557	04/0557	12310	
	04/0802	04/0802	12710	
1OLFAN	04/1928	04/1928	12710	
1SPAIN	04/2154	04/2154	90004	unclassified troubles
1TOKYO	04/1401	04/1401	12710	
1NATOL	04/1748	04/1748	90004	shot not found
1QUIPA	04/0138	04/0138	90001	
	04/0340	04/0340	90001	
1SHRAZ	04/1748	04/1748	90004	unclassified troubles

LATE RECEIPTS

30 NOVEMBER				
COLEGE	30/0950	30/0950	91004	camera undergoing mofification.
01 DECEMBER				
1VILDO	01/0321	01/0321	13710	
02 DECEMBER				
COLEGE	02/1403	02/1403	94001	
03 DECEMBER				
COLEGE	03/1209	03/1209	11930	Camera not clearly focused
	03/1407	03/1407	11930	Camera not clearly focused
	03/1614	03/1614	11930	Camera not clearly focused
HOMEST	03/0344	03/0344	138X0	
	03/0348	03/0348	94001	
ABERDN	03/0348	03/0348	94001	
GRNVLE	03/0344	03/0344	94001	
	03/0348	03/0348	94001	
	03/0545	03/0545	94001	

STATION	SKED	ACTUAL	RESULTS	REMARKS
HUNTER	03/0344	03/0344	138X0	
	03/0348	03/0348	138X0	
SEMMES	03/0344	03/0344	94001	
	03/0348	03/0348	94001	
	03/0545	03/0545	94001	
1JUPTR	03/0344	03/0344	14730	
	03/0348	03/0348	14730	
	03/0545	03/0545	90001	
1VILDO	03/0116	03/0116	13510	
	03/0132	03/0132	90004	no predict. elev. too low.
1MAUIO	03/0741	03/0741	12710	
	03/0945	03/0945	12710	
AUSBAK	03/1117	03/1117	90001	

FROM: GOCC, GSFC

TO: J. Rosenberg, F. Lercn, J. Berbert, WOLF/FINEGAR, APL/FRAZER

SUBJ: STATION OPTICAL REPORT SUMMARY

The following is a summary of station reports from MVE conducted on 5 December, 1965.

1. Scheduled Times (Z)

05/0125	05/0345	05/0812	05/2207
05/0131	05/0359	05/1126	
05/0140	05/0604	05/1936	
05/0144	05/0806	05/2202	

STATION	SKED	ACTUAL	RESULTS		REMARKS
1BERMX	05/0359	05/0359	90001		none
LIMAPU	05/0131	05/0131	94001		none
	05/0140	05/0140	94001		none
	05/0144	05/0144	94001		none
	05/0345	05/0345	94001		none
1FTMYR	05/0359	05/0359	90001		(Overcast)
1MOJAV	05/0806	05/0806	11910		none
1NEWFL	05/0359	05/0359	90001		none
1GFORK	05/0604	05/0604	11020		none
	05/0806	05/0806	11020		none
	05/0812	05/0812	11020		none
1BPOIN	05/0359	05/0359	11220		none
	05/0604	05/0604	11020		none
1JOBUR	05/1936	05/1936	14920		none
1OOMER	05/1126	05/1126	13930		none
1QUITO	05/0140	05/0140	94001		none
	05/0144	05/0144	94001		none
	05/0345	05/0345	94001		none
1ROSMA		05/0309	12910		none
	05/0604	05/0604	12210		none
1SNTAG	05/0125	05/0125	11230		poor quality due to
	05/0131	05/0131	11810		failure of shutter
1GSFCP	05/0359	05/0359	94001	none	timer. Shutter stayed
	05/0604	05/0604	94001	none	open after drive stopped.
1EDINB	05/0345	05/0345	90001		none
	05/0604	05/0604	90001		none
1DENVR	05/0604	05/0604	90001		none
	05/0806	05/0806	90001		none
1PURIO	05/0144	05/0144	11730		none
	05/0359	05/0359	14920		none
1COLBA	05/0359	05/0359	12320		none
	05/0604	05/0604	13720		none
	05/0812	05/0812	14520		none
ABERDN	05/0359	05/0359	94001		none
	05/0604	05/0604	128X0		none

STATION	SKED	ACTUAL	RESULTS	REMARKS
GRNVLE	05/0359	05/0359	128X0	none
	05/0604	05/0604	128X0	none
DAUPHN	05/0359	05/0359	118X0	none
	05/0604	05/0604	118X0	none
HOMEST	05/0359	05/0359	94001	none
HUNTER	05/0359	05/0359	128X0	none
	05/0604	05/0604	128X0	none
SEMMES	05/0359	05/0359	118X0	none
	05/0604	05/0604	118X0	none
USAFAC	05/0604	05/0604	94001	none
	05/0806	05/0806	94001	none
1CURAC	05/0140	05/0140	12720	none
	05/0144	05/0144	13720	none
	05/0345	05/0345	90001	none
1JUPTR	05/0144	05/0144	90001	none
	05/0345	05/0345	90004	Elevation too low. No predict
	05/0359	05/0359	90001	none
	05/0604	05/0604	90001	none
1VILDO	05/0125	05/0125	90001	none
	05/0131	05/0131	90001	none
1MAVIO	05/0957	05/0957	90004	Unclassified Troubles.
1AUSBAK	05/1126	05/1126	14710	none
1ORGAN	05/0604	05/0604	90004	Elev. Too low. No predict
	05/0806	05/0806	90004	Sky too bright.
1OLFAN	05/1936	05/1936	11110	none
1SPAIN	05/2202	05/2202	90004	Unclassified troubles.
1TOKYO		05/1406		Report not received
1NATOL	05/1554	05/1554	90003	none
	05/1752	05/1752		none
1QUIPA	05/0131	05/0131	90001	none
	05/0140	05/0140	90001	none
	05/0144	05/0144	90004	Elev. too low. No predict.
1SHRAZ	05/1752	05/1752	90001	none

FROM: GOCC, GSFC

TO: J. ROSENBERG, F. LERCH, J. BERBERT, WOLF/FINEGAR, APL/FRAZER

SUBJ: STATION OPTICAL REPORT SUMMARY

The following is a summary of station reports from MVE conducted on 6 December, 1965.

1.Scheduled times (Z)

06/0013	06/0402	06/1221	06/1942
06/0132	06/0555	06/1410	06/2005
06/0147	06/0609	06/1601	06/2158
06/0202	06/0818	06/1625	06/2212
06/0350	06/1022	06/1803	
06/0353	06/1132	06/1936	

STATION	SKED	ACTUAL	RESULTS	REMARKS
1NEWFL	06/0202	06/0202	90001	
1BERMD	06/0202	06/0202	12820	none
	06/0402	06/0402	90001	none
1GSFCP	06/0402	06/0402	13920	pass plate poor quality overexposed due to close proximaty of moon.
1MOJAV	06/0555	06/0555	14920	none
1GFORK	06/0402	06/0402	14930	none
	06/0609	06/0609	11920	none
	06/0818	06/0818	90001	none
	06/1022	06/1022	90001	none
1FTMYR	06/0350	06/0350	13920	none
	06/0353	06/0353	13920	none
	06/0402	06/0402	12920	none
1BPOIN	06/0402	06/0402	11020	none
	06/0609	06/0609	91003	none
1LIMAP	06/0132	06/0132	94004	camera and shack limits prevented
	06/0147	06/0147	94001	pointing of camera.
1ROSMA	06/0353	06/0353	14920	
	06/0402	06/0402	12920	
	06/0609	06/0609	11920	
1DENVR	06/0609	06/0609	90001	
1JOBUR	06/1936	06/1936	90001	none
	06/1942	06/1942	90001	
1QUITO	06/0147	06/0147	94001	
	06/0350	06/0350	94001	
	06/0353	06/0353	94001	
1OOMER	06/1132	06/1132	11920	
ABERDN	06/0402	06/0402	94001	none
	06/0609	06/0609	94001	
GRNVLE	06/0353	06/0353	128X0	none
	06/0402	06/0402	128X0	
	06/0609	06/0609	128X0	

STATION	SKED	ACTUAL	RESULTS	REMARKS
1QUITO	06/0147	06/0147	94001	
	06/0350	06/0350	94001	
	06/0353	06/0353	94001	
1OOMER	06/1132	06/1132	11920	
ABERDN	06/0402	06/0402	94001	none
	06/0609	06/0609	94001	
GRNVLE	06/0353	06/0353	128X0	none
	06/0402	06/0402	128X0	
	06/0609	06/0609	128X0	
DAUPHN	06/0353	06/0353	128X0	
	06/0402	06/0402	128X0	
HOMEST	06/0353	06/0353	94001	none
	06/0402	06/0402	94001	
HUNTER	06/0402	06/0402	94001	none
SEMMES	06/0353	06/0353	118X0	none
	06/0402	06/0402	118X0	
USAFAC	06/0609	06/0609	94001	none
SWANIS	06/0353	06/0353	94001	none
1JUP24	06/0353	06/0353	13920	
	06/0402	06/0402	12920	
1JUP40	06/0353	06/0353	13920	
	06/0402	06/0402	12920	
1JUPC1	06/0353	06/0353	13920	
	06/0402	06/0402	12920	
1JUBC4	06/0353	06/0353	13920	
	06/0402	06/0402	12920	
1PURIO	06/0147	06/0147	11320	
	06/0402	06/0402	11920	
1OOMER	06/1132	06/1132	11230	corrected copy
1SATAG	06/0132	06/0132	11210	
	06/0132	06/0132	13220	
1EDINB	06/0350	06/0350	12920	
	06/0353	06/0353	12920	
	06/0402	06/0402	11920	
	06/0555	06/0550	12920	
CURAC	06/0147	06/0147	90001	
	06/0350	06/0350	90001	
	06/0353	06/0353	90001	
	06/0402	06/0402	90001	
1JUPTR	06/0147	06/0147	14130	
	06/0350	06/0350	90004	Elevation too low. No predict.
	06/0353	06/0353	90004	Sky too bright.
	06/0402	06/0402	14130	
	06/0609	06/0609	14130	
1VILDO	06/0132	06/0132	90004	Unclassified troubles
1MAVIO	06/0749	06/0749	13720	
1AUSBAK	06/1132	06/1132	12710	
1ORGAN	06/0350	06/0350	90004	Sky too bright
	06/0353	06/0353	90004	Sky too bright
	06/0402	06/0402	90004	Sky too bright
	06/0555	06/0555	13720	
	06/0609	06/0609	90004	Elev. Too low. No predict

STATION	SKED	ACTUAL	RESULTS	REMARK
1OLFAN	06/1936	06/1936	90001	
	06/1942	06/1942	90001	
1SPAIN	06/2158	06/2158	90001	
1TOKYO	06/1410	06/1410	90003	
1NATOL	06/1601	06/1601	90004	Shot not found
	06/1803	06/1803	90004	shot not found
1QUIPA	06/0132	06/0132	90001	
	06/0147	06/0147	90004	Elev. too low. No predict
1SHRAZ	06/1803	06/1803	12710	
	06/2005	06/2005	12710	

FROM: GOCC, GSFC

TO: DISTRIBUTION

SUBJ: INTERNATIONAL STATION OPTICAL REPORT SUMMARY

The following is a summary of station reports from MVE conducted on 23 November, 30 November thru 6 December, 1965.

1. Scheduled Times (Z)

30 NOV.	1 DEC.	2DEC.	3 DEC.	4 DEC.	5 DEC.	6 DEC.
0056	0152	0155	0159	0413	2202	0013
2345		0404	2156		2207	2212

STATION	SKED	ACTUAL	RESULTS	REMARKS
MEUDON		23/2345	11810	Plate 23.45 was taken with a new 200/600 camera.
MALVRN	30/2345	30/2345	00001	
	30/0556	30/0556	11720	
ZIMWLD	30/2345	30/2345	90004	Predicts not received.
BERLIN		30/0156		No predicts available.
	30/2345	30/2345	90004	Solid overcast snow. No camera available.
ROYOBS	30/0556	30/0556	90001	Flashes observed visually at a station 13 miles south which was clear of cloud.
	30/2345	30/2345	90002	Camera in use on higher priorit One flash possibly observed visually.
DELFTH	30/2345	30/2345	90004	No Predicts.
BOCHUM	NOTE: No observations 29 Nov. to 5 Dec. 1965, Cloudy.			
MUNCHN	30/2345	30/2345	90004	No predicts
BAMBRG	30/2345	30/2345	90001	
TUORLA	NOTE: Clouds, no photographs 29,30 No. thru 6 Dec., 1965.			
MALVRN	01/0152	01/0152	11710	
ZIMWLD	01/0152	01/0152	90004	Predicts not received
MEUDON	01/0152	01/0152	11820	
BERLIN	01/0152	01/0152	90004	Solid overcast, snow. No Camera available.
ROYOBS	01/0152	01/0152	90001	Flashes observed visually 13 miles south which was clear of clouds.
DELFTH	01/0152	01/0152	90004	No predicts
MUNCHN	01/0152	01/0152	90004	No predicts. NOTE: Readiness predicts received 0700Z 651201.
BAMBRG	01/0152	01/0152	90001	
HAUTEP	02/0155	02/0155	11820	
	02/0404	02/0404	11820	

STATIONS	SKED	ACTUAL	RESULTS	REMARKS
MALVRN	02/0155	02/0155	90001	
	02/0404	02/0404	90001	
ZIMWLD	02/0155	02/0155	90001	
	02/0404	02/0404	90001	
BERLIN	02/0155	02/0155	90004	
	02/0404	02/0404	90004	Solid overcast snow. No Camera available.
ROYOBS	02/0155	02/0155	90001	Cloud
	02/0404	02/0404	90001	Cloud
MEUDON	02/0155	02/0155	13810	
	02/0404	02/0404	90001	
DELFTH	02/0154	02/0154	90001	
MUNCHN	02/0155	02/0155	90001	
	02/0404	02/0404	90001	
BAMBRG	02/0155	02/0155	90001	
	02/0404	02/0404	90001	
MEUDON	03/0159	03/0159	90001	
MALVRN	03/0159	03/0159	90001	
BERLIN	03/0159	03/0159	93004	No camera available. No flashes seen with theodolit Wild T4 and Kern DKM-3A.
DELFTH	03/0159	03/0159	90001	
MEUDON	03/2156	03/2156	90001	
HAUTEP	03/2156	03/2156	13820	
ROYOBS	03/0159	03/0159	90001	
MUNCHN	03/0159	03/0159	90001	
	03/2156	03/2156	90001	
BAMBRG	03/0159	03/0159	90001	
	03/2156	03/2156	90001	
BERLIN	03/0156	03/2156	90001	80-90% overcast. No camera available yet.
MEUDO	04/0413	04/0413	90001	
HAUTEP	04/0413	04/0413	12820	
MALVRN	04/0413	04/0413	12720	
ROYOBS	04/0413	04/0413	11880	
MUNCHN	04/0413	04/0413	90001	
		04/2154	90001	
BAMBRG	04/0413	04/0413	90001	
BERLIN	04/0413	04/0413	90001	Overcast. No camera available yet
MEUDON	05/2202	05/2202	90002	
	05/2207	05/2207	90002	
MALVRN	05/2202	05/2202	90001	
	05/2207	05/2207	90001	
ROYOBS	05/2207	05/2207	90001	
MUNCHN	05/2202	05/2202	90004	Reloading time
	05/2207	05/2207	14930	Clouded, moonlight.
BAMBRG	05/2202	05/2202	90001	
	05/2207	05/2207	90001	
BERLIN	05/2202	05/2202	90001	
	05/2207	05/2207	90001	No Camera available yet.
HAUTEP	05/2202	05/2202	12810	
	05/2207	05/2207	90002	

STATION	SKED	ACTUAL	RESULTS	REMARKS
MEUDON	06/0013	06/0013	90002	
	06/2212	06/2212	90001	
MALVRN	06/0013	06/0013	13430	Trace of cloud at time of
	06/2212	06/2212	90001	exposure.
ROYOBS	06/0013	06/0013	90001	Cloud
MUNCHN	06/0013	06/0013	90001	
	06/2212	06/2212	90001	
BAMBRG	06/0013	06/0013	90001	
	06/2212	06/2212	90001	
BERLIN	06/0013	06/0013	90001	No camera available yet.
	06/2212	06/2212	91004	No camera available yet.
HAUTEP	06/0013	06/0013	90001	
	06/2212	06/2212	13810	

APPENDIX J

GEOS A INJECTION TEST

1.0 GENERAL

This procedure outlines the general test program for checking out the capability of using the ROSMAN I station as a backup injection station for the GEOS A spacecraft. The test will be conducted in two phases. Phase one will be conducted radiating to the GEOS A prototype spacecraft at ROSMAN. Phase two will be conducted with the live GEOS A spacecraft while in its calibration period. Commanding in each phase will be attempted from the ROSMAN site and from the GSFC OAO Control Center with commands transmitted to the ROSMAN command transmitter facility.

Since the programming effort and ground equipment essentially have been debugged, it is assumed for the purposes of this test that the ground station system is operational. The main purpose of this test will be to test out the ground facility and spacecraft as a system.

2.0 PHASE ONE

This test will be conducted approximately two weeks after the GEOS A launch, its starting and completion times being dependent upon when the prototype spacecraft can be made available at the ROSMAN station. Once the prototype is on station, NETCON will establish times when the tests can be run on a noninterfering basis with station operations. Since the prototype will be worked on an RF loop, NETCON will also have to advise on nonconflicting times with operational satellites in view of the station.

2.1 ROSMAN MEMORY INJECTION TEST (PROTOTYPE S/C)

The GEOS A prototype spacecraft must be first set up to operate on an RF loop with the station and the spacecraft timing must then be synchronized with WWV.

The GEOS FSK command modulator must be installed and previously checked out. Transmission to the prototype S/C will be through the 148.98-mc command transmitter. The PCM 5.4-kc discriminator must be set up to produce a 3-volt P-P signal for ± 7.5% deviation of 5.4 kc. The discriminator output (dc offset) must be set so that the zero volt level is one quarter the zero swing to provide zero crossing for every zero bit. The ROSMAN memory injection facilities will be configured as shown in Figure #1.

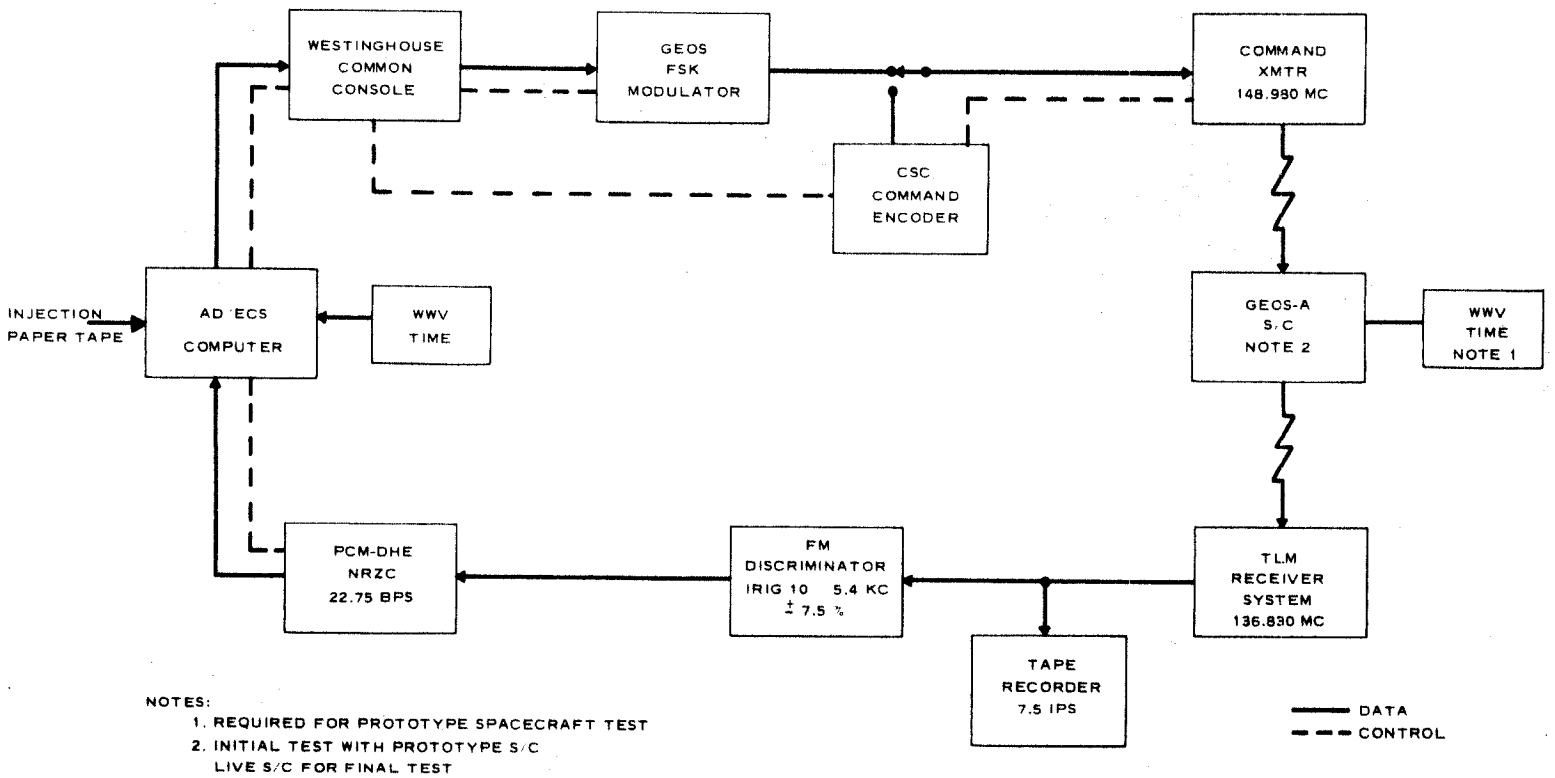


Figure J-1. ROSMAN Injection Test

Once facilities are established, proceed with the test as follows:

a. Perform pretest checkout of the operational equipment for the command injection test.

b. Prior to attempting memory injection manually command telemetry on and ensure a good RF command and telemetry link is in effect.

c. Feed the test memory injection tape into the AD/ECS computer tape reader, loading the computer.

d. Type out a true copy version of the GEOS injection tape.

e. Initiate transmission of a memory load command at the proper time and monitor and provide synchronization for the resulting memory readout.

f. Initiate transmission of the injection message at the properly synchronized time.

g. Compare the post-load memory received from the real time telemetry with the expected message.

h. Repeat items e, f, and g if necessary.

2.2 GSFC OAO CONTROL CENTER MEMORY INJECTION TEST (PROTOTYPE S/C)

While the prototype spacecraft is still available at ROSMAN, a second memory injection test shall be conducted from the GSFC OAO Control Center. This test will be essentially the same as that for ROSMAN except the command will be done at GSFC with the FSK command tones transmitted to ROSMAN over the 15-kc north to south command link between GSFC and ROSMAN. The command tones will be patched to the ROSMAN 148.98-mc command transmitter and transmitted to the prototype S/C on the RF loop.

The PCM telemetry data (PCM/FM) will be transmitted from the ROSMAN TLM system via the south to north 15-kc command link to the GSFC OAO Control Center to the 5.4-kc discriminator.

Memory injection will be accomplished as for ROSMAN. See Figure #2 for equipment configuration.

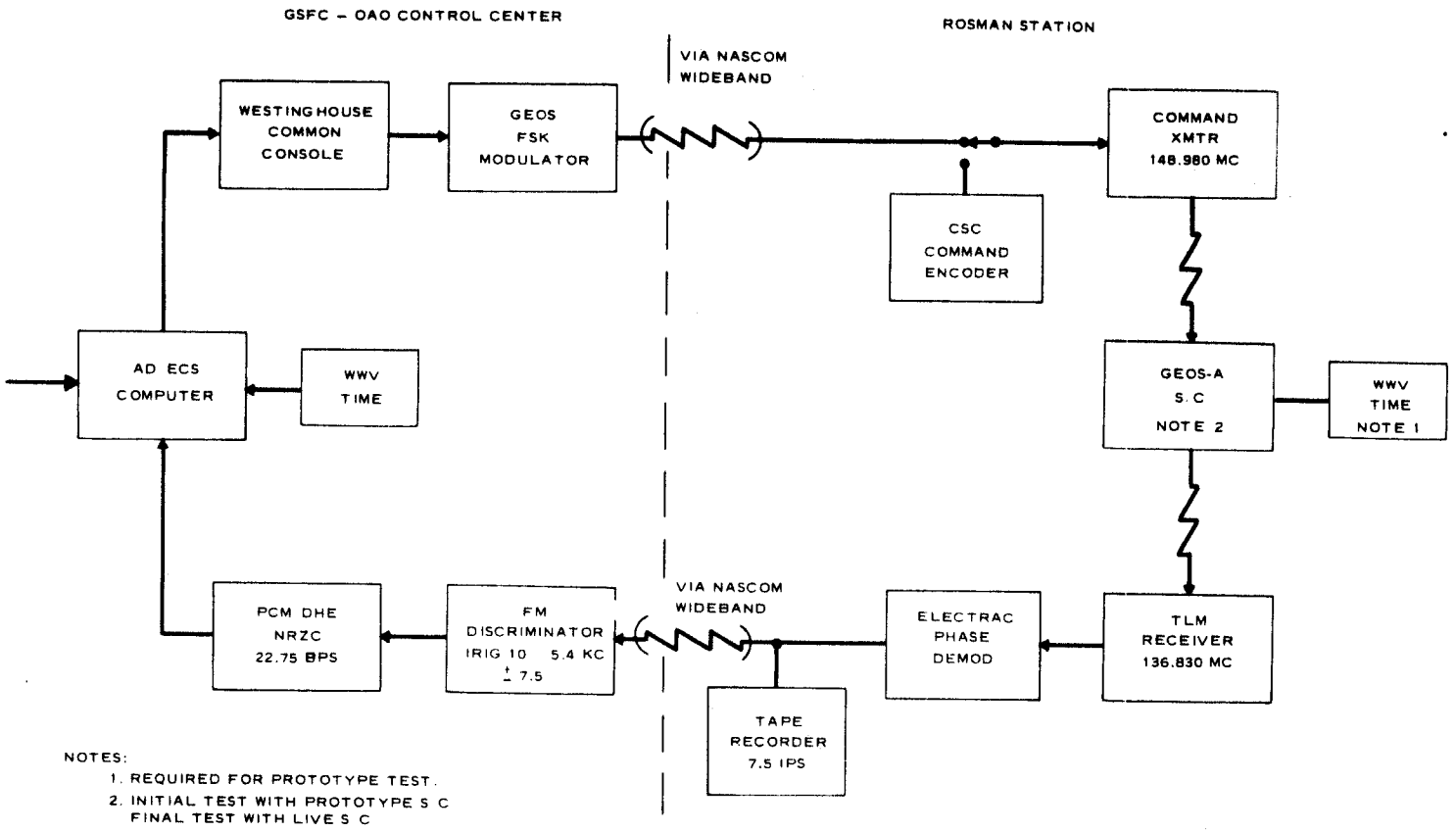


Figure J-2. OAO Control Center Injection Test

3.0 PHASE TWO (LIVE SPACECRAFT INJECTION TEST)

This phase of the test will be conducted after the S/C has been well established in orbit and all subsystems are performing in a nominal manner. This test will exericse essentially all facilities involved in generating the flashing light sequence. Memory injections will be affected from both ROSMAN and the GSFC OAO Control Center as directed below.

3.1 GENERAL

3.1.1 NETCON shall be advised of the planned test so that the test operation can be scheduled. Once the schedule of operation is confirmed the DSD will initiate a test flash schedule.

3.1.2 The DSD will generate an "APL Light Flash Request" paper tape to exercise all functions of the S/C memory subsystem. A limited number of flashing light sequences shall be included, including flashes over the APL Howard County Station, the GSFC Optical Station and the ROSMAN MOTS Station. The DSD will generate an "Operational Prediction" for the ROSMAN MOTS and GSFC Optical stations so that the injected flashing light schedules for these stations can be observed. APL will generate their own prediction as is normal for their operations from the flash injection tape.

3.1.3 The GOCC will transmit the "APL Light Flash Request" by TTY to the APL/SCC for their preparation of a daily injection tape. The injection tape will be hand carried back to the GSFC ready for transmission to ROSMAN or for loading into the system in the OAO Control Center. The GOCC will ensure that predictions are transmitted to the two supporting GSFC stations for observation of the injected flashing light sequences. The GOCC will also coordinate with NETCON in scheduling the test times with the ROSMAN station.

3.2 ROSMAN MEMORY INJECTION TEST (LIVE S/C)

Once NETCON has scheduled the ROSMAN station for the test operation and the DSD and APL have generated the Light Flash Injection tape, the test can commence.

The injection tape will be transmitted to ROSMAN over the NASCOM Digitonics H.S. Paper Tape Transmission System between the GSFC and ROSMAN. This system provides error detection and re-transmission of detected error groups. Upon receipt of the

injection tape, proceed as in Paragraph 2.1 except in this case the station will be radiating to the orbiting GEOS A spacecraft and will have to operate according to station acquisition times and predictions.

3.3 GSFC OAO CONTROL CENTER MEMORY INJECTION TEST (LIVE S/C)

This test will be essentially the same as for ROSMAN except all ground station equipment, with the exception of the RF facilities, are located at GSFC.

Using the same injection tape as used for the ROSMAN live S/C test, follow essentially the same procedure as for the OAO Control Center test with the prototype. The FSK command tones will be transmitted to ROSMAN over the 15-kc command link to the ROSMAN command transmitter for transmission to spacecraft. Spacecraft TLM data will be transmitted to the GSFC OAO Control Center as in the prototype test in Paragraph 2.2.

REFERENCES

1. GSFC Memorandum dated July 28, 1965
   Henry J. Franks, Jr. to Mr. J. B. Zegalia
   Subject: GEOS Compatibility Tests

2. GSFC Test Procedure, GEOS Memory Verification Simulation Test

3. GEOS Command System by Edward P. Greene, September 15, 1965 by ADCOM, Inc., under NASA Contract NAS5-9705.

REFERENCES

1. Special Report on GEOS Command System, Contract NAS 5-9705, by Edward P. Greene, ADCOM, Inc., Cambridge, Massachusetts, September 15, 1965.

2. Results of GEOS Memory Injection Simulation/Monitor - 651223 0102Z, Teletype Message GROS to GOCC 23/1802 Z.

3. Results of GEOS Memory Injection 651224 0107Z, Teletype Message GROS to GOCC 24/0327 Z.

4. NASA-GSFC Memorandum From Mr. Foxe to Mr. Segal dated November 22, 1965 entitled "GEOS A Memory Injection Compatibility Tests."

5. SSC Memorandum from Mr. D. E. Pratt to Record dated December 22, 1965 entitled "NASA ROSMAN Data Acquisition Facility Trip Report Contract NASW-1238."

6. Mailing Adresses of International Participants, Teletype Message LCHT 001 to GOCC DTG 24/1130 Z, from D. Smith to Mr. J. Zegalia.

7. NASA-GSFC Memorandum from Mr. M. Foxe to Mr. C. Looney, dated January 10, 1966, entitled "Initial GEOS Memory Injection."

8. SSC Memorandum from Mr. D. E. Pratt to Record, dated January 20, 1966, entitled "Computer Clock Synchronization and Spacecraft Fine Time Adjustment Capability at ROSMAN DAF."

9. GEOS A Mission Plan, Contract NASW-1238, System Sciences Corp., September 16, 1965.