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REPORT TO THE CONGRESS

Further Improvement Needed In The Management Of Magnetic Tapes By Goddard Space Flight Center

B-164392

National Aeronautics and Space Administration

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

APRIL 22, 1970

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D C 20548

B-164392

To the President of the Senate and the
Speaker of the House of Representatives

This is our report on further improvement needed in
the management of magnetic tapes by the Goddard Space
Flight Center, National Aeronautics and Space Administration.

Our review was made pursuant to the Budget and
Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and
Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director,
Bureau of the Budget, and to the Administrator, National
Aeronautics and Space Administration.

A handwritten signature in cursive script that reads "James P. Stacks".

Comptroller General
of the United States

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ABBREVIATIONS

GAO	General Accounting Office
GSFC	Goddard Space Flight Center
NASA	National Aeronautics and Space Administration
STADAN	Space Tracking and Data Acquisition Network

D I G E S T

WHY THE REVIEW WAS MADE

The General Accounting Office (GAO) reviewed the management of magnetic data tapes by the Goddard Space Flight Center after noting that Goddard was storing substantial quantities of used tapes for indefinite periods and was purchasing large quantities of new tapes instead of rehabilitating tapes for reuse.

At June 30, 1969, there were over 900,000 magnetic data tapes containing data that had been transmitted by satellites and received and recorded by tracking stations in various parts of the world.

FINDINGS AND CONCLUSIONS

A National Aeronautics and Space Administration (NASA) policy established in January 1967 requires that data on magnetic tapes--either analog data tapes or the master digital data tapes--be kept until all meaningful information has been extracted and placed in the National Space Science Data Center.

In May 1968 Goddard was still requiring the indefinite retention of data on both types of magnetic tape. As a result, Goddard was not realizing the savings in procurement costs that were possible through the reuse of certain of the tapes.

After GAO brought this matter to NASA's attention in August 1968, Goddard established procedures in December of that year to implement current NASA policy. (See p. 10.)

These procedures, however, did not require scientists or experimenters to promptly notify Goddard that the experiment data tapes they had received were complete and of acceptable quality. Such notification is required before analog data tapes can be released from storage for reuse. (See p. 12.)

Also, the procedure did not provide for the release from storage of analog data tapes containing data transmitted by satellites that had not been processed for use by experimenters. Apparently Goddard did not consider the data to be essential to the experimenters. At June 30,

1969, Goddard was storing 11,450 unprocessed analog data tapes that had a replacement cost of \$229,000. (See p. 14)

Goddard had not established procedures for retrieving experiment data tapes furnished to experimenters so that the tapes could be rehabilitated and reused. At June 30, 1969, experimenters had in their possession 119,000 of the 196,000 experiment data tapes that had been furnished to them (See p 17.)

Also, Goddard had not taken action to account for, control, and retrieve large quantities of new tapes furnished to the experimenters for use in analyzing the data contained on the experiment data tapes. (See p. 17)

Some experimenters informed GAO that, after the tapes had served their intended purposes, they had either placed the tapes in storage or, in some cases, erased and reused the tapes for other purposes. (See p. 18.)

Because of its limited capacity for rehabilitating tapes, Goddard was not realizing the potential savings possible from greater use of rehabilitated tape. A Goddard official stated in November 1969 that, although tape was then being rehabilitated at a rate of about 50,000 reels a year, additional staffing could increase production to about 90,000 reels. At October 31, 1969, about 110,000 reels of tape awaited rehabilitation (See p 20)

The following table shows (1) Goddard's approximate annual requirements for analog and digital magnetic tapes, (2) the estimated cost to purchase new tapes, and (3) the estimated cost to rehabilitate used data tapes.

<u>Type</u>	<u>Annual reel requirements</u>	<u>Estimated cost of new tapes</u>		<u>Estimated cost to rehabilitate</u>
		<u>Total</u>	<u>Average</u>	
Analog	203,000	\$ 4 million	\$20 a reel	\$4.63 a reel
Digital	219,000	2.4 million	11 a reel	4.63 a reel

Goddard estimated that contracting for the offsite rehabilitation of magnetic tape would cost about \$1 a reel more than the estimated in-house cost of \$4.63. It is apparent that Goddard could realize substantial savings if a significant part of its annual requirements were fulfilled with rehabilitated tape. (See p. 22.)

RECOMMENDATIONS OR SUGGESTIONS

The Administrator, NASA, should

- direct Goddard to revise its procedures to require positive and prompt verification by the experimenters that the data on the experiment data tapes is complete and of acceptable quality. (See p. 12.)

--examine into the need to continue to collect and store unprocessed data from satellites, which apparently is not considered essential to the experimenters, and, if such a need is affirmed, direct Goddard to revise its procedures to provide for periodic reviews and certifications as to the continued need to retain such data in storage. (See p. 15.)

--direct Goddard to establish procedures for:

1. maintaining control over new digital tapes furnished to experimenters,
2. requiring NASA experimenters to promptly return magnetic tapes after they have served their intended purposes,
3. including a requirement in agreements with non-NASA experimenters that magnetic tapes be promptly returned after the tapes have served their intended purposes, and
4. following up periodically to ensure that experimenters are complying with the requirements for the prompt return of magnetic tapes. (See p. 18)

--consider the following possible means by which Goddard might increase its capacity for rehabilitating magnetic tapes.

1. Increase the staffing and the length of the workweek of the rehabilitation facility.
2. Expand the facility and acquire additional equipment.
3. Contract for the offsite rehabilitation of those tapes in excess of the number that can be processed by the facility. (See p 23.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

NASA has taken significant action to improve control over magnetic tapes. Policies and procedures have been established by Goddard for most of the matters discussed in this report, and NASA has agreed to study ways of increasing Goddard's capacity for rehabilitating magnetic tapes so that greater use can be made of rehabilitated tapes and procurement costs for new tapes can be reduced. (See pp. 10 and 23.)

GAO believes, however, that additional action is desirable in certain areas. NASA agreed that continued management attention to the areas was essential and that further improvements were feasible and said that it would evaluate these matters for the purpose of further improving its magnetic tape policies and procedures. (See pp. 13, 15, and 18.)

As part of its continuing work in this area, GAO plans to review the results of the NASA study and any actions taken to improve procedures and to expand the Goddard capacity for rehabilitating magnetic tapes.

MATTERS FOR CONSIDERATION BY THE CONGRESS

GAO is reporting the results of its review to inform the Congress of the actions taken by NASA to save on the cost of procuring magnetic tape and of the further actions needed to effect additional savings to the Government.

CHAPTER 1

INTRODUCTION

The General Accounting Office has examined into the policies, procedures, practices, and controls used in the management of magnetic tape by the National Aeronautics and Space Administration's Goddard Space Flight Center (GSFC) at Greenbelt, Maryland. The scope of our review is discussed on page 26. The principal NASA officials responsible for the activities discussed in this report are listed in appendix III.

NASA's Associate Administrator for Space Science and Applications is responsible for planning, directing, and executing that part of the overall NASA program concerned with scientific explorations of space and extraterrestrial bodies, including GSFC's management of data concerning space science experiments.

GSFC is responsible for the management and operation of two worldwide tracking and data acquisition networks--the Space Tracking and Data Acquisition Network (STADAN) and the Manned Space Flight Network. STADAN provides communications and tracking coverage for unmanned scientific satellites. Our examination was limited primarily to matters concerning magnetic tape management by GSFC for STADAN.

GSFC is responsible also for the construction and launch of satellites, as well as for the receipt, conversion, and analysis of data transmitted by the satellites. After a new satellite is authorized, members of the scientific community generally are invited to submit proposals for experiments (scientific equipment) to be placed on board the satellite. These experimenters include NASA employees located at GSFC and other NASA installations, university professors, and scientists from other Government agencies and other countries.

Upon acceptance of a proposal, GSFC and the experimenter, if non-Government, enter into a contract which provides that the Government pay the cost of the equipment for the experiment and the experimenter's cost to analyze data

from the experiment, generally, for a 2-year period after launch of the satellite. If analysis of additional data is desirable after expiration of the initial 2-year period, NASA Headquarters often awards a grant to the experimenter to pay for the cost of the work. The experiment equipment included aboard satellites performs a variety of functions, such as measuring radiation, recording solar phenomena, photographing cloud formations, and recording electromagnetic radiation from the sun.

Generally, telemetry data transmitted by a satellite is received by the STADAN stations and recorded on analog magnetic tapes, sometimes referred to as instrumentation tapes. Analog tapes are capable of recording fluctuations in electronic signals and are therefore used to record the measurements obtained by experiment equipment aboard the satellite. After the data is recorded on analog tapes at the tracking stations, the analog data tapes are shipped to GSFC's Information Processing Division for processing. This Division edits and consolidates the data, converts it to digital form for use in computer processing, and records it on a master digital data tape. Information contained on the master digital data tapes is recorded on other digital tapes, referred to as experiment data tapes, that are forwarded to the experimenter responsible for a particular experiment. GSFC also provides experimenters with new digital tapes for their use in analyzing the data contained on the experiment data tapes.

Generally, experimenters are required to furnish reports on the results of their experiments to the National Space Science Data Center. NASA established the Data Center at GSFC in 1965 for the purpose of acquiring, organizing, storing, and disseminating scientific data obtained from space probes, satellites, sounding rockets, stratospheric balloons, and high-altitude aircraft.

The number of used analog and digital tapes in the system has been rapidly increasing due to an increased number of active satellites transmitting data and an increased number of experiments on board the satellites.

From its establishment on January 15, 1959, through June 30, 1969, GSFC received about 400,000 analog data

tapes from STADAN tracking stations. The number of master digital data tapes prepared from these analog data tapes was not readily available from GSFC records. As of June 30, 1969, GSFC had prepared and forwarded to experimenters about 196,000 experiment data tapes, of which about 77,000 had been returned to GSFC and about 119,000 were being held by the experimenters. In addition, GSFC had furnished about 116,000 analog data tapes to experimenters in connection with certain special experiments, of which about 5,000 had been returned to GSFC; some of these analog data tapes were original recordings made by STADAN tracking stations, while others were duplicates made by the Information Processing Division.

The following tabulation shows the location of about 928,000 used analog and digital data tapes at June 30, 1969.

Location of Data Tapes
at June 30, 1969

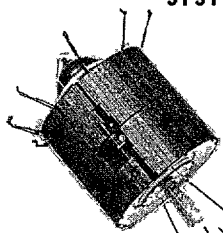
	<u>Total</u>	<u>GSFC</u>	<u>With experi- menters</u>	<u>Washington National Records Center</u>
Analog data tapes	489,000 ^a	68,000	111,000	310,000
Digital data tapes	355,000	123,000	119,000	113,000
Type of data tape undeter- mined (note b)	<u>84,000</u>	<u>84,000</u>	-	-
Total	<u>928,000</u>	<u>275,000</u>	<u>230,000</u>	<u>423,000</u>

^aThis total includes original analog tapes received from STADAN tracking stations and duplicate analog tapes made at GSFC.

^bInventory reports did not indicate whether these were analog or digital data tapes.

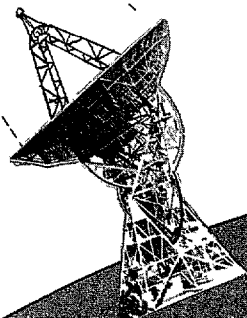
The following illustration shows the distribution of the above tapes at June 30, 1969, and, generally, the system by which data transmitted from a satellite is recorded, processed, and forwarded on magnetic tapes to various locations.

SYSTEM FOR RECEIVING, RECORDING, AND PROCESSING DATA AND THE LOCATION OF RELATED DATA TAPES AT JUNE 30, 1969



UNMANNED SCIENTIFIC SATELLITE

TRACKING STATIONS RECORD DATA FROM SATELLITES ON MAGNETIC ANALOG TAPE

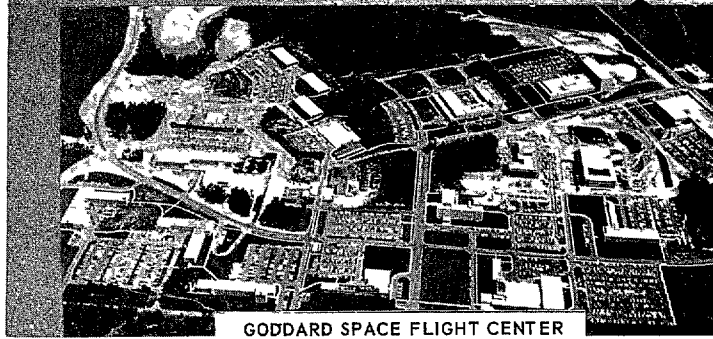


WORLD-WIDE NETWORK OF TRACKING STATIONS

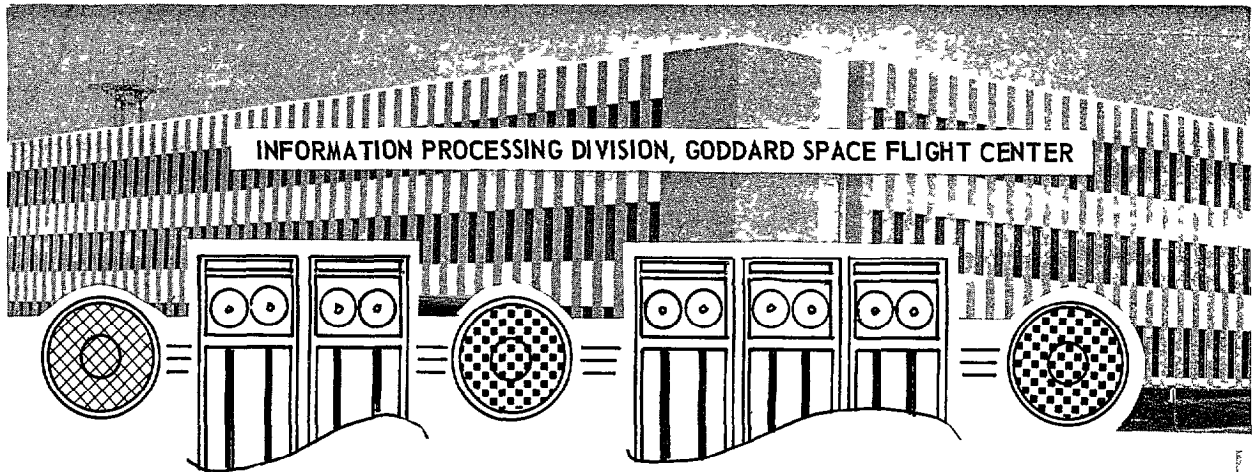
ANALOG DATA TAPES ARE SHIPPED TO THE GODDARD SPACE FLIGHT CENTER



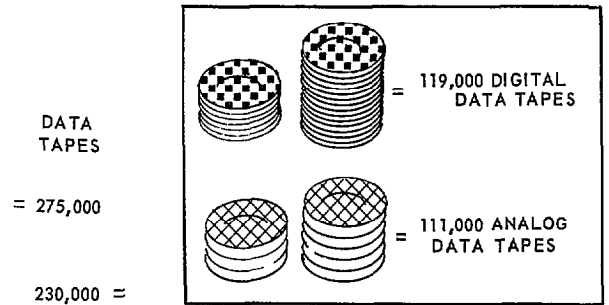
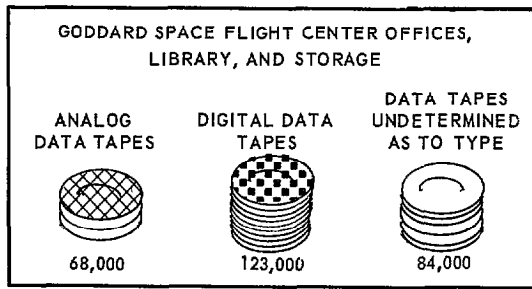
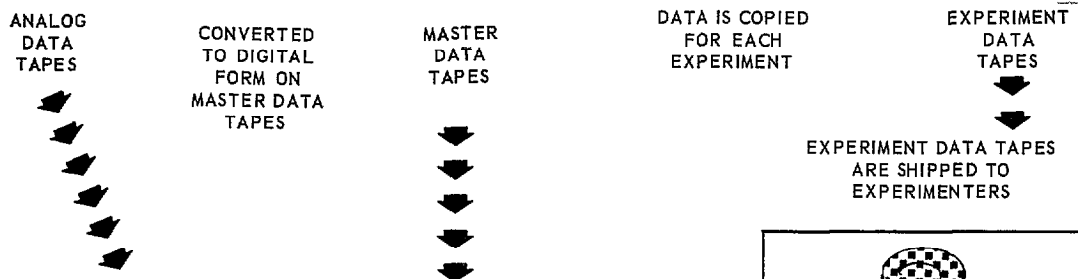
LEGEND		NO OF TAPES
	ANALOG DATA TAPE	489,000
	DIGITAL DATA TAPE	355,000
	TYPE OF DATA TAPE UNDETERMINED	<u>84,000</u>
		<u>928,000</u>



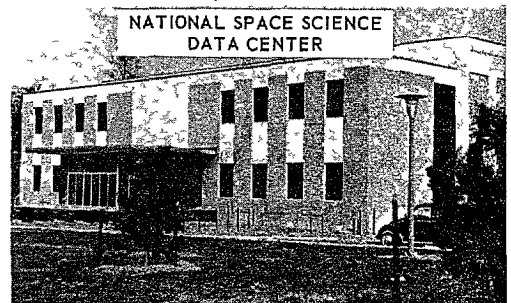
GODDARD SPACE FLIGHT CENTER GREENBELT, MARYLAND



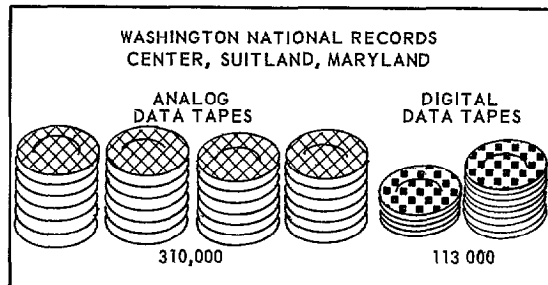
INFORMATION PROCESSING DIVISION, GODDARD SPACE FLIGHT CENTER



REPORTS ON RESULTS OF EXPERIMENTS



INFORMATION TO THE PUBLIC



928,000 = TOTAL DATA TAPES

CHAPTER 2

PROCEDURES ESTABLISHED FOR RELEASE OF

MAGNETIC DATA TAPES FROM STORAGE

A NASA Headquarters policy established in January 1967 requires the retention of data on analog or master digital data tapes until all meaningful information has been extracted from them and placed in the National Space Science Data Center. At the time that we started our review in May 1968, GSFC had not established procedures to implement the 1967 policy but was still following a 1962 NASA policy which required the indefinite retention of data on both the analog and master digital data tapes. As a result, GSFC was not realizing the savings in procurement costs that were possible through the reuse of certain of these tapes in lieu of the purchase of new magnetic tapes. We brought this matter to the attention of NASA officials in a letter dated August 16, 1968.

In December 1968 GSFC issued a Goddard Management Instruction which established policies and procedures to implement the 1967 NASA policy. With respect to the procedures and responsibilities concerning the release of magnetic data tapes from storage for reuse, the instruction provides, in part, as follows:

Analog data tapes

1. Data is to be retained on the analog data tapes until the project manager, project scientist, and Chief of Information Processing Division certify that all meaningful information has been obtained and that the analog data tapes have negligible additional technological or historical value. This decision is usually dependent upon verification by the experimenters that the experiment data tapes are complete and of acceptable quality.
2. The Chief, Information Processing Division, is to establish a procedure for periodically determining the need for the further retention of the data on

the analog data tapes. This periodic checking is to begin not later than 2 years after the data for each year has been delivered to the experimenters and is to be made at least annually thereafter. The release procedure requires certifications by the project manager and project scientist that the experimenters have received all meaningful information in acceptable form.

3. The Chief, Information Processing Division, is to certify that the quality of the master digital data tapes and of the resulting experiment data tapes is as high as can be expected from state-of-the-art techniques and that the possibility of significant advances in the state of the art do not justify further retention of data on the analog data tapes.

Master digital data tapes

1. In cases where data has not been retained on analog data tapes, the data is to be retained on master digital data tapes until the data records produced from the tapes have been placed in the National Space Science Data Center.
2. The Chief, Information Processing Division, is to establish a procedure for periodically determining the need for the further retention of data on master digital data tapes. This periodic checking is to begin not later than 3 years after the data for each year has been delivered to the experimenters and is to be made at least annually thereafter. This release procedure requires a certification by the Director, National Space Science Data Center, that all significant information has been received in the Data Center.

Experiment data tapes

Data need not be retained on experiment data tapes beyond the time required for use by experimenters.

The Goddard Management Instruction does not include a specific procedure for obtaining prompt verification from experimenters as to the quality and completeness of the data on the experiment data tapes. On the basis of our discussions with several experimenters, it appeared to us that, if experimenters were required to furnish GSFC with the necessary verifications immediately upon satisfying themselves as to the quality and completeness of the data, without waiting for the follow-up action provided for in the instruction, it should be possible for GSFC to release many analog data tapes for reuse substantially before the end of the initial 2-year period.

We believe that the establishment of a systematic procedure for determining the need for retention of data on magnetic tapes and for releasing such tapes from storage for reuse would result in improved management of magnetic tape inventories and in a reduction in tape procurement costs.

RECOMMENDATION

We recommend that the Administrator, NASA, direct GSFC to revise its procedures to require positive and prompt verification by the experimenters that the data on the experiment data tapes is complete and of acceptable quality.

NASA COMMENTS AND OUR EVALUATION

By letter dated October 9, 1969 (app. I), commenting on our draft report, NASA pointed out that, to effect economies in computer and scientific manpower utilization, most experimenters process their data in batches, which sometimes results in delays of 1 or more years in processing a given block of data. NASA also said that at today's level of funding it is likely to be approximately 2 years before an experimenter can adequately determine whether all the data that he has received is correct.

We are not proposing that experimenters alter their methods of processing and analyzing data received from GSFC or that the level of funding be increased to reduce the time now required by experimenters to process and

analyze the data. On the basis of our discussions with several experimenters, however, it appeared to us that, in many cases, experimenters were in a position to notify GSFC--if so required--that the data that they had received was of satisfactory quality and was complete and that this could be done substantially sooner than 2 years after receipt of the data.

NASA agreed that it should be possible to reduce the length of time presently required for obtaining verification from experimenters and stated that NASA Headquarters and GSFC were initiating a review aimed at improving the present procedures, which would reduce the storage time for analog data tapes.

NASA also made the following statement.

"Your report seems to imply that while Goddard was aware of the problems associated with the magnetic tape program they had not taken action aimed at the control of magnetic tape prior to the GAO review in May 1968. The fact is, while there is need of continued improvement, GSFC had, prior to the GAO review, initiated the tape rehabilitation program, and updated procedures for review of experimenter tapes and subsequent release from storage of the related analog tapes, as a part of their continuing efforts toward better management of this area." (Underscoring supplied.)

GSFC did not issue an instruction establishing procedures for the release from storage of analog and master digital data tapes until December 1968--7 months after the start of our review and 4 months after our letter of August 16, 1968.

Although GSFC has had the capability to rehabilitate digital tape since 1967, we were told by the Assistant Chief, Information Processing Division, in February 1970, that no master digital tapes had been certified for release from storage at that time. Also, he told us that none of the analog data tapes that had been certified for release from storage had been rehabilitated as of the end of January 1970.

CHAPTER 3

DATA COLLECTED FROM SATELLITES AND

STORED WITHOUT BEING PROCESSED

The December 1968 Goddard Management Instruction (see ch. 2) prescribes procedures for the release of analog data tapes for rehabilitation and reuse after the data has been converted to digital form and furnished to experimenters. The instruction, however, does not prescribe procedures for release of analog data tapes that have been received from tracking stations and placed in storage without processing of the data contained thereon.

We identified four active satellites that were transmitting data which was being recorded on analog data tapes and placed in storage without processing. The following tabulation shows the names of the satellites, the dates on which the processing of the data was discontinued, and the analog data tapes that were in storage as of June 30, 1969.

<u>Satellite</u>	<u>Date processing of data discontinued</u>	<u>Number of stored tapes containing unprocessed data</u>
OGO I	12- 6-67	1,520
OGO III	7-31-68	8,445
Explorer 22	8-13-68	633
Relay II	8-31-68	<u>852</u>
Total, as of June 30, 1969		<u>11,450</u>

On the basis of the current average cost of about \$20 a reel for new analog tapes, the 11,450 tapes have a replacement cost of about \$229,000.

Reports prepared by GSFC showed that in September 1969 it was still receiving and storing analog data tapes without processing the data contained thereon for two of the above four satellites and was following a similar practice for certain other satellites.

RECOMMENDATIONS

We recommend that the Administrator, NASA, examine into the need to continue to collect and store data which apparently is not considered essential to the experimenters. We recommend also that, in the event the results of the examination affirm a need for the continuance of this practice, the Administrator direct GSFC to revise its procedures to provide for periodic reviews and certifications as to the continued need to retain in storage the analog data tapes containing unprocessed data.

NASA COMMENTS AND OUR EVALUATION

In its letter of October 9, 1969, NASA stated that the storage of analog tapes containing unprocessed data was due to limitations in GSFC's present data processing capacity. NASA said that a number of requests had been received from experimenters for processing of data from satellites OGO I and OGO III but that most of the requests were not honored because of the size of the data backlog and the priority structure. NASA stated further that GSFC was involved in a project to increase its computer capacity and that the prospects were good for processing some of the stored data in the coming year. In this connection, a GSFC report showed that, at September 30, 1969, GSFC had a 32-week backlog of analog data tapes for processing.

NASA stated that it had not established a fixed erasure policy for analog tapes containing unprocessed data and that a policy decision would depend on an evaluation of the potential value of the data and the availability of data processing resources. NASA stated also that it had frequently examined its policy pertaining to continued long-term collection of data from specific satellites and that collection of data had been discontinued in several instances. NASA stated further that this subject was again being reviewed with the objective of establishing criteria and guidelines for the discontinuance of data collection from selected satellites, as well as policies concerning retention of unprocessed data.

We recognize the difficulty, under the circumstances, of making a decision to destroy scientific data which has

never been processed or made available to the scientific community. The difficulty of such a decision, however, creates the danger of tying up, for an indefinite period, a substantial investment in magnetic tape containing data that may never be processed. We believe that NASA's comments evidence an appreciation of the problem and a constructive approach to its control.

CHAPTER 4

NEED FOR MORE EFFECTIVE CONTROLS OVER

DIGITAL TAPES FURNISHED TO EXPERIMENTERS

Although GSFC furnished substantial quantities of experiment data tapes and new digital tapes to experimenters for their use in analyzing the data on experiment data tapes, we found that GSFC had not taken adequate action to account for, control, or promptly retrieve these tapes for possible reuse.

Of the 196,000 experiment data tapes furnished by GSFC to experimenters through June 1969, about 119,000 had not been returned. Information on the number of new digital tapes furnished to experimenters was not maintained centrally. We did not review the records of GSFC's nine satellite project offices to determine the number of such tapes that had been furnished to experimenters; however, an official of one satellite project office told us that, during a recent 2-year period, about 12,000 new digital tapes had been furnished to experimenters on that project.

In our August 16, 1968, letter to NASA (see p. 10), we pointed out that procedures should be established to maintain effective control over the experiment data tapes and new digital data tapes furnished to experimenters so that these tapes could be retrieved promptly and reused.

Although NASA advised us in December 1968 that procedures would be established to provide for an annual check of each experimenter--to be initiated 2 years after the issuance of tapes to an experimenter--to ensure the return of all tapes no longer required for the conduct of a particular experiment, the December 1968 Goddard Management Instruction does not specifically cover this matter. The instruction prescribes procedures intended to ensure prompt release of analog data tapes and master digital data tapes after they have served their purposes, but the only reference to the release of experiment data tapes is a brief statement that such tapes need not be retained beyond the time required for their use by experimenters.

In February 1969 we interviewed eight non-NASA experimenters at three universities, who had about 14,000 experiment data tapes in their possession at June 30, 1968. The experimenters informed us that they had not received any instructions from GSFC concerning the return of either the experiment data tapes or the new digital tapes after the tapes had served their intended purposes. They said that they had therefore either placed the tapes in storage or, in some cases, erased and reused the tapes for other purposes.

RECOMMENDATION

We recommend that the Administrator, NASA, direct GSFC to establish procedures for:

1. maintaining control over new digital tapes furnished to experimenters,
2. requiring NASA experimenters to promptly return magnetic tapes after they have served their intended purposes,
3. including a requirement in agreements with non-NASA experimenters that magnetic tapes be promptly returned after the tapes have served their intended purposes, and
4. following up periodically to ensure that experimenters are complying with the requirements for the prompt return of magnetic tapes to GSFC.

NASA COMMENTS AND OUR EVALUATION

In commenting on our draft report, NASA said that GSFC was reviewing the procedures for improving control of new digital and experiment data tapes furnished to experimenters. NASA also stated that each reel of data tape furnished to experimenters for the past 5 years included a label with instructions for the return of the tapes to GSFC.

A copy of the label referred to by NASA showed that it is a removable tag affixed to each reel of tape stating:

"Return Tape to Digital Data Accounting
Code 565
NASA - Goddard Space Flight Center
Greenbelt, Maryland. 20771"

In our view, this label falls far short of adequate instructions requiring the prompt return of the tapes when they have served their intended purposes. On the basis of our review and discussions with the eight experimenters, GSFC's use of labels has not been effective in encouraging the experimenters to return the data tapes upon completion of their analyses. It seems to us that to include a provision in the agreements with experimenters requiring them to return the magnetic tapes as soon as they have served their intended purposes would provide a greater motivation than now exists for experimenters to return tapes promptly.

CHAPTER 5

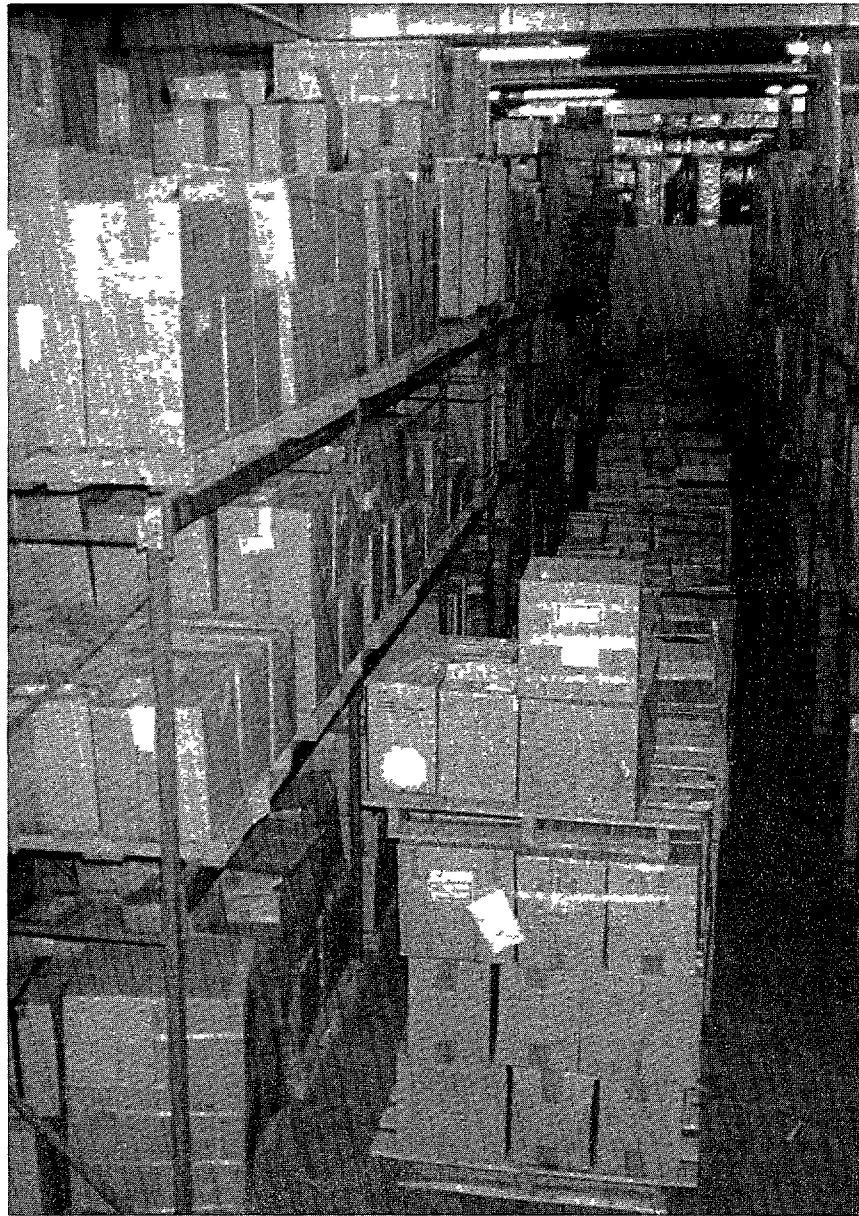
NEED TO EXPAND CAPACITY FOR

REHABILITATING USED MAGNETIC TAPES

Because of the limited capacity of its magnetic tape rehabilitation facility, GSFC has not, in our opinion, realized all the potential savings from the use of rehabilitated magnetic tapes. Such savings would result from the reduced need to purchase new tapes at costs substantially in excess of the costs of rehabilitating used tapes.

Although GSFC has had a facility for rehabilitating digital data tapes since 1967, it did not fully establish a capability to rehabilitate analog data tapes until January 1969. During the first few months of 1969, the number of used tapes of both types available for rehabilitation was only sufficient to require the facility to operate at about half of its capacity; however, GSFC told us that the availability of used tapes increased later in the year. In November 1969 we were told by the GSFC manager of the facility that (1) the facility was operating on a three-shift, 5-day-week basis, (2) the facility was rehabilitating tapes at the rate of about 50,000 a year, and (3) this rate could be increased to about 90,000 tapes a year if staffing were increased.

In October 1969, GSFC had about 59,000 (32,900 analog and 26,100 digital) data tapes in a warehouse awaiting rehabilitation and about 50,800 analog data tapes in storage at the Washington National Records Center that had been authorized for release, rehabilitation, and reuse, pursuant to the December 1968 Goddard Management Instruction. (See picture, p. 21.) Thus, in October 1969, GSFC had about 110,000 reels of magnetic tape available for rehabilitation--about a 2-year backlog at the current level of operation of the rehabilitation facility--and the number was increasing.



**SOME OF THE 59,000 MAGNETIC
DATA TAPES IN A GSFC WAREHOUSE
AWAITING REHABILITATION**

Furthermore, we were subsequently told by the Assistant Chief, Information Processing Division, that the issuance of procedures to encourage the early return of experiment data tapes from experimenters had been deferred because, with the existing backlog of tapes awaiting

rehabilitation, GSFC did not have the space to store any additional tapes that might be returned.

Pictures showing some of the major steps in the rehabilitation of magnetic tapes at GSFC are shown on pages 24 and 25.

On the basis of a cost analysis completed in March 1969, GSFC estimated that its cost to rehabilitate digital tapes in fiscal year 1970 would be \$4.63 a reel. A GSFC official told us that the cost of rehabilitating analog tape would be about the same as for digital tape. GSFC estimated also that the cost of having analog or digital tape rehabilitated offsite under a commercial contract would be about \$1 a reel more than the in-house costs.

GSFC awarded a contract in March 1969 for the purchase of analog tapes. GSFC's estimated annual requirement for analog tapes, as provided for under the contract, was about 203,000 reels at an estimated cost of about \$4 million, or an average price of about \$20 a reel. Since the in-house cost of rehabilitating a reel of analog tape is only about 23 percent of the cost of purchasing a new reel, it is apparent that substantial savings would be realized if a significant part of GSFC's annual requirement for analog tape were fulfilled with rehabilitated tape rather than new tape.

Substantial savings would also be realized through the use of rehabilitated digital tape, although the ratio of the cost of rehabilitating such tape to the cost of new tape--42 percent--is higher than for analog tape. During calendar year 1969, GSFC purchased about 219,000 reels of digital tape at a cost of almost \$2.4 million, or an average price of about \$11 a reel.

In our draft report submitted in July 1969 to NASA for comment, we proposed that GSFC release more used magnetic tape from storage for rehabilitation and that the rehabilitation facility be operated to the maximum extent possible. The subsequent release of a large number of used magnetic tapes and the likelihood of an increasing backlog of used tapes as the new procedures to ensure early release of tapes become effective indicate the need for a considerable

485 2 -
increase in GSFC's rehabilitation capacity if NASA is to realize the savings available through the use of rehabilitated tapes in lieu of new tapes.

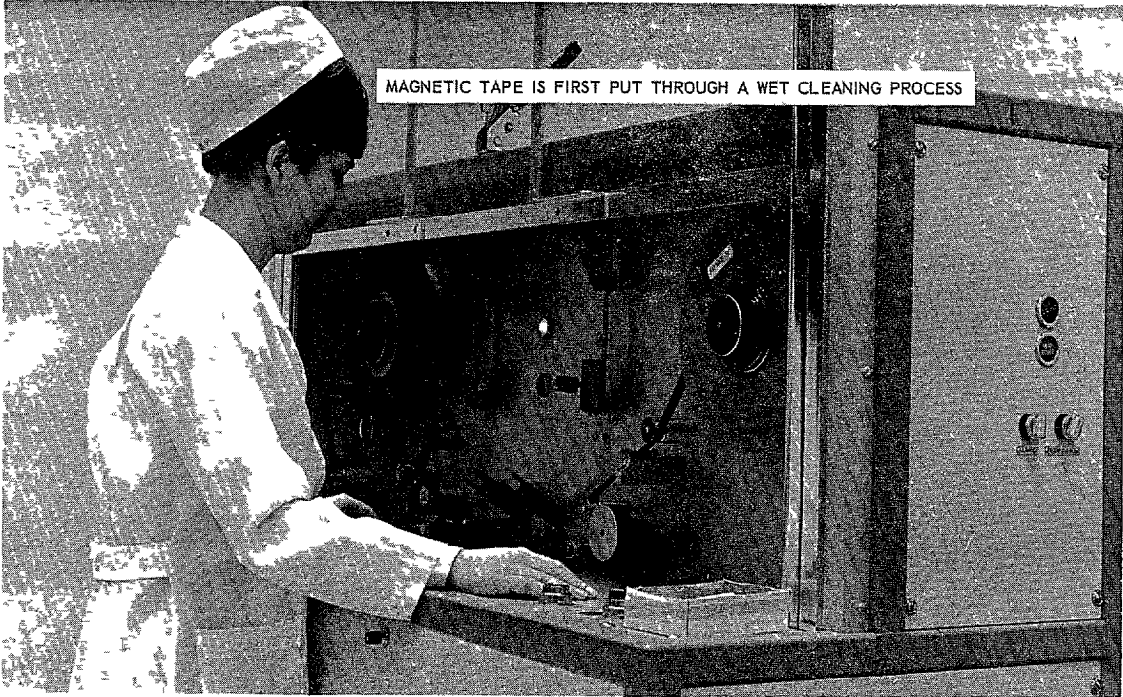
RECOMMENDATION

We recommend that the Administrator, NASA, consider the following possible means by which GSFC might increase its capacity for rehabilitating magnetic tapes.

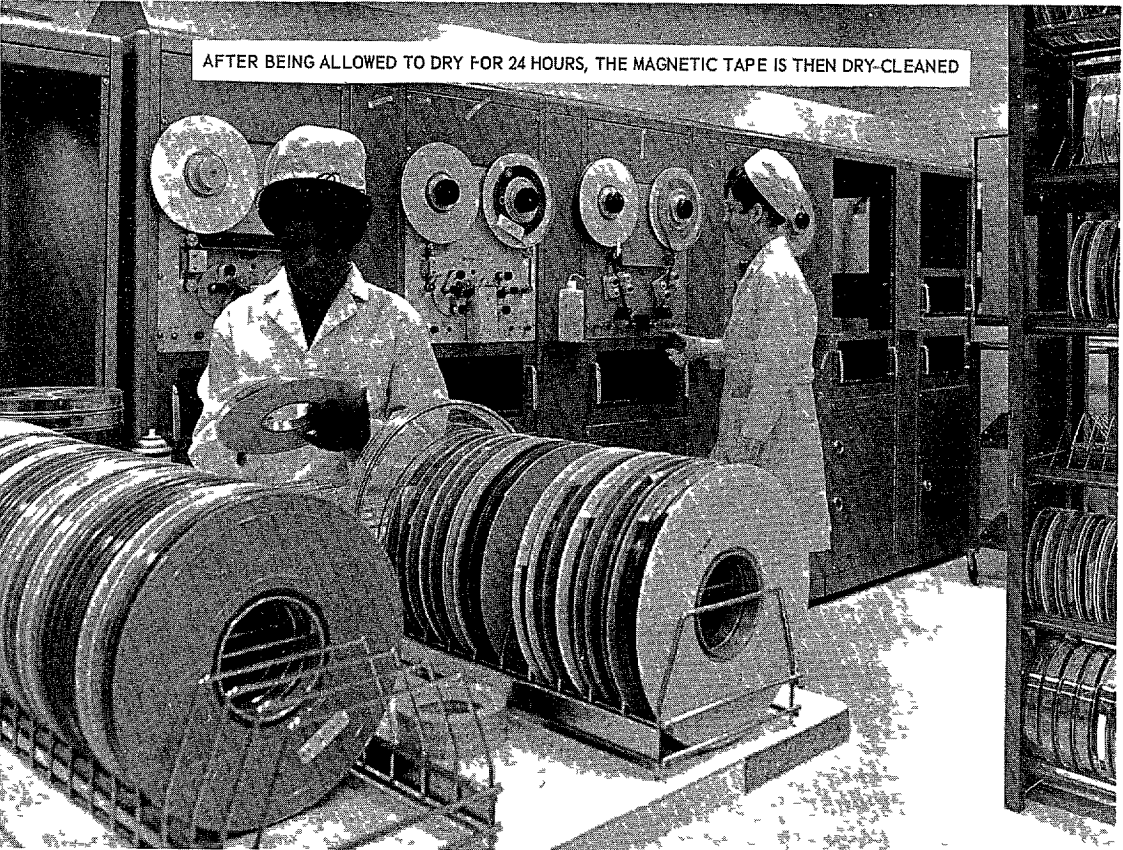
1. Increase the staffing and the length of the work week of the rehabilitation facility.
2. Expand the facility and acquire additional equipment.
3. Contract for the offsite rehabilitation of those tapes in excess of the number that can be processed by the facility.

NASA COMMENTS AND OUR EVALUATION

In a letter dated January 23, 1970 (see app. II), NASA agreed with our recommendation and said that it would study ways of increasing GSFC's capacity for rehabilitating magnetic tapes. As part of our continuing work in this area, we plan to review the results of the NASA study and any actions taken to expand the GSFC capacity for rehabilitating magnetic tapes.



MAGNETIC TAPE IS FIRST PUT THROUGH A WET CLEANING PROCESS



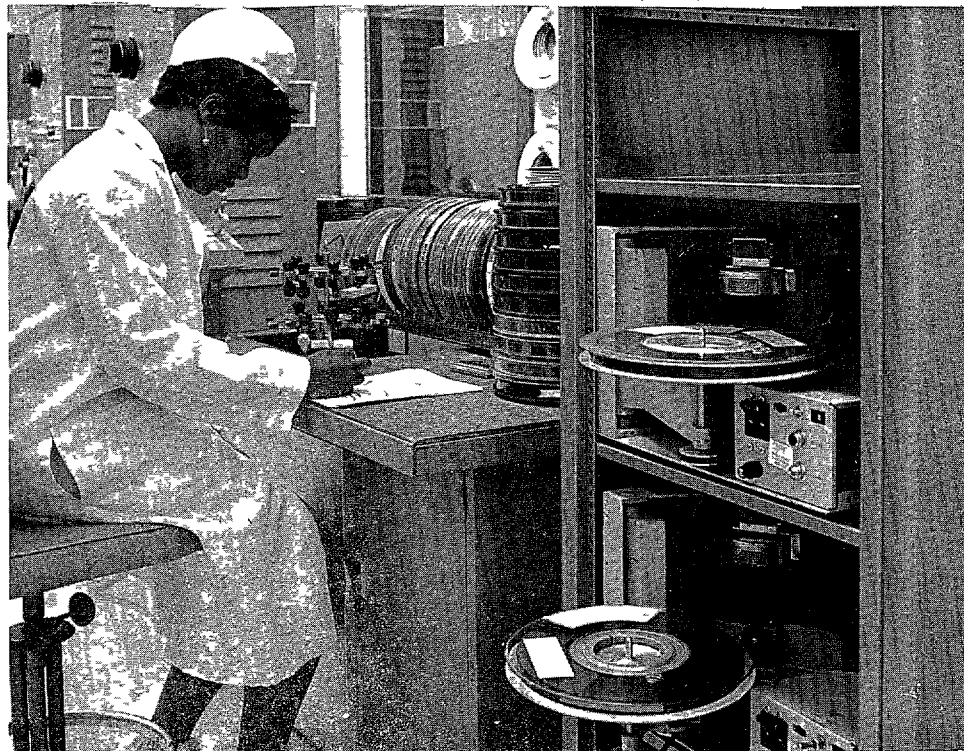
AFTER BEING ALLOWED TO DRY FOR 24 HOURS, THE MAGNETIC TAPE IS THEN DRY-CLEANED

Photographs furnished by NASA

AFTER THE MAGNETIC TAPES ARE CLEANED THEY ARE TESTED



THE TAPES ARE THEN LABELED AND DEGAUSSED (erased)

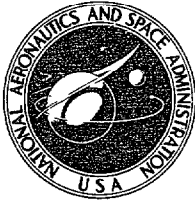


CHAPTER 6

SCOPE OF REVIEW

Our review included an examination of the pertinent records and documents at the Goddard Space Flight Center, Greenbelt, Maryland, and discussions with NASA Headquarters and GSFC officials concerned with the various aspects of magnetic tape operations at the Center. We also held discussions with eight experimenters at three universities, who had been furnished magnetic tape by GSFC.

APPENDIXES



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D C 20546

REPLY TO
ATTN OF SPA

OCT 9 1969

Mr. Morton E. Henig
Assistant Director, Civil Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Henig:

Attached are our comments in response to your draft report on "Need for Improvement in the Management, Control and Utilization of Magnetic Tapes, Goddard Space Flight Center."

We agree with the view expressed in your report that continued attention to the management of magnetic tape at GSFC and additional emphasis on improved policies and procedures are essential. However, we are not in complete agreement with several of the conclusions and recommendations contained in your report,

[See GAO note on p. 37.]

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Your recommendation that GSFC require positive and prompt confirmation by the experimenters that the data on the experimenter data tapes is complete and of acceptable quality is a desirable objective. However, immediate verification of experimenters data tapes upon receipt by

APPENDIX I

Page 2

the experimenter is generally not feasible, and might well increase funding and manpower requirements that would exceed any potential savings through reuse of the related analog tapes.

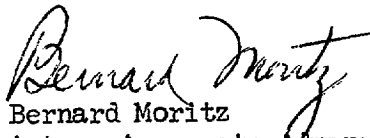
The report also recommends the establishment of minimal retention periods for unprocessed analog tapes held in storage. We have not yet established policies and guidelines for erasure of these unprocessed tapes, as this is a complex problem involving many critical points. For example, which tapes can be disposed of with assurance that we are not destroying valuable scientific information worth, potentially, hundreds of thousands of dollars in an effort to reuse twenty dollar reels of analog tapes? There are important issues which are currently under study and which must be resolved prior to establishing minimal retention periods for unprocessed tape.

In addition, your report recommended that GSFC establish and maintain control over new digital tapes furnished to experimenters. While GSFC has, for the past five years, included instructions with each reel of new tape for the return of the tape to GSFC, we agree that additional emphasis on this phase of the magnetic tape program is worthwhile. Goddard is adding procedures for the periodic follow-up on new tapes shipped to experimenters consistent with the experimenters processing cycle.

Your report seems to imply that while Goddard was aware of the problems associated with the magnetic tape program they had not taken action aimed at the control of magnetic tape prior to the GAO review in May 1968. The fact is, while there is need of continued improvement, GSFC had, prior to the GAO review, initiated the tape rehabilitation program, and updated procedures for review of experimenter tapes and subsequent release from storage of the related analog tapes, as a part of their continuing efforts toward better management of this area.

We appreciate the opportunity to comment on your draft report and assure you that we are continuing to examine methods for improving the management of the magnetic tape activities at Goddard.

Sincerely yours,



Bernard Moritz
Acting Associate Administrator
for Organization and Management

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Attachment

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
COMMENTS ON
GENERAL ACCOUNTING OFFICE
NEED FOR IMPROVEMENT IN THE
MANAGEMENT, CONTROL, AND
UTILIZATION OF MAGNETIC TAPES
GODDARD SPACE FLIGHT CENTER

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The report has been reviewed by Goddard Space Flight Center (GSFC) and NASA Headquarters officials and we agree that continuing management attention is required in order to effectively control the utilization of magnetic tapes at GSFC. Action has been taken and additional steps are planned to reduce costs associated with the acquisition and storage of magnetic tapes. These steps are enumerated in the discussions related to your findings. In addition, we believe a discussion related to each of your findings may serve to clarify some areas of misunderstanding regarding the time factors involved and the value of scientific data recorded on magnetic tape. It may be well to review at the outset the principles and philosophy involved in the acquisition and retention of scientific data as well as the data processing operation itself, for it is an appreciation of these principles that must serve as a basis for many comments contained in our response.

A major goal of NASA is to obtain the greatest possible return from its investigations of space by maximum dissemination and utilization of the scientific and technological findings and data. Space flight experiments designed to acquire data are very expensive and require up to five years from inception of a project to the receipt of data. Also the data are unique, e.g., interplanetary storms, non-recurrent solar or martian activity, etc. With the magnitude of funds and human resources committed to acquiring the raw data we feel it prudent to retain the original data base from these experiments for as long as necessary in order to preserve the scientific nature of the subsequent records.

Analog tapes are those tapes which contain a recording of the instant-by-instant voltage directly from a receiver output. These tapes contain a mixture of the data and the noise which is introduced by the telemetry process. The initial operation in the Central Data Processing Facility at GSFC is to establish synchronization with the data format and to remove the noise. After some checking operations, usually referred to as editing, the data then exist in digital form and are suitable for direct entry into a general purpose computer. After some additional steps on the general purpose computer a master digital tape and the various experimenter data tapes are produced. Provisions are also made for regenerating experimenter data tapes from the master digital tapes by an abbreviated program. It should be noted that the processes of

removing noise from the data and establishing synchronization are statistical in nature usually are obtained by iteration, and can never be done with 100 percent accuracy. In other words, some errors are always present, with the severity of the errors depending on the amount of noise which was added to the data, and on the detailed characteristics and manner of operation of the equipment which converts the receiver output signals (analog data tapes) into digital format. Thus, two consecutive processings of the same analog data tape may not always result in exactly the same output data. In fact, in the case of noisy tapes, the output (digital data tapes) may be appreciably different for two replayings. These differences are due to differences in the adjustment of the equipment, differences in the capabilities and care shown by the operators, and statistical variations due to the specific details of the manner in which the equipment operates. The net result of this is that we can never claim that we have recovered all of the data recorded on the original tapes. Stated differently, this means that some information is always lost in going from analog to digital tape form. Therefore it is NASA's policy to retain the analog tapes until the experimenters verify the adequacy of the data on their tapes or the reduced experimenters data records have been placed in the National Space Science Data Center.

GAO FINDINGS

Need for Improvement in the Implementation of NASA Policy Concerning the Storage of Magnetic Data Tapes

This finding relates to a portion of the Headquarters policy (NPD 8030.3) established in January 1967 which requires the retention of the analog or master digital data records until all meaningful information has been extracted from them.

[See GAO note on p. 37.]

This policy requires that, as we progress from original data record to master digital data record to experimenters data record to reduced data records, the preceding record be retained for a sufficient period after creation of the follow-up record to permit full verification of the processing steps involved. In other words, the original data record must be retained until we are sure that the master digital data records are complete.

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The master digital data records must be retained until we are assured that the reduced data records are placed in the National Space Science Data Center (NSSDC)

[See GAO note on p. 37.]

As noted by GAO, the pre-1967 policy of indefinite analog tape retention was revised by GSFC Management Instruction 8030.1 (December 7, 1968), which complements the NASA Policy Directive 8030.3 regarding the retention of magnetic data records. Briefly, present NASA and GSFC policy calls for the reuse of analog and master digital tapes as soon as subsequent records have been verified or the National Space Science Data Center has indicated receipt of records derived from the data base.

Verification by project experimenters

GAO reports that the GSFC requirement to commence checking with experimenters on the adequacy of their data tapes two years after delivery may be shortened with the resultant earlier release of the related analog tapes from storage. While this is a desirable objective, at today's level of funding it is likely to be approximately two years before an experimenter can adequately determine if all the data he has received is correct. To reduce this interval appreciably would probably require a significant increase in funding for data reduction and analysis.

Verification, in general, requires not only a check to see if the tapes can be read on a computer, i.e., that errors have not been made in recording, but that the content of the data is of adequate quality and completeness for the experimenters purposes. Thus, the verification process requires that the records be processed on a computer to the point where output suitable for analysis is available. In order to effect economies in computer and scientific manpower utilization, most experimenters process their data in batches. Furthermore, they may concentrate on one block of data for a period of time and defer processing of newly arriving data, sometimes for one or more years.

However, in spite of these factors, it is our belief that it is possible to reduce the length of time presently required for experimenters verification. Toward this end NASA Headquarters together with GSFC will initiate a review aimed at improving these procedures and thus reducing the analog tape storage time.

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[See GAO note on p. 37.]

Unprocessed analog data tapes retained in storage

GAO points out that GSFC has no procedures for release of analog data tapes that are received from tracking stations and are placed in storage without being processed.

The practice of storing analog data tapes that are beyond GSFC's present capacity to convert to digital form was begun during the third quarter of 1968. We have not yet established a fixed erasure policy for these tapes. Such a decision will depend on an evaluation of the potential value and the resources available for the processing of these tapes. A number of requests have already been received from experimenters for processing the data stored in this manner for OGO's I and III. We have responded to a few of these requests, but most of them have not been honored because of the size of our present backlog and the established priority structure. However, GSFC is involved at the present time on a project to increase the capacity of the 1108 computer, and the prospects are quite good for being able to process some of this warehoused data in the coming year.

It should be mentioned that NASA has frequently examined the policy pertaining to continued long-term collection of data from specific satellites. Collection has been discontinued from several older satellites. The OSSA and the OTDA together with GSFC are again reviewing this subject with a view toward establishing criteria and guidelines for the discontinuance of data from selected satellites as well as policies concerning retention of unprocessed tape.

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[See GAO note on p. 37.]

Need for more effective control over digital tapes furnished experimenters

GAO reports at the time of their review they found that large quantities of experiment data tapes furnished experimenters were still outstanding (of the 188,000 tapes furnished to experimenters during 1962-1968, 112,000 were still in the possession of the experimenters) and that effective follow-up action had not been taken to have the tapes returned in a timely manner. Also, GAO reports that GSFC had not taken action to control and retrieve new digital tapes furnished to experimenters for their use in analyzing data contained in the experiment data tapes.

Each reel of data tape furnished to experimenters by Goddard has for the past five years included a label with instructions for the return of the tapes to GSFC. However, in order to emphasize the obligation to return the tapes to GSFC, Goddard is writing all experimenters possessing their tapes reminding them to return the tapes when they are no longer of use. It should be noted that, because of the increasing data rate from spacecraft, 60 per cent of the total 188,000 experiment data tapes noted above have been shipped to the experimenters since the beginning of 1967. This indicates that, on the average, experimenters are presently retaining their tapes for a period of two years. This retention period is believed to be entirely reasonable when one considers the processing cycle. The significant value to the Government of the tape inventory at GSFC is well recognized and they are presently reviewing procedures for the improved control of new and experiment data tapes.

Specifically, they will provide for an annual check of each experimenter to insure that he has returned all tapes no longer required for the conduct of particular experiments for which they were provided. This follow-up action begins two years after the experimenter first receives his tape for analysis. In view of the lengthy time often required for the reduction and analysis of data, a review of the experimenters requirements within these time periods seems adequate at present. However as noted previously we are striving to improve this total process.

Need for improvement in the practices related to the reuse of magnetic tapes

GAO advised NASA in August 1968 of their belief that procedures should be established by GSFC requiring the reuse of magnetic tape where such tapes have been found suitable for reuse.

As noted in the draft report, GSFC established practices and documented policies regarding the reuse of magnetic tape. A GSFC policy requiring tracking stations to use rehabilitated tapes to the maximum extent possible has been in force ever since rehabilitated tapes have been available and this policy has been continually monitored.

Stations are supplied with magnetic tape on an automatic resupply basis by the Network Support Branch, based on usage rates reported and upcoming data collection requirements. GSFC established stock numbers for rehabilitated magnetic tape and classified it for use for prime data collection, use restricted to engineering tests, or voice recording only. It is a regular supply item for magnetic tape requirements.

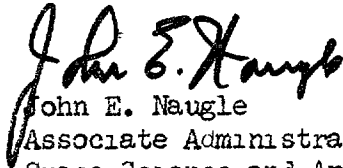
We initiated the rehabilitation tape facility because we recognized that tape could be rehabilitated at lower cost than acquiring new tape. It has proven to be equal to, or better than, the same quality of tape newly manufactured. As early as August 9, 1967, stations were required to turn in all magnetic tape for rehabilitation. In September 1968, the system for returning rehabilitated tape was formalized to guarantee return of tape for rehabilitation.

Your report indicated that during January through April 1969 the GSFC rehabilitation facility only processed about half of the tapes possible with its existing capability. This is true, because there were no more tapes available at that time for rehabilitation. It is expected that with the additional emphasis on the release from storage and the return of magnetic tapes from the experimenters, the rehabilitation facility will operate more nearly to capacity.

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[See GAO note on p. 37.]

We hope that the information provided will clarify many of the issues raised by the GAO report. While we do not agree with some of the findings and recommendations, we are in complete accord with the general aims of the report and will provide additional information if desired.



John E. Naugle
Associate Administrator for
Space Science and Applications

GAO note: Refers to material contained in draft report but omitted from final report.

APPENDIX II



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D C 20546

REPLY TO
ATTN OF

SPA

23 JAN 1970

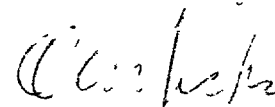
Mr. Morton E. Henig
Assistant Director, Civil Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Henig:

Your letter of January 7, 1970, addressed to Mr. Moritz requested NASA's comments concerning a revision to your draft report "Need for Improvement in the Management, Control and Utilization of Magnetic Tapes by the Goddard Space Flight Center." We have reviewed this revision which relates to that section of your report concerning the reuse of magnetic tapes and agree that, in view of your findings, the change is appropriate.

Your letter also recommends that the NASA Headquarters-GSFC review group on the magnetic tape program at Goddard "consider some of the possible ways of increasing the number of tapes that are rehabilitated." We are in agreement with your recommendation and will insure that the review group includes the area of tape rehabilitation in their overall review.

Sincerely,


John E. Naugle
Associate Administrator for
Space Science and Applications

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PRINCIPAL OFFICIALS OF THE
 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 RESPONSIBLE FOR THE ACTIVITIES DISCUSSED
 IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
ADMINISTRATOR:		
Thomas O. Paine	Oct. 1968	Present
James E. Webb	Feb. 1961	Oct. 1968
Hugh L. Dryden (acting)	Jan. 1961	Feb. 1961
T. Keith Glennan	Oct. 1958	Jan. 1961
DEPUTY ADMINISTRATOR:		
George M. Low	Nov. 1969	Present
Thomas O. Paine	Mar. 1968	Oct. 1968
Robert C. Seamans, Jr.	Dec. 1965	Jan. 1968
Hugh L. Dryden	Oct. 1958	Dec. 1965
ASSOCIATE ADMINISTRATOR FOR SPACE SCIENCE AND APPLICATIONS:		
John E. Naugle	Oct. 1967	Present
Homer E. Newell	Nov. 1961	Oct. 1967
Abe Silverstein	Oct. 1958	Nov. 1961
DIRECTOR, GODDARD SPACE FLIGHT CENTER:		
John F. Clark	May 1966	Present
John F. Clark (acting)	July 1965	May 1966
Harry J. Goett	Sept. 1959	July 1965