NSSDC NATIONAL SPACE SCIENCE DATA CENTER

WORLD DATA CENTER A for ROCKETS AND SATELLITES 88-16

GUIDELINES FOR THE DEVELOPMENT OF A PROJECT DATA MANAGEMENT PLAN (PDMP)

By

James L. Green and Joseph H. King
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PREFACE

The National Space Science Data Center (NSSDC) is responsible for ensuring that quality spacecraft data from past, present, and future NASA missions are archived, readily accessible, and distributed upon request. The purpose of the NSSDC is to provide a mechanism for maximizing the science return from NASA's initial investment in these missions.

The NSSDC places great importance on the Project Data Management Plan, or PDMP, since the quality, accessibility, and usability of the data (in the post-mission phase in particular) is dependent on many aspects of the (previously) active mission's data system. In many cases the submission of data to the NSSDC frequency extends over a period of time much longer than the life of the project office, making the PDMP a valuable post-project agreement. In addition, the PDMP should be viewed by the project and the NSSDC as a resource plan, making its initial completion well before launch an important step toward providing adequate funding for a mission's data system.

The effectiveness of the NSSDC and its associated Discipline Data Centers, or DDCs, in performing their service to the space and Earth science community depends on a well-defined relationship between the archivers, investigators, and the project. With mutual cooperation, NASA's archives will continue to provide a valuable service to all and help preserve our precious space heritage through preserving the data. The creation of the PDMP is the first step in this process.

It should be noted that NMI 8030.3A (1978) is in the process of being updated and will most likely be replaced sometime in late 1989. However, the generation of a PDMP will remain a requirement on spaceflight projects with most of the features of this Guideline still applying. When the new NMI is in effect, the NSSDC will reissue this Guideline document. It is important to note that some of the terminology used in NMI 8030.3A is out of date, however, for consistency, the same terminology is used in this document. The reader is referred to Appendix A for a Glossary of Terms.

James L. Green
July 1988

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this document is to assist NASA Project personnel in the preparation of their Project Data Management Plans (PDMP) in accordance with NASA Management Instruction (NMI) 8030.3A. In addition, this report summarizes the scope of a PDMP and establishes important aspects that must be addressed for the long-term management and archiving of the data from a NASA space flight investigation. For reference, the current NMI 8030.3A (1978) is reproduced in Attachment A.

2.0 OVERVIEW OF NMI 8030.3A

NMI 8030.3A, established in 1978, provides for the policy and responsibilities for reduction, analysis, reposition, preservation, and dissemination of data obtained from space science flight investigations. The most important aspect of NMI 8030.3A is the requirement to establish a Project Data Management Plan, or PDMP.

A PDMP addresses the total activity associated with data acquired by a mission from the generation of the Experiment Data Records (EDR) to the delivery of the Analyzed Data Records (ADR) to a specified data repository. The goal of a PDMP is to provide a plan that will ensure that a mission's reduced/analyzed data, with supporting information and documentation, will become available to the widest possible scientific community in a timely manner for as long as there is demand for the data.

2.1 PDMP ELEMENTS

The following lists the essential functions of a PDMP as stated in the NMI.

- Documents a project's plans for data analysis, dissemination of results, and making the appropriate data and supporting documentation available to a wide scientific community.
- Presents milestones in data reduction, data interpretation, and mission science meetings.
- Specifies the eventual transfer of appropriate data to a more permanent archive, such as the National Space Science Data Center (NSSDC), prior to the termination of the mission activity or the termination of a flight-specific institute established by the mission.
- Contains the timetable for the timely delivery of data to the specified repository.
- Describes the type of data products and documentation that will be delivered to the specified repository.
- Specifies the type of reports and papers/references using data from or pertaining to the mission for which a copy will be sent to the NSSDC.

- Specifies the conditions for the discarding or destroying of the Experiment Data Records.

- Specifies the role of the NSSDC for missions implementing a Guest Investigator Program or involving a facility-class payload.

Detailed aspects of the PDMP must cover agreements on machine-readable documentation, structures of catalog and inventory information, data quality procedures and the use of data format standards, and any requirements for special processing, browsing, or other access methods that the archive must provide.

2.2 ARCHIVING CENTERS

The National Space Science Data Center (NSSDC) is NASA's main central repository for selected data and documentation from space and Earth science flight missions, and serves as a disseminator of archived data and supporting information to users throughout the international scientific community. The NSSDC supports investigations in space and Earth science by making available its scientific data archive and facilities.

The recent development of other discipline data centers (DDCs) within NASA now provides a framework for improved community participation in mission data and information access. The DDCs augment the NSSDC in facilitating data access and utilization, providing an environment designed to maximize the science community's access to archived mission data products. Discipline Data Centers which have a formal NASA role and responsibility are the EROS Data Center, Smithsonian Astrophysics Observatory, Infrared Processing and Analysis Center, Space Telescope Science Institute, NASA Ocean Data System, NASA Climate Data System, and the Planetary Data System.

The NSSDC can selectively delegate to the DDCs major aspects of its responsibility to facilitate data access. A Discipline Data Center usually acts as an active data repository, with the long-term responsibility of mission data archiving remaining with the NSSDC. In many cases the role of the NSSDC with respect to a DDC is to act as a "switching center" referring data requesters to the appropriate contacts and making requests on their behalf as appropriate.

In the cases where the NSSDC is the specified interim and long-term data archive for a mission's data, then the PDMP is viewed as the interface document between a NASA project and the NSSDC.

2.3 DATA ACQUISITION TEAM

As discussed in the NMI, the NSSDC or a designated NASA Discipline Data Center will assign one or more acquisition personnel to every NASA mission that will aid in the preparation of the PDMP. The acquisition team will maintain liaison with each project and its investigators throughout the life of the project. It should be composed of

acquisition scientists with expertise in the appropriate science areas along with standards, information archive, data archive, and computer science support personnel.

2.4 APPROVALS

The personnel needed for the development of a PDMP should include the Project or Mission Scientist, Program Scientist, appropriate scientific personnel or science advisory group associated with the investigation, and the NSSDC acquisition manager. Signatures of approval (including updates to the plan) must be from the Program Scientist, Project Manager, Project Scientist, and the Director of the NSSDC. The Assistant Associate Administrator for Space Science is to ensure that any noncompliance with PDMPs is factored into future selection considerations.

2.5 PDMP LIFECYCLE

It is important to note that a PDMP is not intended to be a static document but should be revised on an "as needed" basis. The emphasis in the PDMP should be on advanced planning of the management of data acquired by NASA. The nature of a flight project and its objectives will strongly influence the data flow and the data products, but the project management must plan this data flow, must determine what and how much processing is done where, and must identify, in conjunction with NSSDC, the appropriate data sets to be archived and the schedule for public access to them.

An NSSDC requirement calls for the initial completion of a Project's PDMP approximately six months prior to launch. In this way, the NSSDC can begin preparations for the actual archiving and distribution of the information and data from each mission. Commitments to develop future and more specific PDMP versions, with the same approval cycle as in 2.4 above, should be made in PDMPs as appropriate.

3.0 OUTLINE FOR A PDMP

This section should be used as an outline for a PDMP. All sections from 3.1 and extending to 3.9 should be addressed. Some currently active and long-lived missions do not have a "data system" per se. In those cases the project only need to address only the appropriate sections.

3.1 MISSION OVERVIEW

This section should briefly discuss the scientific goals of the mission.

3.2 INSTRUMENT OVERVIEW

This section lists the individual instruments, the investigators responsible (or responsible teams in the case of facility instruments), data rates, and any other pertinent characteristics.

3.3 END-TO-END DATA FLOW

This section details the flow of data from its origin to the final archived products. Any process of quick-look data production and dissemination should also be addressed. The repositories of the EDR and ADR should be called out specifically.

3.4 DATA DESCRIPTION, PROCESSING, CALIBRATION, AND ANALYSIS

The PDMP should clearly define the expected levels of processed data, listing those products that need to be archived. In addition, the investigator(s) or the investigator teams that are responsible for the processing, calibration, and analysis must be identified, defining their roles and responsibilities. Ancillary data sets used to support the processing, analysis, or validation of the mission's archived data should be identified and plans made for their archiving. For example, the spacecraft orbit and attitude are usually essential to the further analysis of archived mission data.

3.5 PROPRIETARY DATA POLICIES

The PDMP should specify the nature and duration of any proprietary data rights. For instance, a project's science working team members may agree that during a one-year proprietary period, higher level data products would be accessible to other members on an offer-of-co authorship basis. After one year, the data would become openly accessible to the general scientific community.

The transfer of data to the NSSDC can be made before the end of the proprietary period. These proprietary rights will be honored. Information about the mission and its data products is generally not proprietary, and should be provided as per 3.6.1 below.

3.6 ARCHIVING REQUIREMENTS OVERVIEW

If one does not already exist, an advisory committee should be formed early in the mission (well before launch) to determine which data sets should be archived, what ancillary information should be stored with the data, and when and where the archiving should be done. The committee should include representatives from the project, the science investigators, the NSSDC or DDC if appropriate, and if possible, potential investigators not associated with the mission.

The archiving of a data set, creation of the associated directories, catalogs, and inventories should be done during the mission and begin as soon after launch as

possible. Online information facilitates the research done during the mission. It is to the advantage of the Principal Investigators (PIs) to ensure that information about his data are readily available to other (including non-mission) scientists.

A data set that is not used by its creator in its archived form is notoriously unreliable. Consequently, a project's archives should be originally created, developed, and exercised by the investigator or investigator team. The mission data should be moved to the archiving center at the earliest possible date when the data are still in active use and yet are not continuously undergoing recalibration, recalculation, etc. The PDMP must contain a timeline for data transfer into the archive that provides adequate milestones in order to determine that all the appropriate data and documentation will be archived during the project's lifetime.

The content of the archive should include (but need not be limited to): the processed data records (for remote sensing data, the "level 1" data sets are desired for archiving); orbit/attitude (ancillary) information; command and telemetry information (as appropriate); information about the data, such as catalogs and general documentation; and any useful, well-documented software that is transportable. It is very desirable that catalogs and documentation, as well as software, should be machine-readable, to facilitate both online access and archival storage. For data sets that are not machine-readable, such as photographs and microfilm plots, the documentation and catalog information should still be machine-readable. It should be recognized that microfilm plots, for example, are often extremely effective and convenient for providing a variety of users with quick and simple access to archived digital data for summary purposes.

3.6.1 INFORMATION ARCHIVE

This section should discuss the requirements for the archiving of the relevant information about a mission's data. In archiving, there is a hierarchy of information necessary to adequately describe a NASA mission and its data.

3.6.1.1 DIRECTORIES AND CATALOGS

All new data sets coming into the NSSDC and the DDCs must have Master Directory entries. The Master Directory contains brief high-level information about data sets, allowing a user to determine where further details may be obtained. The formats of the data entries for the Master Directory can be obtained from the NSSDC on request. The NASA Master Directory is an online search system located at the NSSDC that provides brief overview information about NASA, as well as important non-NASA, space and Earth science data and information systems.

It is in the area of catalogs to be created by space flight projects that those projects can contribute significantly to the scientific usefulness of the data. The lowest level catalogs should contain simple information about which data segments have been received, processed, and made available for use. This type of catalog is called an inventory. The catalog should be updated by the project as the data become available. Some general background information will also be important and will

probably be entered manually. This includes topics such as data quality, processing history, and resolution.

The catalog should be made available for browsing by the outside community as soon as the data described by it are scheduled for release to the general community. If only portions of the data described in the catalog are nonproprietary, it is still useful that information about the proprietary data, usually the time periods, instrument modes, etc., be displayable with some indication as to when these data become nonproprietary. The catalog should be transferred to the NSSDC (or DDC) at the time that the data are archived. In some cases it may be appropriate that NSSDC receive periodic copies of the catalog while the master catalog is still being modified at the remote institution. The PDMP should contain a discussion of the catalog, its resolution in independent variable space, its information contents, its managing DBMS or other software, etc.

Catalogs (especially the highest level catalogs) should be created to a common standard in order to facilitate intercomparisons, allow common software usage, and prevent confusion to the outside user. Catalogs should have a browse capability and this should be standardized within each scientific discipline. A consistent user-friendly interface to the browse capability is necessary. The NSSDC is in the process of providing guidelines for catalog creation to fulfill these objectives. Information about the data sets and their associated catalogs should be entered into a central directory before or as soon as they are usable by other investigators, regardless of whether the data set is complete. The NSSDC will also provide guidelines for the automated input and update of catalog and directory entries as the data sets are created or augmented. This will allow the catalog and the NASA Master Directory to provide useful, up-to-date information.

3.6.1.2 OTHER DOCUMENTATION

Documentation that describes the detailed aspects of the data that are being archived must accompany the data. This written (electronic form is preferable) documentation should be organized into a Data Users Handbook that adequately describes the quality, the calibration, and other pertinent scientific information about the data.

The documentation provided for a particular data set should be oriented toward the second generation of users (i.e., those users who are scientifically competent, who understand the terminology, but who have never seen the data before). For example the documentation must include, when appropriate:

- A description of the instrument or measuring device, with particular emphasis placed on describing those parts of the instrument that affect the data and their interpretation
- A discussion of the calibration procedures used, the resulting calibration of the instrument (both on a relative and an absolute basis), and its corresponding uncertainty, as best it can be determined

- A discussion of the scientific areas where the data are known to be excellent, as well as a discussion of scientific areas where the data are known to be invalid or misleading

- A discussion of any unusual or important events which may have occurred during the operational life of the experiment that may affect the resulting data and their interpretation

- A discussion of the overall data reduction procedure used to generate the data set, with attention being placed on arbitrary or controversial decisions (reversible or otherwise) that affect the resulting data

- A thorough discussion of any procedures that the next user should follow in his reduction/analysis of the data

- References to particularly useful published results and descriptions, especially those publications that explain aspects of the experiment that affect the data (the NSSDC sends all data requesters a bibliography of all known papers resulting from the experiment in question), and

- Any other known conditions in the data, or affecting the data, that should be brought to the attention of any user.

3.6.1.3 SOFTWARE ARCHIVE

In cases where the investigator has developed extensive software to read, search, select, display, or perform certain standard analysis or calibration functions, it is desirable that this software be archived and made available for subsequent users of the archived data set. The NSSDC has been involved in such software archiving to a limited extent in the past, and intends to expand and develop this service. Software documentation and management should facilitate later maintenance by the developer as well as portability to other computers. NSSDC will provide advice and guidance in this area, and expects this to become a valuable part of the service of NSSDC in providing better access to useful data. The PDMP must contain a list of the delivered software and the documentation of that software for each of the archived data sets.

3.6.2 DATA ARCHIVE

The data normally archived at the NSSDC or at a DDC are the Analyzed Data Records (ADR). This section discusses several aspects of the ADRs that must be addressed in the PDMP. The document "Guidelines for Submitting Data to the National Space Science Data Center" is available on request.

In the case of microfilm or photographic data, the most useful generation (usually the generation closest to the original) should be provided as the working copy. When the original is archived at the NSSDC, the NSSDC will produce a working copy from it.

3.6.2.1 DATA FORMAT STANDARDS

One of the major problems in the management and analysis of diverse data sets is in the area of standard formats. Projects and investigators must take steps to ensure that all archived mission data are generated in a format compatible with an appropriate recognized standard. The PDMP must describe which standard data formats will be used for the data to be archived.

Examples are the Flexible Image Transport System (FITS) format, being used worldwide in astrophysics; NSSDC-developed Common Data Format or CDF (Treinish and Gough, 1987 and Gough, 1987), which is a self-describing data structure that provides a common framework for acquisition and distribution of data; FLATDBMS (Smith and Clauer, 1986); and the Standard Formatted Data Unit or SFDU, which is a unit of machine-sensible digital data which complies with the logical structure of such data as defined by the Consultative Committee for Space Data Systems (CCSDS).

3.6.2.2 DATA QUALITY

It is the responsibility of the PI to ensure the integrity of the data whether located at the investigator's institution, at a central project archive, or at a permanent archive. The NSSDC will undertake every effort to quickly facilitate the investigator's task of verifying data integrity for his data at the NSSDC. Once the data are archived, it is the responsibility of the NSSDC or DDC to maintain their integrity.

The NSSDC will accept space and Earth science data from NASA's spaceflight missions with a range of quality. A PDMP must have a plan to produce good quality data sets for all instruments. The NSSDC recognizes that, particularly during the funded mission phase, the quality of individual data sets improves with time. A variety of instrument data undergoes constant updating of calibration and cross-calibration as the investigators continue to gain a better understanding of the instrument capabilities.

However, the NSSDC also recognizes that to delay to sending data to the archiving center because they are not of the highest quality, may jeopardize getting any representative mission data archived, since funding for spaceflight missions is finite and decreases rapidly with time. Resubmission of data to the NSSDC does occur and is expected in some cases. The important factor in the archiving of data is knowing the data quality. The philosophy of the NSSDC is that archiving some data of quality sufficient for many analyses, although possibly not all analyses, is better than archiving no data at all.

It is obvious that the NSSDC does not want, nor has the staff to handle, continual re-submission of data. The NSSDC has formed a team of individuals assigned to help the project and the PI and his team. Currently, the NSSDC has a small and diverse science research and data acquisition staff whose main responsibility is to review incoming data sets and documentation for completeness and to quality-check the data. These dedicated individuals, who are serving the community along with performing their own individual research, must work closely with the PI and his team. On request,

the NSSDC will provide the project and investigators with guidelines for submission of data that are designed to provide more detailed specifications to follow to ensure the highest quality of data and documentation for archiving and data comparison workshops. These detailed specifications must be adhered to in order to avoid the three major data archiving problems cited by the CODMAC report, 1982. These problems, as put forward in the executive summary of the CODMAC report (p.3), are:

"Data archives generally contain insufficient or inaccurate information concerning the quality and limitations of the archived data."

"In those cases where data are returned to the data center, the documentation is often incomplete, resulting in the processed data being unusable for other investigators."

"Data archives generally contain insufficient ancillary data such as time, attitude, orbit, or sensor calibration data."

3.6.2.3 MEDIA

In past NSSDC experience, digital data has generally been received in tape form. It is anticipated, however, that other media (such as optical disk or electronically over a network) will become more and more popular. The PDMP should specifically address the expected media for receipt and for distribution. As an example of appropriate procedures for archiving data on optical disk, the reader is referred to the document "DE submission of data on optical disk to NSSDC" (Sawyer et al., 1988). This document is available on request.

3.6.2.4 DATA BROWSE CAPABILITIES

In general, the usefulness of archived data is reduced by the lack of adequate browse capabilities. Many of the current projects have a variety of mission-specific capabilities for browse, analysis, or display that may be moved to the NSSDC or DDC to support post-project access to the archived data. The PDMP should include any plans for the acquisition of special facilities (whether by the NSSDC, DDC, or the project) to accommodate future data access requirements.

3.6.3 ARCHIVE REQUIREMENTS CHECK LIST

The PDMP should answer the following questions for the long-term data management and archiving of its mission data:

(1) What data products will be archived? Will calibrated, full resolution, digital data be archived? If not, why not, and what products are suggested as an alternative? Will low resolution or other more highly processed data be archived? Will ancillary data such as orbit and attitude be archived?

(2) Where will each data product be archived? There may be national archives or discipline data centers other than the NSSDC where these data can appropriately be archived.

(3) What is the estimated volume of mission data to be archived?

(4) When will each data product be archived? If not within two years of PI data acquisition, then why not?

(5) Are there any special handling instructions? Note that the NSSDC has handled and will accept proprietary data in accordance with project rules.

(6) What medium will be used for transmission of data to the archive? In addition to magnetic tape, the NSSDC receives data over a variety of networks and on optical disks. The NSSDC also archives microfilm, photos, and negatives.

(7) What catalogs with what structures and contents will be associated with each data product? For mission-specific catalogs that are turned over to the NSSDC, what are the data management systems needed for online operations?

(8) What data and mission information will be required to be online and accessible over networks and when and to whom will it be accessible? What other information or data access capabilities will be accessible? What will be transferred to the NSSDC with each data product?

(9) What additional documentation will be provided with each product? This information should include processing histories and data quality analyses.

(10) What data formats and structures will be used? If the archived data are not in a standard format such as FITS, CDF, SFDU, then why not?

(11) What data handling software tools (including browse) will be supplied to the archive? What will be remotely accessible and in what time frame? How will it be supported?

(12) To handle the incoming data, will any hardware be provided to the archiver from the project data management system (or be transferred to the archiver in the post-project phase)?

The mission science working group, with representation from the participating archive, should decide on the type of data to be archived based on their assessment of instrument capabilities and what will likely be most valuable to the research community, given any mission or archive resource constraints. This group should answer questions 1, 2, and parts of 7. Direct participation by the flight project with the mission science working group will be necessary for determining the answers to the remaining questions.

3.7 DATA DISCARDING POLICY

The PDMP must contain the policy for the discarding of Experiment and Analyzed Data Records (EDR's and ADR's) and the timeline for such disposition. Over the last 25 years NASA has accumulated an impressive volume of space and Earth science flight data (Experiment Data Records). Much of this is stored in the Federal Records Center (FRC) in Washington D.C. and makes up approximately 37,000 cubic feet of records. The appropriate ADR's are those that are archived at the NSSDC or NASA DDCs.

Article 1441.1A of the NASA Handbook authorizes the transfer of EDR mission data to the FRC and places the burden of justifying retention of this accumulated data on the scientists responsible for its creation. It is important to note that the FRC data in question comes straight from the mission and does not go through the NSSDC. Consequently, if the policy for disposition has not been created by the project, it does not fall under the general archiving policies of the NSSDC. If this is the case, when a mission is terminated, its corresponding stored data in the FRC is immediately subject to discarding without guidance from the science community. However, the data archived at the NSSDC will be continuously maintained following the scientific guidelines set by the science community.

3.8 GUEST INVESTIGATOR PROGRAMS

Many NASA spaceflight programs have Guest Investigator (GI) or Associate Investigator (AI) programs. These programs are designed to bring the highly talented external community of scientists, not directly involved in the mission's actual instrument design, integration, flight operation, and data analysis, into the operations and scientific analysis part of the program. These programs are essential elements to the enhanced scientific return of any of NASA's missions and in many cases rely on the NSSDC for supplying the archived data (such as in the case of the International Ultraviolet Explorer).

The NSSDC strongly recommends that the project provide one of the GIs or AIs directly for mission data support at the archiving data center as early in the mission as possible. Further, it is recommended that this person be appointed as early in the mission as possible, perhaps even before data acquisition. This person would be resident at the archiving data center. This should be a guaranteed position each year of the GI/AI program and should be filled before any other position. A designated member from the NSSDC should sit on the proposal review committee. The responsibility of the data center GI/AI would be to ensure the maximum scientific usefulness of the archived data by performing the following tasks:

- Maintains liaison with the science community and the archive personnel
- Ensures early identification of problems with incoming data

- Provides needed value-added services such as the creation of data-associated software libraries, useful electronic catalogs/directories, reduced/calibrated data sets, instrument-composite data sets, and other relevant scientific data services

- Provides the data center with an overview of the scientific value of the mission data being archived and an independent assessment of data quality

It is important to note that this GI/AI is not a request coordinator, but provides the appropriate scientific focus for the mission data archived. The data center GI/AI position should provide the individual with substantial personal scientific gain in addition to performing a valuable scientific community service.

The major benefits for such an arrangement are obvious. The data center GI/AI position goes a long way toward assuring that the mission data deposited in the archive are of the highest quality (see Data Quality section) and scientifically useful. In addition, problems with the archived database can be detected early because of the immediate active use of the data. Everyone in the science field can benefit from the value-added services that this GI/AI would provide.

At the NSSDC, all archived data, computational, photographic, and publication facilities would be available to the NSSDC GI/AI scientist. All efforts will be made to accommodate the GI/AI scientific research needs. Upon completion of his or her work within the NSSDC, the GI/AI returns to the scientific community with a better understanding of all aspects of the NSSDC and its services.

3.9 REPORTS

The NSSDC (and some of the DDCs) sends out, or makes available online along with the data and documentation, a bibliography of papers related to the experiment and data. In order to help the NSSDC maintain its bibliographic file, it is most helpful if investigators and their co-workers add the NSSDC to their mailing list for copies of all papers deriving from data that the NSSDC will eventually archive. Copies of any bibliographies, such as those periodically sent to project offices, are also very useful. In some cases, supplying this information is a contractual obligation between NASA and the investigators.

4.0 SUMMARY

The PDMP is a statement of NASA project data management and defines the roles and responsibilities of the individual investigators, the federal officials implementing the programs, and the NSSDC (or DDC), to ensure proper use and preservation of space and Earth science data. The PDMP addresses the total activity associated with the mission data from the delivery of the experiment data records (EDR) to the investigators to the delivery of selected reduced and analyzed data records (ADR) along with supporting documentation to a specified repository. The PDMP must also specify the conditions for discarding the EDRs that are not archived at the NSSDC.

These guidelines for the development of a PDMP were written to aid spaceflight projects in identifying and addressing those elements to be included in the plan to ensure the preservation of, and easy long-term access to, high quality, well documented, appropriately reduced and resolved, conveniently formatted data.

5.0 ACKNOWLEDGEMENTS

The authors would like to thank the entire staff of the NSSDC for their technical contributions to this document. In addition, important comments from Kent Hills, Jim Thieman, Ralph Kahn, Mike Martin, and James Brown are gratefully acknowledged.

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ATTACHMENT A: NMI 8030.3A

SUBJECT: Policy Concerning Data Obtained from Space Flight Investigations.

INCORPORATION: The policy concerning data obtained from space flight investigations (14 CFR 1205.1) is stated in Attachment A and is hereby incorporated in the NASA Issuance System. It is applicable to all NASA installations.

SUMMARY: The National Aeronautics and Space Administration (NASA) finalizes revision to its policy concerning data obtained from Space Science Flight Investigations. This revision is necessary redefine the roles and responsibilities of individuals conducting space science investigations, Federal officials concerned with implementation of program, and the National Space Science Data Center (NSSDC) to ensure proper use and preservation of space science data. The revised policy, through the use of a Project Data Management Plan, will reduce the amount of data acquired by the NSSDC and ensure that the data deposited in the NSSDC is processed in the most efficient, cost effective manner.

SUPPLEMENTARY INFORMATION: On December 28, 1977, a notice of revision to the Policy Concerning Data Obtained from Space Science Flight Investigations was published in the FEDERAL REGISTER (42 FR 64706). The purpose of the revision is to redefine responsibilities of individuals concerned with implementation of programs and the NSSDC to insure proper use and preservation of space science data in the most cost efficient manner. Interested parties were granted 30 days to submit written comments regarding the proposed revisions. No written comments were received.

The proposed revised Policy Concerning Data Obtained from Space Science regulations is hereby adopted without change, as set forth below.

Robert A. Frosch, Administrator

DATE: Effective date May 2, 1978.

Subpart 1205.1–Policy Concerning Data Obtained From Space Science Flight Investigations.

SECTION

Subpart 1205.1–Policy Concerning Data Obtained From Space Science Flight Investigations.

§1205.100 Scope

(a) This subpart continues the policy and responsibilities for reduction, analysis, reposition, preservation, and dissemination of data obtained from space science flight investigations. For glossary of terms and abbreviations, see Appendix A to this subpart.

(b) These provisions apply to all data obtained from space flight experiments processed by the Space Science Steering Committee and approved by the Associate Administrator for Space Science. The policy and procedures for the conduct of the Space Science Program and the responsibilities for the selection and support of scientific investigations and Investigators are set forth in NASA Management Instruction 7100.11 and NASA Handbook 8030.6.

§1205.101 Policy

(a) In conducting space science flight experiments, NASA shall seek to:

(1) Preserve the integrity of each investigation.

(2) Encourage the participation of the best qualified scientists.

(3) Make the results of investigations generally available to the scientific community at the earliest practicable time.

(4) Document the instrument performance and probable cause of malfunctions that occur.

(b) NASA shall rely on individual scientists as Principal Investigators (PIs) to carry out a complete investigation by:

(1) Selecting, when appropriate, associates know as Co-Investigators (CO-Is) who have supporting roles in the investigation.

(2) Conceiving specific investigations.

(3) Developing, when appropriate, the instrumentation for the investigation.

(4) Participating actively, wherever appropriate, in the actual conduct of the investigation.

(5) Reducing and analyzing the data obtained.

(6) Publishing their findings as soon as practicable.

(7) Making their Reduced Data Records (RDRs) and Analyzed Data Records (ADRs) along with supporting documentation available on a timely basis for use by the scientific community and the news media, in accordance with a Project Data Management Plan (PDMP).

(8) Documenting any significant malfunctions which occur during the lifetime of the experiment.

(c) For certain missions, NASA shall also rely on Guest Investigators to obtain data within the capability of a given mission, which are additional to the mission's primary objectives, and to perform an analysis of the acquired data. Such projects generally maintain a data retrieval and dissemination system or provide a data analysis system for the life of the project. In such cases the PDMP should address the exchange of information with the National Space Science Data Center (NSSDC) so it can act as a switching center by referring data requesters to the appropriate contact or making requests on their behalf and handling the distribution. In addition, the eventual transfer of appropriate data to a more permanent repository prior to termination of the project shall be addressed in the PDMP.

(d) For facility-class payload missions, NASA may rely on Guest Investigators to obtain and analyze data. In connection with such missions a complete analysis activity may be provided for the Investigators; this activity may involve the creation of an institute with a significant lifetime. In such cases the PDMP should address the exchange of information with the NSSDC so it can act as a switching center by referring data requesters to the appropriate contact or making requests on their behalf and handling the distribution. In addition, the eventual transfer for appropriate

data to more permanent repository prior to termination of the mission activity or institute shall be addressed in the PDMP.

(e) A provision for the release of data obtained by the individual Investigator from the investigation shall be included in an agreement with the Investigator at the time of selection to participate. NASA shall take such action as necessary to insure that data are released as required to meet scientific, technological, and public information needs.

(f) Foreign scientists participating in cooperative space science flight investigations shall be governed by appropriate international agreements and/or memorandums of understanding.

§1205.102 Responsibility

(a) OSS. The Associate Administrator for Space Science is responsible for the issuance of implementing management instructions and guidelines consistent with the provisions of this subpart. The Assistant Associate Administrator for Space Science (Science) is responsible for the program management of the NSSDC and for insuring that any noncompliance with PDMPs will be factored into future selection consideration.

(b) OSS Program Scientist

(1) Each Program Scientist is responsible for establishing the data analysis policies for each mission including data sharing and collaborations on data analysis. He/she will review the PDMP to assure that data interpretation meetings will be conducted, that wide dissemination of data through presentations and publications will occur and that data and supporting information will be made available to the scientific community in accordance with the PDMP and, along with the Project Scientist, he/she will monitor the execution of the PDMP. He/she will assist NASA public affairs personnel in meeting public information needs.

(2) Each Program Scientist will insure that the letter of notification of selection stipulates that the Principal Investigator (PI), Team Leader (TL), or Guest Investigator (GI) contributes to a PDMP prior to receipt of flight data which documents the plans for data analysis, dissemination of results and for making ADRs, RDRs and supporting documentation available to the scientific community through the designated data dissemination facility. The notification letter will further stipulate that selection for further opportunities will be jeopardized by failure to meet the commitments of the PDMP. The Program Scientist is also responsible for sending information for the Space Investigations Documentation System (SIDS) to the NSSDC after letters of notification have been sent.

(c) Office of Management Operations. The Head, Scientific and Technical Information Branch is responsible for the issuance of instructions to the Scientific and Technical Information Facility (STIF) to provide to the NSSDC a monthly listing of newly acquired articles and documents that contain information about of results from

NASA-supported space science flight experiments, especially those which can be identified through the contract, grant, or NASA Unique Project Numbers (UPN) supplied by the NSSDC.

(d) Field installations. NASA field installations assigned project management responsibility for space science flight projects are responsible for:

(1) Ensuring that the project plan includes a statement within the project results (or equivalent) section that the Project Scientist, or Mission Scientist, the appropriate scientific personnel associated with the investigations that comprise the mission, and the NSSDC acquisition manager will develop a PDMP. This PDMP will be approved by the project manager with concurrence signatures by the Project Scientist and the Director of the NSSDC.

(2) Ensuring that the contracts or written agreements negotiated between the PIs, TLs, or GIs institution and the project management center specify the responsibility of the PI, TL, or GI for data reduction, data analysis, publication of results, and, where appropriate, the preparation of selected ADRs, RDRs and necessary documentation for delivery to a data disseminating repository. The contracts or written agreements will stipulate that the contract number or, in the case of a NASA field center Investigator, that the UPN number appear in all reports or articles. Copies of all reports and preprints shall be sent to the STIF and to the NSSDC. This responsibility will be documented in a PDMP to which the Investigators, the Project Scientists, the NSSDC Acquisition Manager, and the appropriate scientific advisory groups will contribute. The PDMP will commit the Investigator, where appropriate, to supply to a specified repository the following documentation upon submission of the selected ADRs and RDRs:

(i) General information about each data set, such as:

(A) Form of data set-hard copy, magnetic tape, microfiche, microfilm, photographic film, etc.

(B) quantity of data set-number of units of the form.

(C) External identification for each physical unit of the data set-space-craft, experiment, Investigator's internal ID.

(D) Time period covered by the data set.

(E) Quantity by which data set is ordered-time, orbit number, spatial coordinate, etc.

(F) Supporting documentation-tape formats, catalog, directory, indexes, User's Guide, etc.

(G) Brief description of the data set (not to exceed 250 words).

(ii) Specific information about each data set, such as:

(A) Magnetic tape-track density, recording density, recording mode, recording parity, make and model number of computer used, number of files, size of physical records, logical record format with specification of each field, etc.

(B) Photographic or microform type of film, frame and/or reel numbers where supporting data and description are located, index of frames and each reel, assurance that all reels are quality controlled to allow proper duplication, etc.

(C) Hard copy-assurance that copy is clean, legible and of proper contrast so it can be photographed; index or catalog if appropriate; form of binding (burst, unburst, loose leaf, bound); etc.

(iii) A Data User's Guide which includes a summary of the investigation, a description of pertinent events in the operational history that might affect data interpretation, a discussion of overall data reduction procedures used in generating the various data sets, and other information useful to a scientifically trained recipient of the data.

(iv) A list of all published articles related to the investigation by the investigator group or team and copies of all reports and preprints.

(3) Ensuring that Investigators on these projects fulfill the stipulations of the contracts or written agreements pertaining to the responsibilities described in paragraph (d.1) of this section.

(4) Delivery of EDRs to Investigators on a timely basis. Conditions for discarding or destroying EDRs shall be specified in the PDMP.

(5) Providing to the NSSDC during the writing of the project plan (and provided updates during revisions and specifically after launch) the following information:

(i) Brief statement of the mission objectives for each launch (not to exceed 200 words).

(ii) The names, addresses and telephone and telex numbers of the program manager, Program Scientists for each mission.

(iii) The launch site, launch vehicle, spacecraft weight, and planned orbit parameters.

(iv) A brief description of the spacecraft, not exceeding 250 words.

(v) For each investigation the names, addresses and telephone and telex number of all the Investigators and the relevant contract or UPN numbers.

(vi) The name of each experiment, its weight, average power, and approximate bit rate.

(vii) A brief description of each experiment, not exceeding 250 words.

(e) The PI, TL, or GI (NASA, Non-NASA, and foreign). At the time an investigation is selected, the PI, TL, or GI will be notified by letter signed by the Associate Administrator for Space Science of his responsibilities (subject in the case of foreign scientists to the specifications of the governing international agreement) will include:

(1) Completion of data reduction and prime analysis of the data from his experiment within the period of time agreed upon between the PI, TL, or GI and the Associate Administrator for Space Science.

(2) Publication of the results of his analyses as soon as practicable.

(3) Preparation of selected ADRs and RDRs together with the necessary background information to make them usable by other scientists as specified in the PDMP.

(f) National Space Science Data Center (NSSDC). The Director, Goddard Space Flight Center (GSFC), is responsible for management of the NSSDC, the central data disseminating repository for data obtained from space science flight investigations. For functions and operation of the NSSDC, see Appendix B. The NSSDC Director, appointed by the Director, GSFC, is responsible for:

(1) Implementing the NASA project plan for the operation of the NSSDC.

(2) Recommending through the Director, GSFC , any changes in policies, procedures, and plans for the operation of the NSSDC deemed appropriate to the effective attainment of project objectives.

(3) Preparing budget estimates for operation of the NSSDC.

(4) Recommending fees for the computer and reproduction services performed by the Center to Director, Financial Management Divisions, NASA Headquarters, and obtaining from that office a fee schedule which is consistent with NASA practice.

(5) Based upon information contained in the PDMPs, compiling schedules for transmission of ADRs and RDRs to the NSSDC by investigators on NASA space science flight projects.

(6) Assigning an NSSDC acquisition manager to each flight project to participate in the development of the PDMP and to assure that the plan is carried out on an established schedule concerning the deposition of any data and documentation in the NSSDC.

(7) Providing to the STIF a monthly listing of contract, grant, or UPN numbers for all NASA funded space science flight experiments and related investigations.

(8) Preparing guidelines for the submission to the NSSDC of ADRs and RDRs with documentation from non-NASA missions, and disseminating these guidelines to appropriate individuals and agencies to serve in lieu of a formal PDMP.

(9) Reporting through the Director, GSFC, to the Assistant Associate Administrator for Space Science (Science) semiannually on the data acquisition, request activities and financial status of the NSSDC operations.

(10) Accessing adequacy of the NSSDC facilities and the effectiveness of their utilization; and recommending through the Director, GSFC, the necessary actions to meet future facility requirements.

(11) Maintaining, protecting, and retiring NASA records in the custody of the NSSDC in accordance with the policies and practices of the NASA Records Management Program, NASA Records Disposition Handbook (NASA Handbook 1441.1A) and other pertinent management instructions.

§1205.103 Support of Research

The NSSDC will support investigations in space sciences by making available its scientific data and facilities. However, the NSSDC will not provide financial support for such research. The Office of Space Science will entertain proposals for space science research based on data available in the NSSDC.

NMI APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Analyzed Data Records (ADRs). Those records which the Investigator designates as the best to display the scientific results of an experiment and provide the physical quantities by applying calibration curves or algorithms to the corrected observed quantities of the Reduced Data Records. The data may be time averaged and may incorporate model-dependant assumptions to obtain the physical quantities. Charts, graphs, tables, correlation coefficients, model parameters, photographs, and plots are possible forms of these records.

Co-Investigator (Co-I). An associate of the Principal Investigator (PI) who is assigned a supporting role in the investigation. In addition, some data rights may be assigned to the Co-I by the PI.

Experiment. A term used interchangeably with investigation (the latter is preferred). Activity or effort aimed at the generation of data obtained by measurement of space phenomens or the use of space to observe earth phenomens and the resulting analysis of such data.

Experiment Data Records (EDRs). Those records provided to the Principal Investigator, Team Leader, Guest Investigator, Co-Investigator, or team member containing all the data from the mission required to carry out the investigation specified in the contract or launch agreement. These records may include orbital position, spacecraft attitude, instrument attitude, commands, housekeeping data, ground time, spacecraft time, data from other investigations and other information as agreed upon. The exact form of these records and manner in which these data are provided may vary depending upon the policies, procedures, and capabilities of the project, the payload or mission control centers, the data acquisition network, and any support processing facilities. These records shall be specified in the Project Data Management Plan.

Facility-Class Payload Missions. A mission in which the Payload is an instrument or set of instruments which serve as facility for a large group of Guest Investigators who may be selected at different times throughout the life of the mission to participate. This type of mission may not have Principal Investigators or Team Leaders and all the data collected from such a mission is generally maintained by the project for use by Guest Investigators. Availability of data for the scientific community at large shall be specified at the Project Data Management Plan.

Guest Investigator (GI). Investigator selected to conduct observations and obtain data within the capability of a NASA mission, which are additional to the mission's primary objectives, or for a facility-class payload mission.

Investigation. Activity or effort aimed at the generation of data obtained by measurement of space phenomens or the use of space to observe Earth phenomens and the resulting analysis of such data.

Investigator. A participant in an investigation. This term may refer to a Principal Investigator, Co-Investigator, Team Leader, team member, Guest Investigator, or any other member of an investigation group.

Mission. One or more flights within an approved payload project.

Mission Scientist. A scientist from a NASA field center assigned to a space flight mission, the Mission Scientist has similar functions as the Project Scientist with the exception of direct responsibility for the development of any experiments.

National Space Science Data Center (NSSDC). The main central repository for selected data and documentation from space science flight missions that serves as a disseminator of this archived data and supporting information to users throughout the international scientific community. The NSSDC, located at Goddard Space Flight Center, serves as a switching center for requesters who desire data still held individually by Principal Investigators (PIs) or Team Leaders (TLs) by providing a description of the spacecraft and experiment and the name, address, and telephone number of the PI or TL. For missions involving Guest Investigator program in association with a PI or TL experiment or involving a facility-class payload the role of the NSSDC shall be specified in the Project Data Management Plan.

Principal Investigator (PI). A person who conceives an investigation and is responsible for carrying it out, reporting its results, and providing appropriately selected data and supporting documentation to the scientific community in accordance with the Project Data Management Plan. The PI chooses his Co-Investigators and assigns them roles and privileges. The PI is the primary point of contact with the project office regarding the investigation.

Program Scientist. A NASA Headquarters official assigned to each mission who has a number of roles and responsibilities defined in NASA Management Instruction 7100.11, Attachment D. The most relevant one for this subpart is the responsibility to establish the data analysis, data dissemination, and data archiving policies for the mission, which will be documented in the Project Data Management Plan.

Project Data Management Plan (PDMP). A plan that addresses the total activity associated with the data acquired by a mission from the delivery of the Experiment Data Records to the Investigators to the delivery of selected reduced and analyzed records along with supporting documentation to a specified repository. The plan should provide the milestones in the data reduction, data interpretation, and resource requirements for these phases. Any planned data interpretation meetings, workshops, or other activities should be identified. The type of data records, data products, and compilations that have been selected in concert by the Investigators, the Project Scientist, the Program Scientist, the NSSDC acquisition manager, and any appropriate scientific advisory personnel for general availability to the international scientific community and for delivery to disseminating repository, such as the NSSDC, shall be specified. For missions where the data will be maintained for many years by the project, the Principal Investigator handling a Guest Investigator program, or by an institute established by the mission, the eventual transfer of appropriate data to a more permanent archive, such as NSSDC or other repository, shall be specified.

Conditions for discarding or destroying the Experiment Data Records shall be specified.

Project Scientist. A scientist from a NASA field center assigned to a project to manage the scientific aspects. The roles and responsibilities of this function are given in NASA Management Instruction 7100.11, Attachment E.

Reduced Data Records (RDRs). Those records prepared from the Experiment Data Records by applying corrections, where applicable, for temperature, voltage, gain change, offsets, dead time, drift and other known instrument changes, as well as eliminating unuseable noisy periods and periods of Guestionable instrument performance. The Reduced Data Record should contain all the basic and supporting measurements obtained from the experiment, such as time position, attitude, settings of instrument by command, housekeeping data, and other information needed to analyze the data in an independent fashion. Visual data, such as photographs, derived from imaging processing techniques, may also be considered as RDRs.

Scientific and Technical Informations. Facility (STIF). NASA's document, and report acquisition and abstracting facility that produces a biweekly abstract journal, STAR, covering the aerospace report literature and a biweekly abstract journal, IAA, covering the published literature in these fields. The facility also produces microfiche copies of the report literature for primary distribution.

Space Science Flight Investigations. Investigations of natural phenomens of the earth and its environment, the moon, other planets, the sun, interplanetary space, and other celestial objects and regions made from aircraft, balloons, sounding rockets, satellites, probes, and manned spacecraft for the purpose of increasing basic knowledge of these natural phenomens. Biological investigations involving the search for extraterrestrial life are included.

NMI APPENDIX B: FUNCTIONS AND OPERATION OF THE NATIONAL SPACE SCIENCE DATA CENTER

The National Space Science Data Center (NSSDC) has been established at the Goddard Space Flight Center to provide scientific data and facilities in support of investigations in space science.

(A) Data to be acquired. The NSSDC will acquire or accept:

(1) RDRs and ADRs from NASA-sponsored space Science Flight experiments which are deemed appropriate for secondary distribution and archiving by PDMPs or directly by the Program Scientist. The vast majority of records will be from satellite borne instruments. Any departures from a PDMP shall be approved in writing by the Program Scientist, the Project Manager, and the NSSDC Director.

(2) Unclassified ADRs and RDRs made available from space science flight experiments by other agencies in accordance with interagency agreements providing the data media meet standards for reproduction and the supporting documentation is adequate.

(3) Ground-based correlative data, only when it is considered absolutely necessary for the utilization of data in the NSSDC.

(4) ADRs and RDRs from foreign space science flight experiments made available by international exchange of data through the World Data Centers or by cooperative agreements.

(B) Data not to be acquired.

(1) Data obtained from operational observations made for specific applications such as weather forecasting, navigation, communication, tracking and telemetry, medical investigations, and technological investigations which contribute only to the development of space flight hardware will not be acquired by the NSSDC.

(2) Any data from space science flight experiments that is excluded from archiving in the NSSDC by a PDMP.

(3) EDRs (including magnetic tapes, telemetry records, exposed film and meteorite collection panels) will not be acquired by the Center.

(C) Availability of data. Data records in the NSSDC will be available to users on the following basis:

(1) To U.S. residents and organizations upon request.

(2) To foreign nationals in accordance with procedures of World Data Center A.

(3) To foreign nationals on the basis of cooperative agreements between NASA and the space agencies of foreign governments or multi-lateral organizations devoted to space research.

(4) To foreign governments on the basis of bilateral inter-government agreements made by the U.S. on behalf of NASA.

(D) Preservation of data. This should be specifically addressed in the PDMP. In general, data in the NSSDC will be preserved for the longest practicable time consistent with the physical life of the record. Records will be reproduced to extend their storage life only if the record of their past utilization justifies such prolongation. Specific categories of data may be reproduced to extend their storage life regardless of past usage in accordance with international or interagency agreements or with the PDMP.

(E) Interface with other sources of data from NASA missions. Certain NASA missions such as those involving national facility payloads or those with Guest Investigator programs may maintain the data within the project for many years. The NSSDC will route requesters of such data to the appropriate facility or make request on their behalf depending on the agreement specified in the PDMP. The distribution of catalogs produced by such a mission shall also be determined by the PDMP.

(F) NSSDC publications. The NSSDC will issue or provide publications as necessary to facilitate the use of available data. Publications will include:

(1) Data users guides. Provides the data user the experiment information and describes the reduced data available. These will usually be written by the Investigators and supplied to the NSSDC as specified in the PDMP:

(2) Catalogs of data. Lists of all data from space science flight experiments available from the NSSDC, issued as needed. The forms in which the data are available will also be indicated; i.e., microfilm, tapes, printouts, etc. Catalogs of data available from projects that maintain their own data base, such as Guest Investigator or facility missions, will also be distributed if the PDMP so specifies.

(3) Data Announcements. Announces those data sets which are known to have wide appeal when such sets become available.

(G) Other services. The NSSDC will provide technical assistance to data users. In some cases, this may involve the conversion of data records into compatible formats to facilitate correlation of data from various sources. When facilities are available the NSSDC will provide lecture rooms, study rooms, and office space for use by visiting scientists for research involving the use of available data.

(H) User charges.

(1) User charges will, as a matter of policy, be in accordance with the policies set forth in the Bureau of the Budget Circular A-25 and NASA Financial

Management Manual 9000. The methods to be used in computing the user charges will be reviewed by the Director, Financial Management Division, NASA Headquarters.

(2) Appropriate fees will be charged for reproduction, computer and dissemination services provided to individual users by the Data Center. The NSSDC may perform conversion of data records and general technical assistance without charge to individual users. Fees for reproduction and dissemination services may be waived by the NSSDC Director if:

(i) The cost of collecting the fee would be an unduly large proportion of the amount of the fee.

(ii) The data furnished are required to accomplish a research task approved by NASA Headquarters or field installations.

(iii) The data are to be used by a Federal, State, or local government agency or by nonprofit organization.