PLANETARY DATA SYSTEM

POLICY BOOK

March 1997

PDS POLICY BOOK

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STATE OF THE DATA UNION

NASA Office of Space Science and Applications

1992

National Aeronautics and Space Administration
Office of Space Science and Applications
Information Systems Branch

Prepared with the assistance of
Futron Corporation
Under Contract NASW-4493

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PREFACE

This is the first report on the State of the Data Union (SDU) for the NASA Office of Space Science and Applications (OSSA). OSSA responsibilities include the collection, analysis and permanent archival of data critical to space science research. The nature of how this is done by OSSA is evolving to keep pace with changes in space research. Current and planned missions have evolved to be more complex and multidisciplinary, and are generating much more data and lasting longer than earlier missions. New technologies enable global access to data, transfer of huge volumes of data, and increasingly complex analysis. The SDU provides a snapshot of this dynamic environment, identifying trends in capabilities and requirements.

The SDU is envisioned as an annual report. This first report will describe the current space science data environment, and present parameters which capture the pulse of key functions within that environment. It reports on the continuous efforts of OSSA to improve the availability and quality of data provided to the scientific community, highlighting efforts such as the Data Management Initiative. Subsequent reports will focus on evolutionary changes, as well as ongoing status of the parameters included in this report.

The SDU is intended to be an information resource for space research stakeholders in NASA and the science community. In addition, it provides important information to other government agencies and interested parties. It should help ensure the ability of OSSA to better serve the science community, and to meet the increasingly demanding data management needs of future space science and applications missions.

Chief
Information Systems Branch

EXECUTIVE SUMMARY

Space science data is a critical national asset. From understanding the origins of our solar system and the universe to predicting global environmental change, space science data holds the keys to our past and future. Collecting data and transforming it into knowledge and discovery are fundamental activities of the space science community. In addition, enabling activities in data storage, transmission, and scientific computing are critical to the success of space science endeavors. It is the objective of these supporting activities to ensure the availability and accessibility of data to a broad array of users, and to ensure the preservation of data through a proper flow into permanent archives.

Recent years have seen a transition in the nature of space science research. Operationally, these changes include an increase in the number of multi-agency efforts and international collaborations with correlative science, increased use of data beyond the original experiments, greater diversity in the style of research and modes of operation, and a continuity from project operations to post-mission research. Space science missions are becoming much more data intensive than in the past. Spacecraft are increasing in capability and carrying more instruments. These instruments are increasing in complexity with higher and higher data rates. Mission lifetimes are increasing, with some expected to last 15 years or longer. Annual data volume generated by these missions is rising explosively, from 0.5 terabits in 1989 to an expected volume of more than 2,500 terabytes by the late 1990's, as shown below in Figure 1.

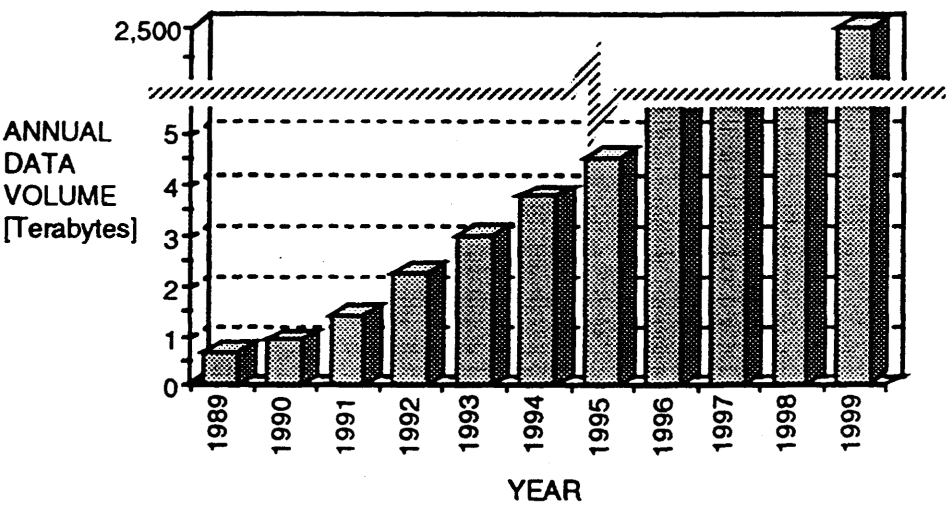


Figure 1 *Projections for annual OSSA mission data volume.*

Users of OSSA science data are growing in sophistication. Their expectations about the quality of data provided and degree of data management and analysis services available are increasing. Technological advances are also changing space science research. Wide area information servers and services enable distributed computing through client/server relationships, and enhance distributed collaboration as networking capabilities and capacities increase. Advanced workstations provide powerful local capability, which can access centralized supercomputing resources as required.

These changes have led to new requirements and demands on the data management system. The data and information systems which support space science research must experience a rise in capability commensurate with ever increasing requirements. Greater integration and coordination of data management efforts is required. This includes better interoperability between data management systems, through standards and guidelines, and integrated policies and architectures. Sharing of infrastructure elements and services will leverage limited resources through economies of scale, to focus limited resources on conducting science. Long range planning for data management must balance needs with available resources to ensure the development of the appropriate technologies in a rapidly evolving environment.

The data management environment of OSSA involves many stakeholders, who in conjunction with the data comprise the OSSA Data Union. Central to the data union are scientists who transform data into scientific knowledge and discovery. Primary users develop experiments and generally have initial rights to data generated by their experiments, whereas secondary users or retrospective investigators perform continuing analysis of science data. Non-science users such as journalists are also considered. OSSA data systems maximize the efficient use of resources through a hybrid mix of distributed and centralized elements. Requirements unique to discipline research are supported by a discipline data system (DDS) for each of the six science divisions. Data system elements are also provided as required for each of a number of projects within each division. Elements which support the needs of all divisions are centralized and provided as OSSA institutional support in the areas of data management and archiving, scientific computing, networking, and applied research & technology. These centralized support areas consolidate requirements and provide economies of scale for common OSSA data management needs. Underlying all of the stakeholders in the data union is the data itself, including science data, mission data and ancillary data necessary for calibration or analysis of science data. Figure 2 illustrates all of these data union elements.

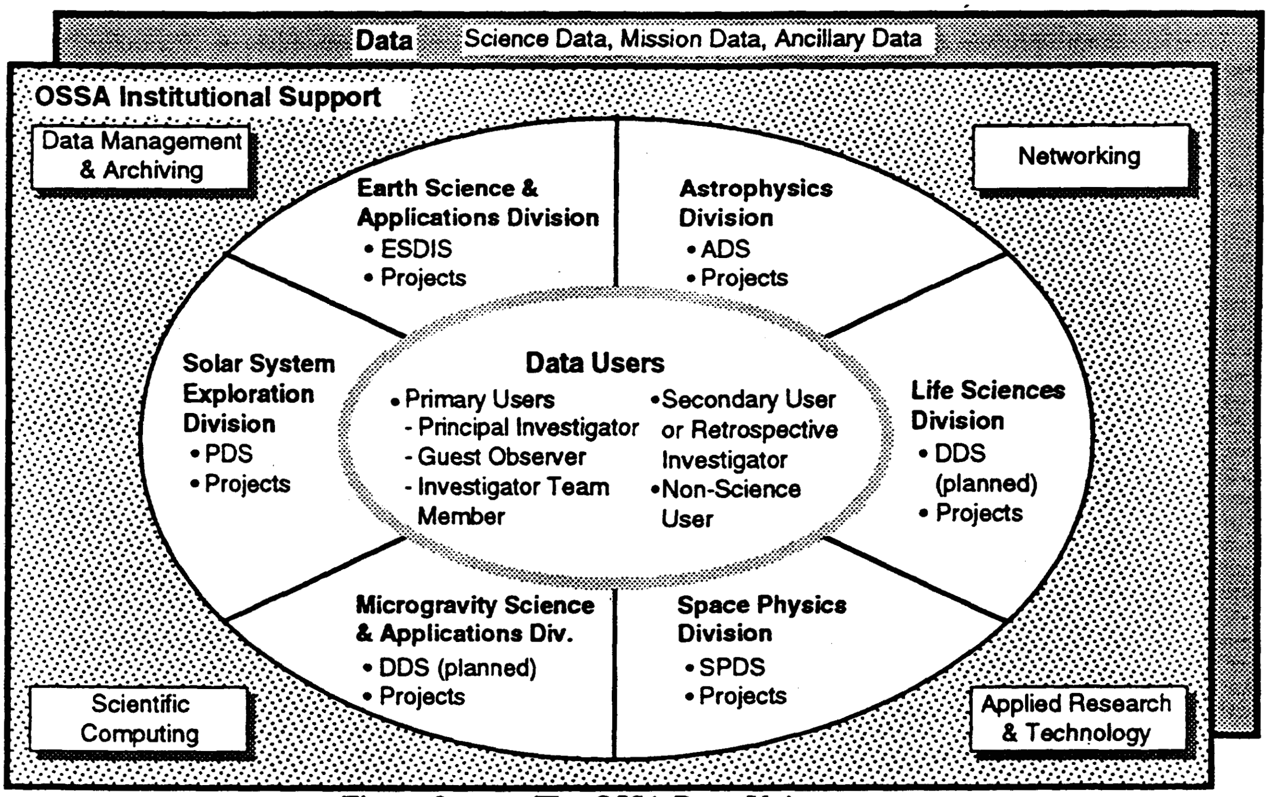


Figure 2 *The OSSA Data Union*

There have been many studies and reports in recent years that have played important roles in addressing these changes, and shaping the data union. From the CODMAC reports in the 1980's to the more recent GAO reports, and ongoing initiatives in Data Management and High Performance Computing, attention is being focused on meeting increasingly demanding user needs and ensuring preservation of critical data within limited budgets. NASA's Information Systems

Strategic Planning Project (ISSP) was a year long effort culminating in a strategy for meeting the evolutionary needs of space science research. Finally, a new OSSA data management policy directive was approved in March of 1992.

The new policy stresses the importance of data management planning, addressing the complete life cycle of data from initial collection and processing through permanent archiving. It stresses the continued trend to decentralize where appropriate through discipline based data management systems. In order to ensure appropriate input and involvement by the research community, the policy recommends establishing review processes throughout the data life cycle. In addition, the new policy emphasizes the need for continuous infrastructure and technology enhancements.

In the drive to decentralize many data management functions, OSSA's approach to data access and storage has evolved towards an environment in which:

(1) Science investigators initially access data from the project data repository.
(2) Data then flows from the project data repository to a discipline data archive for broader access by the scientific community.
(3) Then the data typically goes to the NSSDC for permanent retention and ongoing access.
(4) The NASA Master Directory provides cross cutting information regarding identification and location for all data of OSSA interest.

In this context, the combination of DDS's and NSSDC make up the OSSA archive environment. This distributed architecture enables the DDS's to enhance intra-discipline research, and promote increased researcher participation through improved accessibility to discipline science data. Additionally, initiatives in the areas of data format standards, network interconnectivity, user access services, etc. will enhance inter-disciplinary research and further promote increased researcher participation.

The NASA/OSSA Data Management Initiative (DMI) was initiated in 1991 as an integration and extension of previously related activities. It is a multi-year, multi-million dollar effort that will ensure archiving of appropriate data from past missions, and creation of an infrastructure to enable the orderly archiving of data from future missions. The program will also ensure that data are preserved, inventoried and documented to facilitate broad future access by the science community. In support of these goals, there are three principal activities associated with the DMI, including:

1) Identification and community assessment and prioritization of data sets in need of "restoration"
2) Restoration and/or archiving of appropriate data sets
3) Creation/Improvement of the capabilities and capacities of the Discipline Data Systems (DDS) and of the NSSDC, and of the procedures and tools whereby those entities assure the routine flow of increasing volumes of the right data into the OSSA archive environment (and retrievability of there from that environment).

There are six program Divisions within OSSA, each of which emphasizes and applies a different scientific discipline to successfully accomplish the goals of OSSA. These goals are pursued through an integrated program of ground-based laboratory research and experimentation; suborbital flight of instruments on airplanes, balloons, and sounding rockets; flight of instruments and the conduct of life sciences and microgravity research on the Shuttle/Spacelab system and on Space Station Freedom; and development and flight of automated Earth-orbiting and interplanetary spacecraft. The number of space missions in support of OSSA research has been increasing along with the amount of data being generated. Figure 3 indicates the number of space missions to be operational per year for each discipline division through the year 2000. Only those missions currently operational or under development are included in this projection.

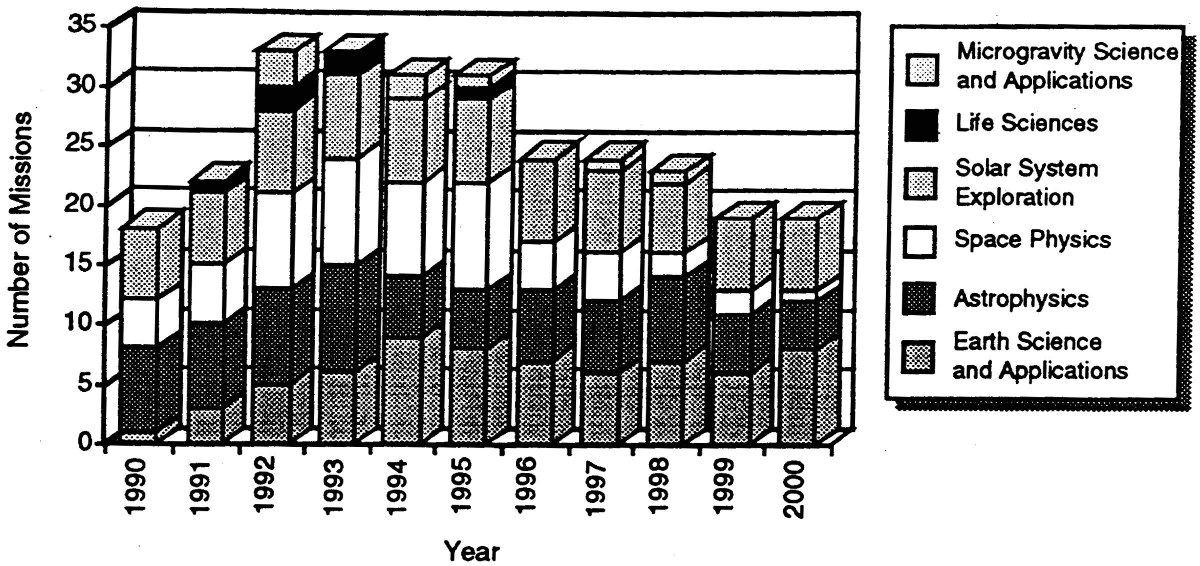


Figure 3 *Projections for annual OSSA operational missions.*

As stated in the roles and responsibilities of the new data policy directive, a long term goal for each of these disciplines is to have an integrated discipline data system (DDS) which will support the data management activities of the division. Some of the divisions have currently operational data systems, while others are beginning to plan their DDS. A summary of divisions and their respective DDS is shown in Table 1 below.

Table 1 *OSSA Discipline Data Systems and status.*

Code	Division	Discipline Data System	Status
SB	Life Sciences Division	TBD	Under Definition
SE	Earth Science & Applications Division	Earth Science Data & Information System (ESDIS)	Operational
SL	Solar System Exploration Division	Planetary Data System (PDS)	Operational
SN	Microgravity Science & Applications Division	TBD	Under Definition
SS	Space Physics Division	Space Physics Data System (SPDS)	Under Development
SZ	Astrophysics Division	Astrophysics Data System (ADS)	Operational

Each discipline is developing a data management strategy guided by the advice and counsel of their respective science communities. These strategies will define their data management environment, and address standard approaches to use of discipline resources as well as institutional resources such as networking, computing and archiving. Data management and archiving issues will be afforded appropriate emphasis and priority from the onset of mission planning. Projects will address these issues and document them in Project Data Management Plans, which will be reviewed by discipline divisions as part of the new start approval process. The status of PDMPs for each of the disciplines is shown below, in Figure 4. The figure distinguishes between projects in Phase C/D and operational projects, although PDMPs are required for all these projects.

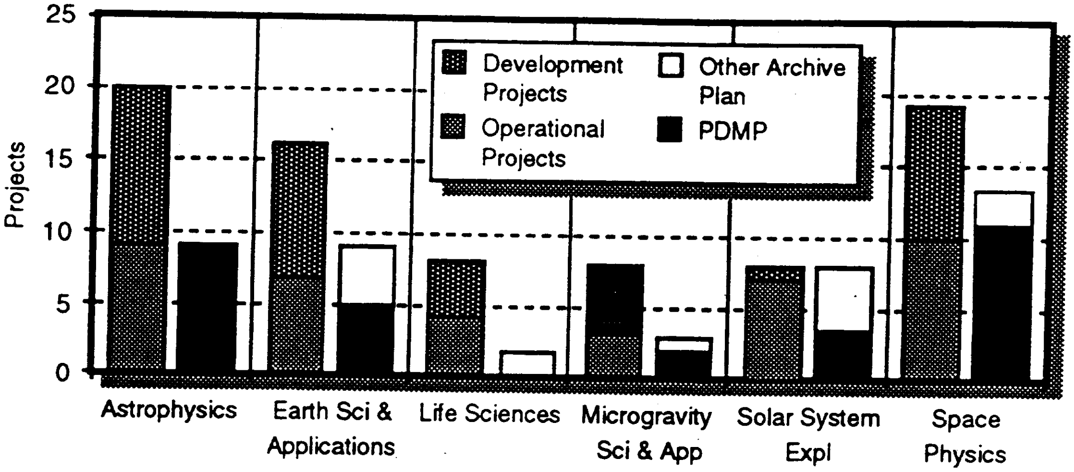


Figure 4 *Current Data Management Planning Status by Discipline*

INTRODUCTION

As OSSA moves into the data-intensive era of the 1990s, timely and responsive data and information systems support increases in importance as a crucial element of overall success in achieving science mission objectives. Data volume alone represents a significant challenge, with the flow of science data into archives expected to increase by several orders of magnitude over the next decade. Furthermore, new trends in the character of space research will drive the evolution of data and information systems. Broad scientific questions to be addressed will be increasingly multidisciplinary in nature, will involve widely dispersed investigator teams, and will require the combination and analysis of data from many different sources. The importance of data products will extend well beyond a particular flight mission, and researchers will increasingly use data sets to address scientific questions and study phenomena not anticipated during initial mission planning.

These changes lead to new requirements on data management systems requiring greater integration and coordination. This includes better interoperability between data management systems through standards and guidelines, and integrated policies and architectures. Sharing of infrastructure elements and services leverages limited resources to focus more on conducting science. Finally, there is the continuing challenge of selecting and applying the appropriate technologies in a rapidly evolving environment. There have been many studies and reports in recent years that have played important roles in addressing these changes, and shaping the data union as shown in Figure 5.

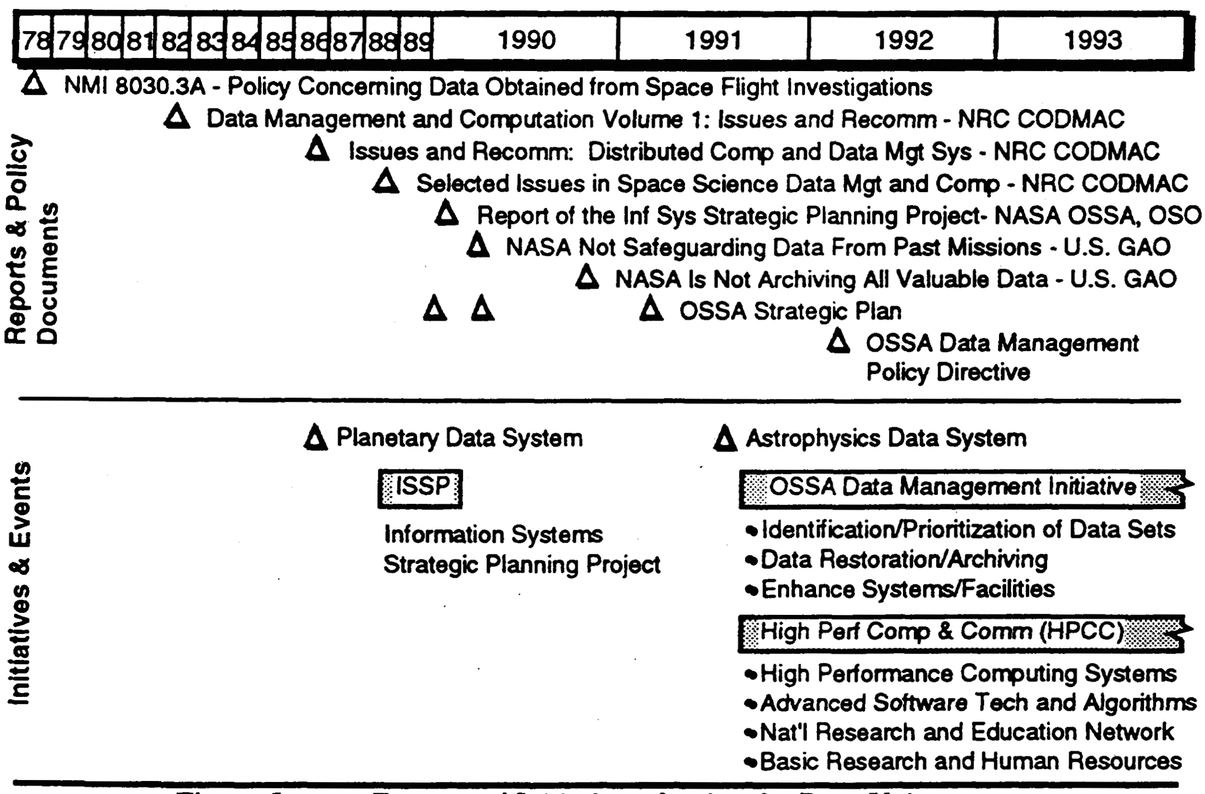


Figure 5 *Events and Initiatives shaping the Data Union*

From the CODMAC reports in the 1980's to the more recent GAO reports, and ongoing initiatives in Data Management and High Performance Computing, attention is being focused on meeting increasingly demanding user needs and ensuring preservation of critical data within limited budgets. NASA's Information Systems Strategic Planning Project (ISSP) was a year long effort culminating in a strategy for meeting the evolutionary needs of space science research. Finally, a new OSSA data management policy directive was approved in March of 1992.

The new policy stresses the importance of data management planning, addressing the complete life cycle of data from initial collection and processing through permanent archiving. It stresses the continued trend to decentralize where appropriate through discipline based data management systems. In order to ensure appropriate input and involvement by the research community, the policy recommends establishing review processes throughout the data life cycle. In addition, the new policy emphasizes the need for continuous infrastructure and technology enhancements.

Space science investigations are complex in nature, involving the interaction of many elements of the data union. Though each mission is unique, there are fundamental elements, functions, and services that are common across space science missions. In general, space science investigations can be divided into three segments of operation: mission operations, science operations, and continuing research. During each segment of the project, fundamental functions and services are performed as part of the integrated investigation. Those functions and services performed during the mission and science operations phases are generally project specific, whereas those performed during continuing research are not. A diagram depicting the OSSA architecture for Mission Operations & Data Analysis (MO&DA) is shown in Figure 6.

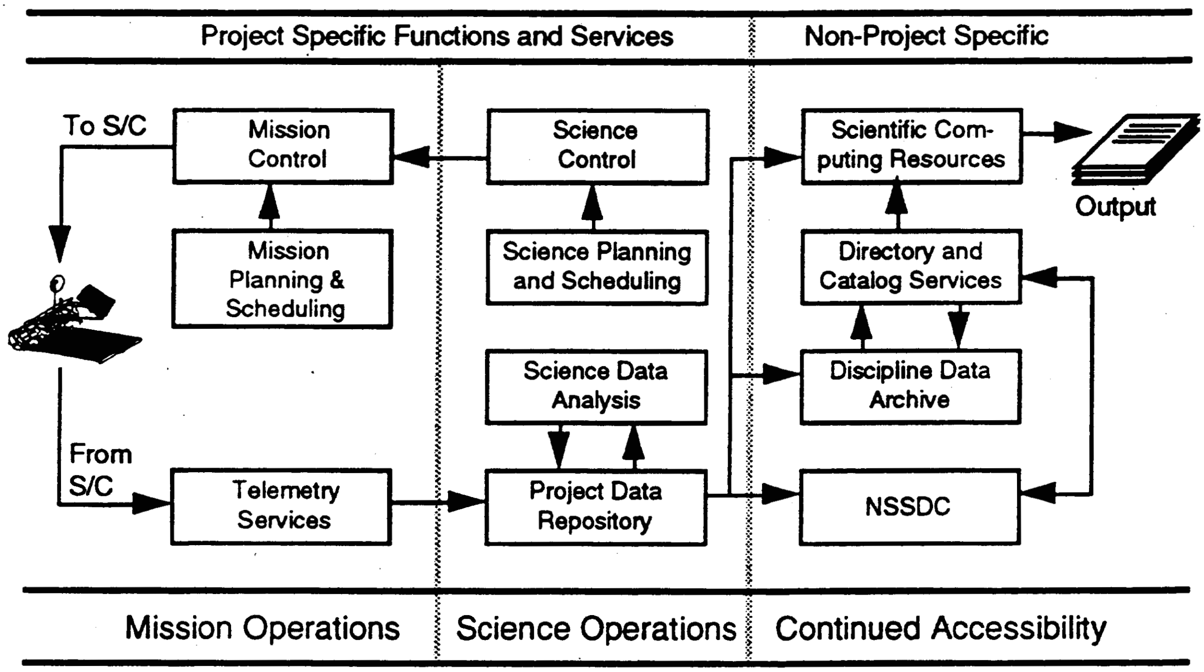


Figure 6 *OSSA MO&DA generalized information flow.*

Mission operations involve the safe and efficient operation of the spacecraft and associated payloads during the active flight portion of the investigation. The principal functions and services associated with mission operations include telemetry services, mission planning and scheduling, and mission control.

Science operations involve the functions and services required to ensure the production of valuable science data or samples during the active flight portion of the investigation. Principal functions and services provided as science operations include science planning and scheduling, science control, project data archive, and science data analysis.

The third segment of the integrated architecture is continuing accessibility. This is the continued derivation and dissemination of useful science knowledge and insight resulting from the data collected during mission and science operations. This segment of operations can go on indefinitely beyond the mission life, performing retrospective analysis and correlative studies. Permanent archive of the original data is critical for this subsequent analysis that may improve results by the use of improved calibration algorithms, or support new investigations that were not envisioned or planned for when the data was collected. The functions and services provided during continuing research include directory and catalog services, scientific computing resources, discipline data archives, and other archives and databases. OSSA's approach to data management has evolved towards a system in which:

(1) Science investigators initially access data from the project data repository.
(2) Data then flows from the project data repository to a discipline data archive for broader access by the scientific community.
(3) Then the data typically goes to the NSSDC for permanent retention and ongoing access.
(4) The NASA Master Directory provides cross-discipline information regarding identification and location for all data of OSSA interest.

In this context, the combination of DDS's and NSSDC make up the OSSA archive strategy. This development within NASA now provides a framework for improved community participation in mission data and information access. This trend facilitates a distributed data management architecture within OSSA where the DDS's enhance intra-discipline research, and promote increased researcher participation through improved accessibility to discipline science data. Additionally, continuing activities in the areas of data format standards, network interconnectivity, user access services, etc. will enhance inter-disciplinary research and further promote increased researcher participation.

As data progresses throughout its life cycle, the involvement of various elements of the data union varies. This progression may be characterized by many phases including development, operations, various stages of research, storage and archive. A representative illustration of the progressing phases of data activity, overlaid against the functions performed on the data and the users of the data, is shown in Figure 7.

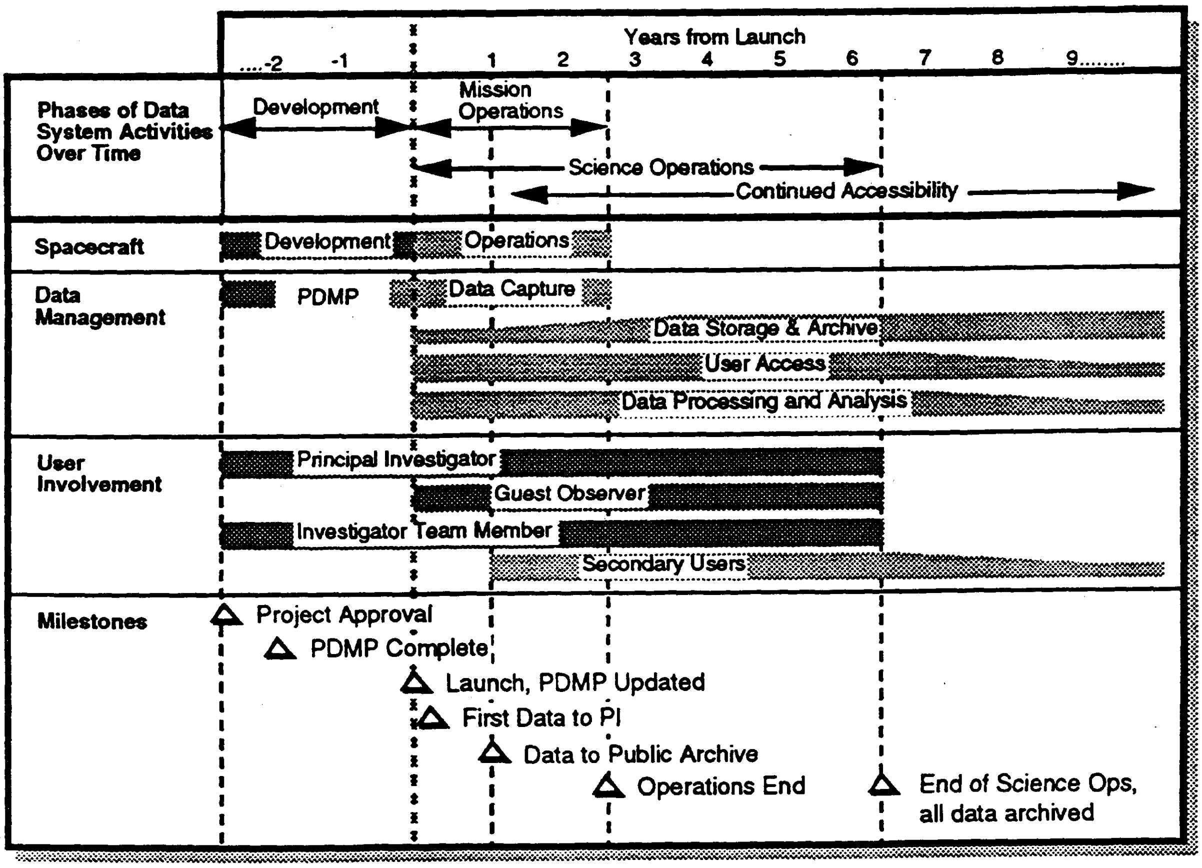


Figure 7 *Data Management over time*

USERS

The purpose of developing science missions and collecting data from observations is so that scientists can use the data to gain insight and make new scientific discoveries. There are a number of users of OSSA scientific data, each with different requirements and needs. Principal categories of usage are:

- Primary User - Science investigators who plan and design the experiments, and have an immediate need for access to the data being generated. They have initial access to the data.
  - Principal Investigator - Often works with co-investigators, responsible for planning, development, and integration of experiments and instruments, data analysis, and the selection and preparation of the analyzed data for archiving. Principal Investigator is usually tied to a particular instrument.
  - Guest Observer - Has access to observation time, to generate specific space science data to conduct independent investigations, although seldom participates in initial mission planning or instrument design.
  - Investigator Team Member -- Member of an investigator team who shares data acquired by the instruments of the team.
- Secondary User or Retrospective Investigator - Members of the general science community, could include discipline peers, or interdisciplinary scientists. Usually conduct their analysis using data that has been archived, as well as data provided or published by the PI. Secondary users also work in collaboration with primary users.
- Non-Science User - Includes general public, Public Affairs/Outreach or curious individuals seeking data for information purposes rather than further scientific investigation.

OSSA DISCIPLINE DIVISIONS

OSSA has the responsibility for using the unique environment of space to conduct scientific study of the universe, to understand how the Earth works as an integrated system, to solve practical problems on Earth, and to provide the scientific foundations for expanding human presence beyond earth. Missions to perform these activities are conducted by the six science discipline Divisions within OSSA. As stated in the roles and responsibilities of the new data policy directive, a long term goal for each of these disciplines is to have an integrated DDS which will support the data management activities of the division. Some of the divisions have operational data systems, while others are beginning to plan their DDS. Each discipline is developing a data management strategy that will define their data management environment, and address standard approaches to use of discipline resources as well as institutional resources such as networking, computing and archiving.

Each of the OSSA discipline divisions will be discussed in the following sections. The composition and status of each DDS will be described, in addition to ongoing missions and those under development.

ASTROPHYSICS DIVISION

The Astrophysics Division uses space missions in Earth orbit and, perhaps someday on the moon, to observe the universe and develop physical models of the phenomena observed. The program has been implemented in close coordination with the astronomical community, especially through the cognizant committees of the National Academy of Sciences. Themes of the Astrophysics program are three-fold: Cosmology, the study of the origins, structure and eventual fate of the universe; Astronomy, research into the origin and evolution of galaxies, stars, planets and life; and Physics, studies to understand the physics of matter under the extreme conditions found in astrophysical objects.

To address these themes, a strategy of observations across the electromagnetic spectrum has been developed including four Great Observatories. The Hubble Space Telescope (HST) and the Compton Gamma Ray Observatory (GRO) are currently operational. The Advanced X-ray Astrophysics Facility (AXAF) and the Space Infrared Telescope Facility (SIRTF) are planned for implementation during the 1990s. Additional astrophysics data is generated by other division-funded free flyer and shuttle-attached instruments, from astrophysics instruments flown on past missions and funded by the division or predecessors, and from ground based research.

In March of 1988, NASA released the report of the Astrophysics Data System Study addressing the data management needs of the astrophysics science community. This report recommended that the data sets and those most knowledgeable about them remain in the same physical location. It suggested that a change needed to come in the form of a link between these multiple locations and their data sets. The study recommended that in the future these locations be linked via high speed communications networks, and that the various data sets should be accessible through a common set of tools. The results of the study were used to develop the Astrophysics Data System.

The Astrophysics mission operations and data analysis (MO&DA) programs are in a period of transition resulting from changes in operations including incorporation of extensive guest observer (GO) programs and extended mission time scales. These changes have prompted a review and revision of division policies for MO&DA which are being compiled in a Flight Program MO&DA Policies and Guidelines document. This document will help investigators improve their activities in the preparation, implementation and management of Astrophysics missions and the collection, reduction, analysis, dissemination, and archiving of mission science data.

Astrophysics Data System

The Astrophysics Data System (ADS) was conceived to provide the scientific community with an efficient and effective means to access NASA's Astrophysics data holdings. User requirements and design concepts for the ADS were developed during a series of workshops in 1987 which resulted in the March 1988 report of the Astrophysics Data System Study. Beginning development in 1989, the ADS became operational in the second quarter of 1991, consisting of the following elements:

a) Operational sites providing authentication, routing, and other project services
b) A set of host nodes (suppliers of data and/or services) along with the databases, data archives, catalogs, and other services these sites provide
c) A distributed set of users.

The project adopted a distributed database system that could be accessed via NSI from the user's home institution. The ADS currently includes eight physically distributed nodes that are interconnected via NSI as depicted in Figure 8. Additional nodes are planned at the Center for EUV Astrophysics in Berkeley, CA providing information in extreme ultraviolet astronomy, and at the GRO Science Center in Greenbelt, MD providing information in gamma ray astronomy. Most currently important data sets are held at sites responsible for their source missions and/or instruments. Many data sets from early missions are held at NSSDC, as well as duplicate data sets from selected current missions.

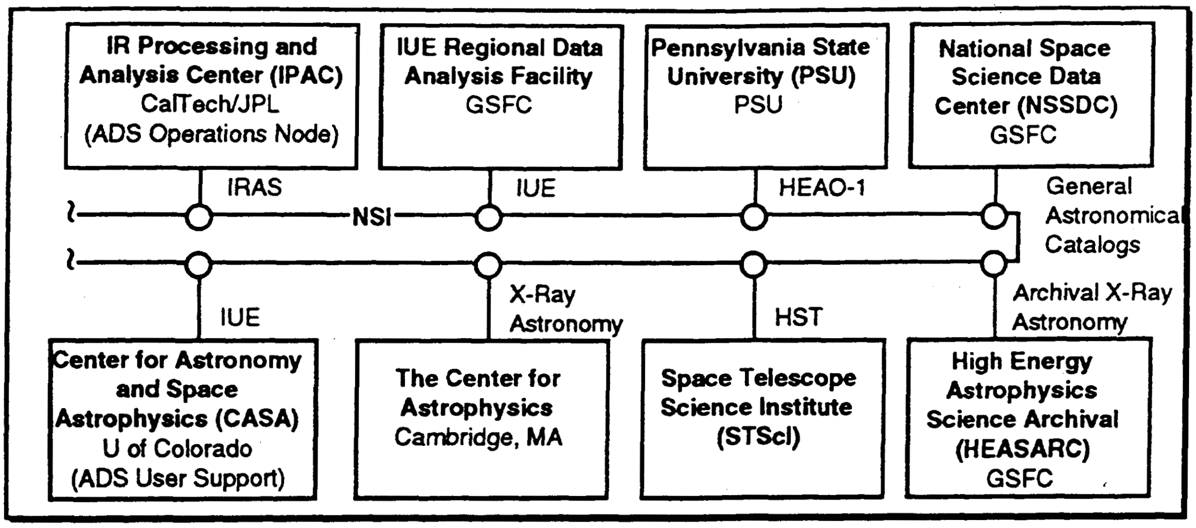


Figure 8 *The ADS is a distributed system.*

The distributed database system allows the scientists to simply access data and software tools at any of the NASA Astrophysics Science Operations and Data Centers, employing a client-server mode of operation. Key features of the ADS include the following:

- Free use to qualified researchers
- Interaction with all NASA Astrophysics data and operations centers
- Single, integrated, uniform user interface
- Multispectral, multidisciplinary data system
- Multiple platform support (e.g., UNIX, PC)
- Internet connectivity
- Access to textual information, astronomical databases, data archives, observation logs and plans.

As a precursor to equivalent facilities for other wavelength bands, the High Energy Astrophysics Science Archival Research Center (HEASARC) was established at GSFC to manage data from x-ray and gamma ray missions. The HEASARC is building a cadre of scientists to help create an archive of the right data, documentation, ancillary data, software, etc., and to be able to support researchers' findings, access, and use of the archived data. The HEASARC uses NSSDC data management expertise and hardware and software systems to the maximum extent feasible so that it can focus on scientific data and scientific user issues.

The Space Telescope Science Institute Facility (STScI) is located at Johns Hopkins University in Baltimore, Maryland. Responsibilities include obtaining, reviewing, and prioritizing observation proposals. In addition, it provides long-range science planning, participates in real time science operations, and performs science data calibration, data analysis, science instrument trend analysis, science data archiving, and data distribution for the selected observers.

The Infrared Processing and Analysis Center (IPAC) facility is jointly operated by the California Institute of Technology (CalTech) and the Jet Propulsion Laboratory (JPL). This facility is the ADS operations node. It is responsible for supporting the astrophysics researcher through archiving, reducing and analyzing the IRAS data sets and integrating their data processing tools. Additional responsibilities include: project management, system operations, system integration oversight, overall systems engineering, participate in software integration, and direct user support.

The Pennsylvania State University (PSU), Dept. of Astronomy and Astrophysics has taken responsibility for providing access to and for maintaining the HEAO-1 data sets. PSU is responsible for the organization and coordination of the ADS User's Group.

The Center for Astronomy and Space Astrophysics (CASA) is located in Boulder, Colorado. CASA is responsible for the following: Integrated System Test and Quality Assurance, User Documentation Integration and Validation, and Training Material Generation and Integration.

The next step in ADS development will be to provide access to data archives as well as databases. The ADS will allow users to transfer data to their own data processing facilities in standards formats such as the flexible image transport system (FITS). Additionally, the ADS plans to offer users information searching and retrieval services. Such services may include a searchable archive of abstracts from astronomy and astrophysical literature, on-line access to documentation on NASA missions, mission operations centers, and data products, and complete descriptions of data processing algorithms used to create data products.

Astrophysics Projects

Table 2 summarizes the Operational and Planned (Phase C/D) projects of the Astrophysics Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 2 *Astrophysics projects and status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
ASTRO-1	12/2/90	10 days	Signed PDMP	NSSDC	ASTRO Series
COBE	11/18/89	2 yr / 4 yr	Signed PDMP	NSSDC	
EUVE	6/4/92	2 yr / 4 yr	Signed PDMP	SDSF (ADS), NSSDC	300 GB planned
GRO	4/5/91	12 yr	Signed PDMP	NSSDC	300 GB planned
HEAO-2	11/13/78		No PDMP	SAO, NSSDC	
HST	4/24/90	15 yr	Signed PDMP	STScI, NSSDC	
IRAS	1/25/83		Signed PDMP	NSSDC	
IUE	1/26/78	15 yr	No PDMP	NSSDC	
ROSAT	6/1/90	2.5 yr	Signed PDMP	ROSAT Data Archive Facility, NSSDC	375 GB planned
Development *Phase C/D*					
ASTRO-2	9/94	10 days	Signed PDMP	NSSDC	Astro Series 40 GB planned
ASTRO-D	2/6/93	2 yr	Draft PDMP	NSSDC	300 GB planned
AXAF	3/99	15 yr	No PDMP		Prelim SIRD
DXS	1/13/93	6 days	No PDMP		Hitchhiker Program
IEH/SHUTTLE			No PDMP		
Radioastron	1996	3 yr	No PDMP		
Spartan 204/SHUTTLE			No PDMP		
SPECTRUM-X	1995	5 yr	No PDMP		
SWAS	6/95	3 yr	No PDMP	SAO	Element of SMEX, Operations Concept Document (OCD) Available
XMM	1998		No PDMP		
XTE	4/96	2 yr	No PDMP		Explorer Program, SIRD available

SOLAR SYSTEM EXPLORATION DIVISION

The fundamental goals and approaches of the Solar System Exploration Division focus on scientific research in the following areas:

Origin and Evolution: To determine the present nature of the solar system, its planets, moons, and primitive bodies, and to search for other planetary systems in various stages of formation, in order to understand how the solar system and its objects formed, evolved, and (in at least one case) produced environments that could sustain life.

Comparative Planetology: To better understand the planet Earth by determining the general processes that govern all planetary development and by understanding why the "terrestrial" planets of the solar system are so different from each other.

Pathfinders to Space: To establish the scientific and technical data base required for undertaking major human endeavors in space, including the survey of near-Earth resources and the characterization of planetary surfaces.

These goals are consistent with recommendations by the Committee on Planetary and Lunar Exploration of the National Academy of Sciences and the Solar System Exploration Committee of the NASA Advisory Council. Solar system exploration is conducted in three distinct stages:

(1) Reconnaissance, involving flyby missions

(2) Exploration, generally conducted with orbiting spacecraft and atmospheric probes

(3) Intensive study, involving soft landers, sample returns, and human exploration.

Over the past three decades, the reconnaissance phase (initial robotic mission flybys) of solar system exploration was completed, with the exception of the Pluto-Charon system. A more capable robotic exploration phase has been underway for several years for the Moon and Mars with the Surveyor and Viking missions, respectively. Finally, an intensive study phase of the moon was initiated during the Apollo era. In the coming decades, efforts will include missions to both the outer and inner planets, as well as to the small bodies (e.g., asteroids) of the solar system. Also, in preparation for missions with humans, both the Moon and Mars will be studied extensively by robotic spacecraft, either on the surfaces or from low orbits.

In response to the needs for broad access to planetary data by the research community, the Solar System Exploration Division has established the Planetary Data System (PDS).

Planetary Data System

The goal of the PDS is to provide the best planetary data to the most users forever. It provides cost-effective archiving and access to high quality planetary science data sets, expert scientific help to the community in using the data, and a mechanism to develop the technologies needed to support such a scientific information system. In addition, the PDS has developed a generalized science catalog, nomenclature and data standards, data distribution technology, and distributed software tools to assist in the archive process.

The Planetary Data System (PDS) is based upon a widely distributed, electronically connected architecture that includes seven discipline nodes and a central node. The Central Node located at the Jet Propulsion Laboratory (JPL) in Pasadena, California provides overall project management, coordinates and distributes data standards, evaluates emerging technologies and provides an interface to planetary missions. The discipline nodes are located at institutions around the country, each having an expertise in a particular area of planetary science. A schematic of the PDS is shown in Figure 9.

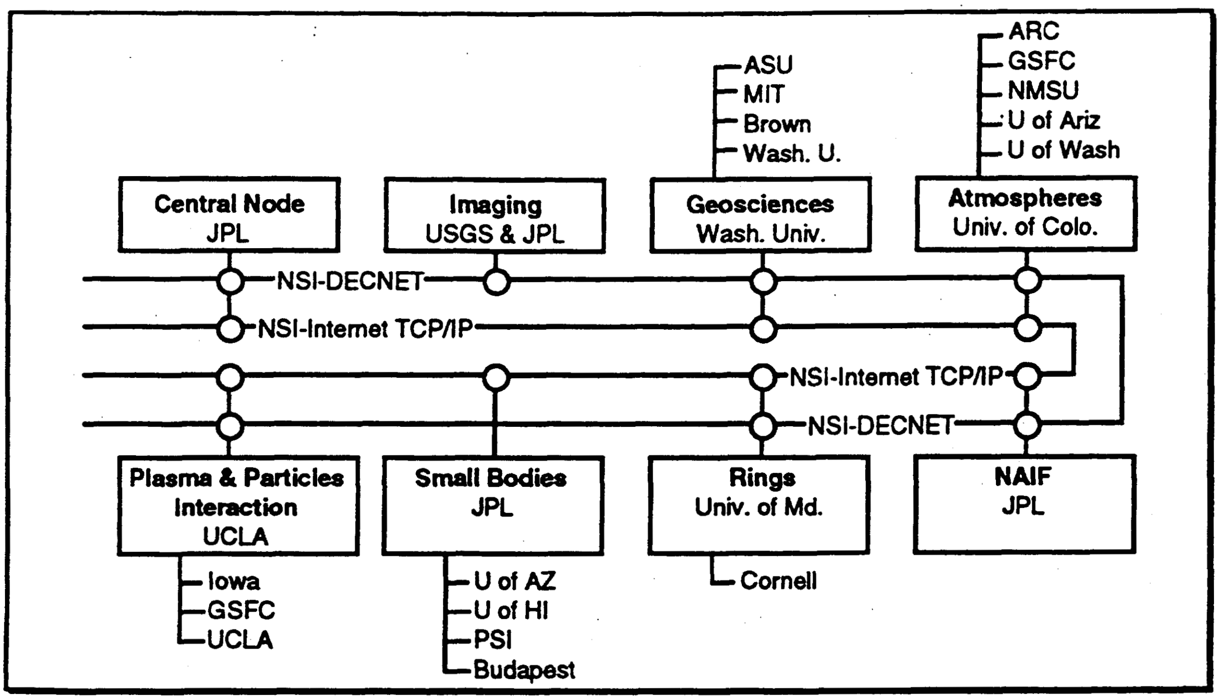


Figure 9 *PDS Architecture.*

The NSSDC supports the PDS by providing a safe and separate deep archive for the long term backup of planetary data on magnetic tapes. PDS nodes distribute products at no charge to users electronically, on tape and on CD-ROM. Priority is given to users funded by the Solar System Exploration Division. The NSSDC currently provides distribution to other requesters at a nominal charge.

PDS works with flight projects during all phases of a project to help it plan, design and implement a quality archive. During the planning phase several archive planning documents are prepared by the mission and reviewed by the PDS. These documents include the PDMP, the Archive Policy and Data Transfer Plan, and the Science Data Management Plan. PDS helps projects design their archive products and coordinate the validation or peer review of data products prior to their submittal to archive. Currently the majority of PDS archive products are published and distributed on CD-ROM.

PDS maintains catalogs at both the Central Node and Discipline Nodes that describe the data sets and data products available for distribution. PDS also provides information about the archive data products to the NSSDC which is used to populate the Master Directory.

The Navigation Ancillary Information Facility (NAIF) at JPL provides the planetary science community with datasets and transportable software tools appropriate for computing, archiving, accessing and distributing the ancillary observation geometry data needed for full interpretation of science instrument observations of solar system bodies. The ancillary data and allied software are distributed to flight project science teams while a mission is in its active stage, and are subsequently archived within the PDS. NAIF also provides ephemeris products and allied software to support other OSSA discipline division activities such as HST, Galileo, etc.

The Geosciences node at Washington University is responsible for working with planetary missions to help ensure that the data of relevance to the geosciences disciplines are properly documented and archived in the PDS. The node also restores and publishes selected data sets from past missions on CD-ROMs for delivery to the planetary science community. Additional services include information and expert assistance on its data holdings. Archivals include derived image data, geophysics data, microwave data, spaceborne thermal data and spectroscopy data.

The Plasma and Particles Interaction node at UCLA is responsible for the acquisition, preservation and distribution of fields and particle data from all planetary missions (excluding Earth observations). Services provided to the research community include a menu-based interactive on-line interface for selection, viewing, and ordering of data sets, limited ability to build customized data sets, and indirect access to science consultants.

The Small Bodies node at JPL, along with its subnodes have expertise on comets, asteroids, and interplanetary dust. There are a number of on-line tools available including access to NAIF software, and epheride calculation of comets or asteroids.

The Planetary Rings node is responsible for restoring, archiving, and publishing data sets describing planetary ring systems. This includes all of the relevant data sets acquired from previous and future spacecraft, as well as from Earth-based observatories. In order to support research with these data sets, the node also provides expert assistance, catalog information to help scientists pinpoint the most relevant data, and a suite of software tools to simplify data manipulation.

The Planetary Atmospheres node is a consortium of research groups led by the University of Colorado, with five subnodes. Researchers associated with the node curate data sets within their sub-disciplines and provide a wealth of research expertise to space scientists and other users of the PDS.

Solar System Exploration Projects

Table 3 summarizes the Operational and Planned (Phase C/D) projects of the Solar Systems Exploration Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 3 *Solar System Exploration projects and PDMP status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
GALILEO	10/18/89	8 yr	Signed PDMP	PDS	
MAGELLAN	5/4/89	4 yr / 10 yr	Signed PDMP	PDS	3,070 GB planned
MARS OBSERVER	9/25/92	4 yr	Other plan in place	PDS	Science Data Mgmt. Plan; Archive Policy & Data xfer Plan in place
PIONEER 10, 11	3/3/72 4/6/73	20 yr +	Other plan in place	Original data in NSSDC, new versions in PDS	
VOYAGER 1,2	9/5/77 8/20/77	30 yr	Other plan in place	Original data in NSSDC, new versions in PDS	Archive Policy & Data Transfer Plan in Place (updated Nov. 1990)
Development *Phase C/D*					
CASSINI	10/97	13 yr	PDMP in progress	PDS	Draft Archive Policy & Data Transfer Plan

SPACE PHYSICS DIVISION

The Space Physics Division (SPD) investigates the origin, evolution, and interactions of space plasmas in the heliosphere and the cosmos. The objectives of the division, endorsed by the Committee on Solar and Space Physics of the National Academy of Sciences, are to understand the following: solar and heliosphere physics (understanding the Sun, both as a star and as the dominant source of energy, plasma, and energetic particles in the solar system); the physics of the magnetospheres and ionospheres of planets, especially earth; the upper atmosphere and solar-terrestrial coupling (understanding the interactions between the solar wind and other particles and the electromagnetic fields and atmospheres of solar system bodies). Comparative planetary studies of interactions of the solar wind with other bodies allows solar terrestrial interactions to be placed in a broader context.

The Space Physics Division is responsible for assuring the coordinated, effective, and appropriate management of data for space physics missions. Associated with these responsibilities, the Space Physics Division has identified four major information systems challenges for the near future:

1. Identifying space physics data sets from past missions; then, prioritizing and implementing the restoration and archiving of relevant data sets.
2. Developing the archives of data and information from currently operating flight projects and making them accessible to scientists.
3. Managing the highly diversified and sophisticated data and information streams from new flight projects.
4. Capturing supporting and correlative data and information and incorporating mathematical and numerical models and tools essential to the full realization of science return on all flight projects.

The Space Physics Division is proposing a Space Physics Data System (SPDS) as a logical framework within which to address these challenges and discharge its data management responsibilities.

Space Physics Data System

Data from space physics missions will be provided to the science community through the Space Physics Data System (SPDS). An SPDS Steering Committee (SPDS/SC) was established in 1990 to begin definition of the SPDS. Several meetings were held in 1990 and 1991, including input from representatives of data systems already in existence. It was concluded by the SPDS/SC that the SPDS should be a widely distributed system in which most of the resources would be in the hands of the scientists who were actively analyzing, maintaining and distributing the data. The fundamental objectives of the SPDS are as follows:

- Curate those data deemed important to the SPD mission by the space physics community
- Provide information about those data to the potential users
- Provide access to the data and ancillary information
- Enable the efficient and cost-effective analysis of data, particularly in a synergistic or correlative manner
- Act as a focus for information, evaluation and guidelines in the appropriate use of new data management technologies in the space physics community.

Initially SPDS will use existing, project-specific data systems linked to each other and the user community by the NASA telecommunications infrastructure. Participation in the initial SPDS confederation will be driven from the grass roots and will be stimulated by the ability to perform correlative analysis. The SPDS will, in time, develop an architecture with nodes defined by science discipline and should become a common framework and common resource for other data systems subsequently developed by individual institutions, laboratories, universities and missions. As the scientific productivity of SPDS is demonstrated to a broader community with cost-effective access to more datasets, it can be expected that the future institution-level data systems will develop to be more readily compatible with SPDS. SPDS will also have a key role in working with future

SPD flight projects to best assure their adequate and coordinated long-term data management planning.

The SPDS is currently being further defined by the space physics division, with support from the NSSDC. There are a number of factors being addressed in defining the full SPDS, including the following:

- The system in all phases of design, implementation, operation and management must be kept closely coupled to the science community
- The system design and implementation strategy must be able to meet the constraints of
  - The need to evolve and adapt
  - Limited funding throughout the system lifetime
  - Rapid changes in feasible and/or cost-effective technologies
- The overall system design and the implementation strategies must be orderly, well-considered, appropriately complete and both technically and operationally robust.

SPDS community workshops are planned for next year, with the goal of developing an SPDS project plan and initiating systems engineering and design for the data system. Development of SPDS design and implementation strategies will continue through FY94. A preliminary concept for the SPDS configuration is shown in Figure 10, indicating preliminary nodes. An NRA is planned for permanent SPDS nodes, with awards in late FY94 and initial funding in mid FY95.

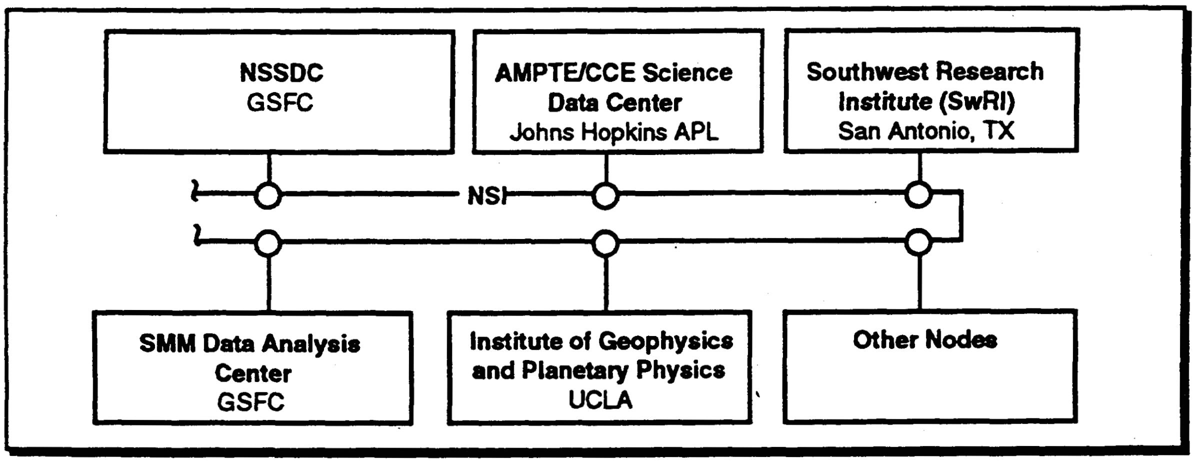


Figure 10 *A preliminary concept for the SPDS is a distributed architecture of multiple nodes.*

The SPDS is envisioned to be a network of data centers united under a common theme. Existing institutional capabilities are to be leveraged in getting SPDS started. Some of these capabilities include the NASA Master Directory, NDADS, NASA/OSSA Office of Standards and Technology (NOST), and the NSSDC.

Space Physics Projects

Table 4 summarizes the Operational and Planned (Phase C/D) projects of the Space Physics Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 4 *Space Physics projects and PDMP status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
Atmospheric Balloons	Various	10-90 days each	Other plan in place	Wallops, NSBF	SIRD
CRRES	7/25/90	1 yr / 4 yr	Signed PDMP	NSSDC	Element of ISTP, Joint with DoD in conjunction with sounding rockets
Geotail	7/14/92	2 yr / 3 yr	Signed PDMP	ISTP CDHF, NSSDC	Element of ISTP/COSTR 138.7 GB EDR planned 0.5 GB KPD planned
ICE/ISEE 3	8/12/78	10 yr / 25 yr	Other plan in place	NSSDC	
IMP-8	10/25/73	19 yr	Draft PDMP, Other plan in place	NSSDC	
SAMPEX	6/19/92	3 yr	Draft PDMP	UMSOC, NSSDC	Element of SMEX 112 GB planned
Suborbital	Various		No PDMP	Wallops Flight Facility	
TSS	7/16/92	36 hr	No PDMP		
Ulysses	10/6/90	5 yr	Draft PDMP	NSSDC	
Yohkoh	8/30/91	3 yr	Signed PDMP	NSSDC	Formerly named Solar-A, 150 GB planned
Development *Phase C/D*					
ACE	6/97	1 yr / 3 yr			
CLUSTER	12/95	2 yr	Signed PDMP	NSSDC	Element of ISTP/COSTR
EHIC (TIROS-J)		3 yr	No PDMP		Secondary payload on Tiros-J
FAST	9/94	1 yr	Draft PDMP		Element of SMEX
POLAR	5/94	1.5 yr / 3 yr	Signed PDMP	NSSDC	Element of ISTP/GGS 366.8 GB EDR planned 11.1 GB KPD planned
SOHO	7/95	2 yr 5 mo	Signed PDMP	NSSDC	Element of ISTP/COSTR
SPARTAN-2 (ASP)	3/23/93	9 days	No PDMP		
WIND	8/93	2 yr / 3 yr	Signed PDMP	NSSDC	Element of ISTP/GGS 94.9 GB EDR planned 0.4 GB KPD planned
WISP			No PDMP		

EARTH SCIENCE AND APPLICATIONS DIVISION

The overarching goal of the Earth Science and Applications Division, as formulated by the Earth System Sciences Committee of the NASA Advisory Council, is to:

Obtain a scientific understanding of the entire Earth system on a global scale by describing how its component parts and their interactions have evolved, how they function, and how they may be expected to continue to evolve on all timescales.

The challenge associated with these goals is to:

Develop the capability to predict those changes that will occur in the next decade to century, both naturally and in response to human activity.

The study of terrestrial phenomena should not be limited to particular components solely in the atmosphere, in the oceans, on land, or within the biosphere. Instead, such study must be directed at understanding the responsible physical, chemical, and biological processes that operate to unify the Earth environment as a system. These processes must then be cast in the form of algorithms for assimilation into global models. Finally, these models must be tested against comprehensive, long-term global-scale data sets in order to validate their accuracy as descriptive and predictive tools.

The Earth Observing System (EOS) will carry out multidisciplinary Earth science studies employing a variety of remote sensing techniques. Its primary goal is the generation of long term Earth science data sets of measurements and processes in the areas of:

- Agriculture
- Forestry
- Geology
- Hydrology
- Oceanography
- Snow and Ice
- Troposphere and Upper Atmosphere
  - Chemistry
  - Radiation
  - Dynamics

The intent of the EOS program is to obtain data sets that pertain to global studies of the Earth as a system, emphasizing the interactions and couplings of the atmosphere-ocean-land-cryosphere system.

Earth Science Data and Information System

The goal of the Earth Science Data and Information System (ESDIS) is to achieve greater interoperability and resource sharing among NASA Earth science data systems, the Earth science data centers of other agencies, and Earth scientists themselves.

Present activities include the NASA Ocean Data System (NODS), the NASA Climate Data System (NCDS), the Pilot Land Data System (PLDS), the Crustal Dynamics Data and Information System, and the Synthetic Aperture Radar (SAR) Data Catalog System, together with the processing and archiving of data from the Coastal Zone Color Scanner, the Earth Radiation Budget Experiment, and the Total Ozone Mapping Spectrometer. Building upon this extensive experience, ESAD provides information systems prototypes for a wide variety of future Earth science missions, including the Earth Probe series of Explorer-class missions and the Earth Observing System mission. Present ESAD activities, such as the UARS and TOPEX/Poseidon flight project data system developments, form the basis for an Earth science data management infrastructure that will support data systems for future flight projects.

The goal of the NASA Ocean Data System (NODS) is to support the Oceans research community by providing interactive access to data sets, catalogs and documentation from spaceborne ocean viewing sensors. The NODS provides support in the acquisition, archiving, and distribution of physical data of the oceans. The NODS is part of the existing core of the JPL Distributed Active Archive Center (DAAC).

The NASA Climate Data System (NCDS) is an interactive scientific data management system composed of an integrated set of software tools for locating, accessing, manipulating, and displaying data from research missions. The NCDS was a part of the NSSDC, but has recently become a part of the GSFC DAAC. The NSSDC still provides a range of data and computer support to the NCDS.

The Pilot Land Data System (PLDS) is a distributed information management system designed to support NASA's land science community. The PLDS was a part of the NSSDC, but has recently become a part of the GSFC DAAC. The NSSDC still provides a range of data and computer support to the PLDS. The PLDS provides a wide range of services including:

- Management of information about scientific data
- Access to a library of scientific data
- A data ordering capability
- Communications
- CD-ROM publication
- Browse facility
- Science project support
- User assistance

The most important future system is the Earth Observing System Data and Information System (EOSDIS), which is being implemented as a part of the EOS program. EOSDIS will begin by building upon the efforts mentioned above. EOSDIS will provide the underlying infrastructure for the EOS mission by providing planning, scheduling, command, control, and monitoring services for the EOS spacecraft and instruments, and also by supporting the production, archiving, distribution, and analysis of Earth science data. EOSDIS will be a widely distributed network of spacecraft and instrument control centers, data processing facilities, and data archives. The EOS program will generate new data at the rate of about 2 terabytes per day, deriving from 50 Megabits per second of raw data from the spacecraft alone. EOSDIS will manage these data, creating a comprehensive, global, 15-year data set containing over 10 petabytes (10 to the power of 15 bytes) of data.

The development of EOSDIS will be evolutionary, starting with pathfinder data sets drawn from existing data systems. The principal components of the EOSDIS are the Distributed Active Archive Centers (DAACs) identified in Table 5 below, and Affiliated Data Centers (ADCs).

Table 5 *Distributed Active Archive Centers (DAACs) of the EOSDIS.*

Responsible Organization	Location	Data Topics
GSFC	Greenbelt, MD	Upper Atmosphere, Meteorology, Global Biosphere, Geophysics
JPL	Pasadena, CA	Ocean Circulation, Air-Sea Interaction
LaRC	Hampton, VA	Radiation Budget, Aerosols, Tropospheric Chemistry
University of Colorado, National Snow and Ice Data Center (NSIDC)	Boulder, CO	Cryosphere (non-SAR)
USGS / Earth Resources Observation System (EROS) Data Center	Sioux Falls, SD	Land Processes Imagery
University of Alaska / Fairbanks (UAF)	Fairbanks, AK	Sea Ice (SAR), Polar Processes Imagery
MSFC	Huntsville, AL	Hydrologic Cycle
Oak Ridge National Laboratory	Oak Ridge, TN	Biochemical Dynamics

An initial capability, called Version 0 EOSDIS, will be put in place in 1994. Version 0 will continue to provide the operational capabilities at the DAACs, will improve access to existing data, and will have working prototypes of integrating elements providing users with an Earth sciences view. EOSDIS will then gradually grow in its capabilities to permit acquiring, processing, archiving, and distributing the large volumes of data from the EOS instruments as they are deployed. It will also evolve into NASA's Earth Science Data and Information System for the archival and distribution of existing data and data from future non-EOS missions.

Earth Science and Applications Projects

Table 6 summarizes the Operational and Planned (Phase C/D) projects of the Earth Science and Applications Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 6 *Earth Science and Applications projects and PDMP status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
ATLAS-1	3/24/92	10 days	Draft PDMP	NSSDC	included SSBUV
ERBS	10/5/84	7 yr / 11 yr	Other plan in place	NSSDC	
LAGEOS-II	9/92	10,000 yr	Other plan in place	Crustal Dynamics DIS	
San Marco-D	3/25/88	1 yr	Signed PDMP	NSSDC	
SSBUV-3	8/2/91	9 days	Other plan in place	NSSDC	
Topex/Poseidon	8/10/92	3 yr / 5 yr	Other plan in place	NODS @ JPL	Preliminary SIRD
UARS	9/12/91	3 yr	Draft PDMP	NSSDC	
Development *Phase C/D*					
ADEOS Japanese Spacecraft	2/96	3 yr	No PDMP		Earth Probe; NSCAT & TOMS
ATLAS Series	5/93, 6/94, 95, 97 - 01	10 days each mission	Draft PDMP	NSSDC	Includes SSBUV series over a solar cycle
EOS	6/98 First Launch	15 yr 3-5 yr each	Draft PDMP	EOSDIS	5 series of 3-5 spacecraft each, 10 petabytes planned
ERS-2	2/94	3 yr	No PDMP		
LANDSAT-7	12/97	5 yr	No PDMP	EOSDIS	Continuation of series
RADARSAT	12/94	3 yr	No PDMP	Alaska SAR Facility	
SeaWiFS	9/93	3 yr	No PDMP	EOSDIS	
TOMS	7/94	2 yr	No PDMP		Earth Probe
TRRM	8/97	3 yr	No PDMP	EOSDIS	Earth Probe

LIFE SCIENCES DIVISION

The Life Sciences Division is responsible for planning, directing, implementing, and evaluating that part of the overall NASA program that deals with the understanding of how living systems respond to the space environment; the search for the origin, evolution, and distribution of life in the universe; the development of the scientific and technological foundations for expanding human presence beyond Earth orbit and into the solar system; and the provision of operational medical support to all space missions involving humans.

The goals of the Life Sciences Division include ensuring the health, safety, and productivity of humans in space, and acquiring fundamental scientific knowledge concerning space biological sciences. These goals are supported by the following objectives:

1) To provide for the health and productivity of humans in space,
2) To develop an understanding of the role of gravity on living systems,
3) To expand our understanding of life in the universe, and
4) To promote the application of life sciences research to improve the quality of life on Earth.

The data management elements that will support Life Sciences activities are under study. A Life Sciences Data Archive Workshop was held in December 1990, and planning activities continue. The NSSDC will have the master directory entries from the Life Sciences data system. If cost effective, the NSSDC may archive digital or film data for the Life Sciences data system, but the NSSDC will not archive other materials.

Life Sciences Projects

Table 7 summarizes the Operational and Planned (Phase C/D) projects of the Life Sciences Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 7 *Life Sciences projects and PDMP status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
COSMOS	11/92	19 days	No PDMP		Part of Russian Biosat Program
IML-1	1/22/92	8 days	Other plan in place		
Spacelab-J	9/1/92	7 days	No PDMP		PIP
SLS-1	6/6/91		Other plan in place	Archive Plan in Place	
Development *Phase C/D*					
IML-2	7/94	13 days	No PDMP		
Spacelab-D2	1/27/93	9 days	No PDMP		PIP
SLS-2	6/22/93	13 days	No PDMP		PIP
SLS-3	2Q 95		No PDMP		

MICROGRAVITY SCIENCE AND APPLICATIONS DIVISION

The mission of the NASA Microgravity Program is to obtain new knowledge and increase understanding of gravity-dependent physical phenomena and those phenomena obscured by the effects of gravity in biological, chemical and physical systems, and, where feasible, to facilitate the application of that knowledge to commercially viable products and processes. The OSSA Microgravity Science and Applications Division (MSAD) uses the unique attributes of the space environment to conduct research basic and applied research in three primary areas:

(1) Fundamental science, which includes the study of the behavior of fluids, transport phenomena, condensed matter physics, and combustion science.
(2) Materials science, which includes electronic and photonic materials, metals, alloys, glasses, and ceramics.
(3) Biotechnology, which focuses on macromolecular crystal growth and cell science.

Participants in these research areas are a diverse community of university, government and industry investigators. Many of the participants are already engaged in extensive ground-based research programs, brought together by the common need to perform experiments in the microgravity space environment in order to advance their individual areas of research.

The program uses the future capabilities of Space Station Freedom, together with free-flying platforms and Extended Duration Orbiter missions resulting in the number of MSAD investigations increasing significantly over the next decade, which will correspondingly multiply the quantity of data and other products generated, archived and subsequently accessed by the science community.

The data management elements that will support Microgravity Science and Applications activities are being addressed by the MSAD archiving study. Phase one of the study was completed in November 1992. It is expected that a distributed system will be developed, with several nodes. Node locations may include MSFC, LeRC, and NIST in Maryland. The NSSDC will have the master directory entries from the MSAD data system. If cost effective, the NSSDC may archive digital or film data for the MSAD data system, but the NSSDC will not archive other materials.

Microgravity Science and Applications Projects

Table 8 summarizes the Operational and Planned (Phase C/D) projects of the Microgravity Science and Applications Division. The table provides status of the Program Data Management Plan (PDMP) for each project, and indicates whether other archive plans are in place and the principal planned archive location.

Table 8 *Microgravity Science and Applications projects and PDMP status.*

Project Name	Launch Date	Mission Life Nom/Pot'l	PDMP Status	Archive Location	Comments
Operational					
IML-1	1/22/92	8 days	Other plan in place		
USML-1	6/92	13 days	Draft PDMP		PIP
USMP-1	10/8/92	9 days	Draft PDMP		PIP
Development *Phase C/D*					
IML-2	7/94	13 days	No PDMP		
USMP-2	1/94		No PDMP		
USMP-3	1995				
USMP-4	1997				
USMP-5	1998				

OSSA INSTITUTIONAL INFRASTRUCTURE

The effective management and utilization of rapidly growing space science data assets calls for new approaches and modifications to the infrastructure for accomplishing quality research. Ultimate success in meeting this challenge will be measured in terms of responsiveness to science user needs for convenient access both to data and to the tools and capabilities to convert data into meaningful information and use the information for improved scientific insight. The OSSA institutional infrastructure has been established to augment all discipline data systems in providing timely and responsive information systems services to the OSSA science community. The Information Systems Branch in OSSA is responsible for the institutional infrastructure, and promotes policies, standards and practices to facilitate interoperability and resource sharing. Activities within the program include the following:

- Data Management & Archiving
- Networking
- Scientific Computing
- Applied Research & Technology

DATA MANAGEMENT & ARCHIVING

The objective of data management and archiving is to contribute discipline-independent tools, facilities, and expertise to the overall OSSA effort whereby NASA mission data are best exploited for scientific gain in the near and long terms. Principal elements of the data management and archiving function include the NSSDC for OSSA-wide data archiving and dissemination, and the NASA Master Directory for finding data in a widely distributed data environment. The archive environment is in the midst of an extended transition from a centralized architecture (NSSDC only) to a distributed architecture (Discipline Data Systems plus the NSSDC). The national network of OSSA is shown in Figure 11.

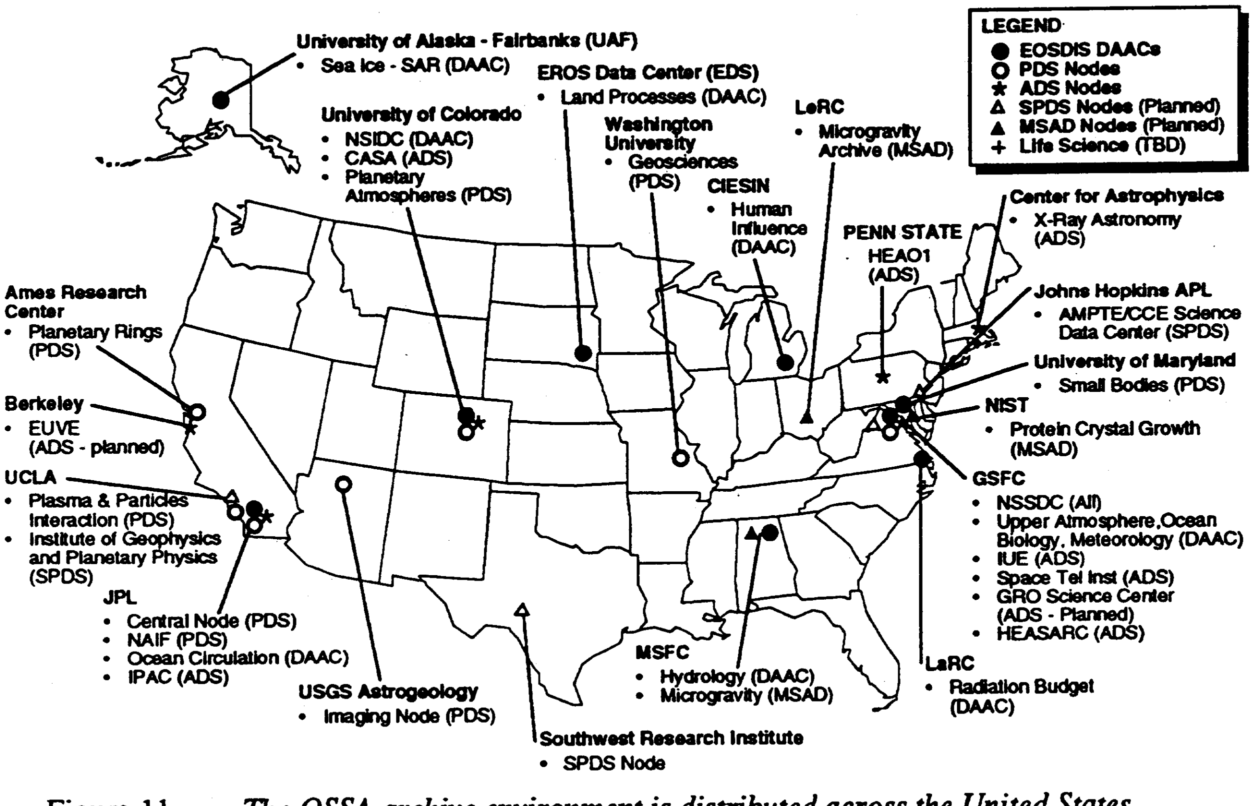


Figure 11 *The OSSA archive environment is distributed across the United States.*

The NASA/OSSA Data Management Initiative (DMI) was initiated in 1991 as an integration and extension of previously related activities. It is a multi-year, multi-million dollar effort that will ensure archiving of appropriate data from past missions, and creation of an infrastructure to enable the orderly archiving of data from future missions. The program will also ensure that data are preserved, inventoried and documented to facilitate broad future access by the science community. In support of these goals, there are three principal activities associated with the DMI, including:

1) Identification and community assessment and prioritization of data sets in need of "restoration"
2) Restoration and/or archiving of appropriate data sets
3) Creation/Improvement of the capabilities and capacities of the Discipline Data Systems (DDS) and of the NSSDC, and of the procedures and tools whereby those entities assure the routine flow of increasing volumes of the right data into the OSSA archive environment (and retrievability of there from that environment).

A complete description of the OSSA DMI can be found in Appendix A.

Effective data management is critical to the success of OSSA's science investigations, and to the near-term and long-term exploitation of the science data. Program Data Management Plans (PDMP's) are a requirement for all OSSA science investigations and should address all the data flow of a given space flight project, from early planning and scheduling through the archiving phase of a project. The essential functions of the PDMP are to:

a. Provide consistent documentation to facilitate planning and implementation of science data management needs.
b. Identify and characterize all project data sets and indicate those which require archiving.
c Specify the time, location, and format for Project data and supporting documentation to flow into the OSSA archive environment.

PDMP requirements relative to the Project Development Cycle are described in the OSSA Program Directive: Policy for the Management of the OSSA Science Data. The first version of the PDMP should be prepared in the same time as the Project Plan, shortly after new start approval for the project. It is envisioned that updates to the document will be made to reflect significant changes in data management planning throughout the period prior to launch, and throughout the mission operations and data analysis phase of the project. The formal definition (non advocate) review or equivalent mechanism conducted before a project receiving new start approval will assess data management plans as well as spacecraft development, instrument plans, etc. The requirements for PDMP development over project phases are shown in Figure 12.

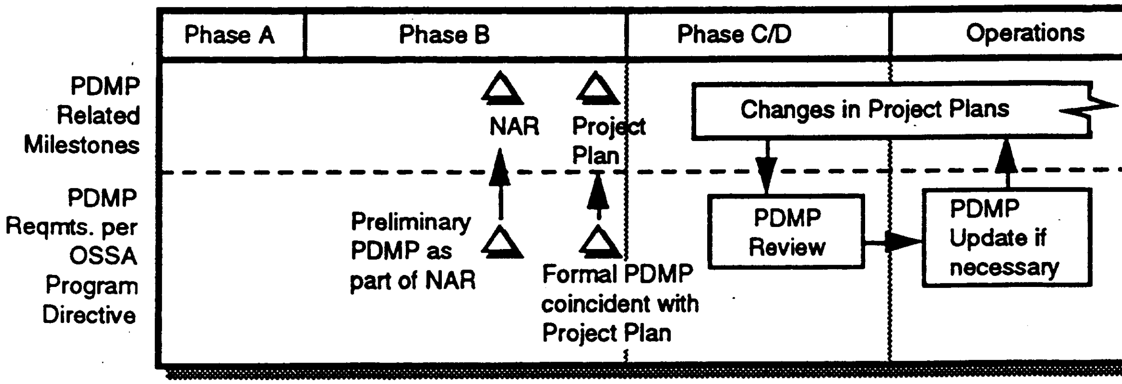


Figure 12 *PDMP Requirements.*

Current PDMP status for relevant OSSA missions, in the appropriate phase of development or operations is shown in Figure 13. From this information, it can be seen that there are currently 84 projects requiring PDMPs per OSSA policy. Of the projects requiring PDMPs, 30 projects have PDMPs while 14 projects have an alternative document that addresses archiving and data management plans. Many of these projects were in operation prior to the requirement for a PDMP.

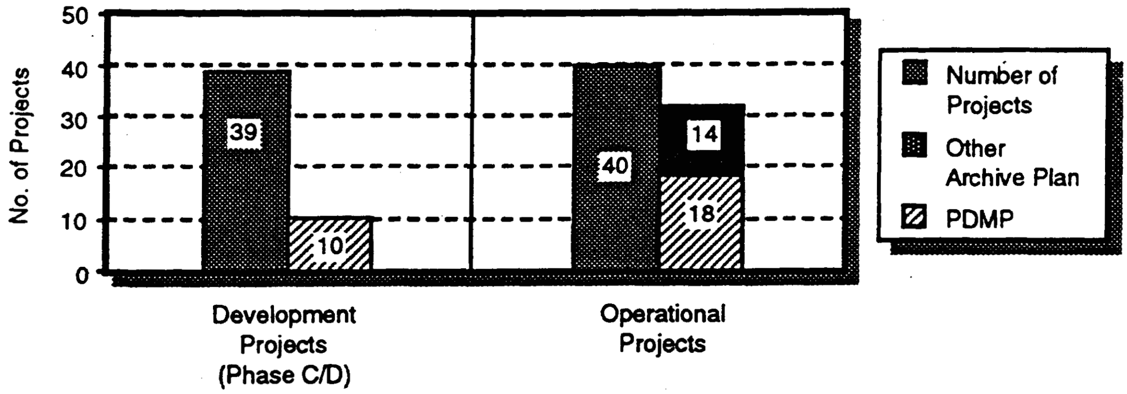


Figure 13 *Data Management Planning Status.*

OSSA is revising the "Guidelines for Developing a PDMP" as part of the overall update of data management policies. These guidelines, originally distributed to flight projects in 1988 to provide uniform guidance for developing plans, have contributed to the progress in generating effective plans. On the basis of experience to date, more specific guidance will be given with key data management parameters to be addressed and tracked as the project develops. These parameters will provide a general overview of project data management requirements. The NIMS database at the NSSDC will be a primary resource for compiling data from all OSSA PDMPs. It incorporates parameters that can be used for planning at the spacecraft, experiment, and dataset levels. The PDMPs should address those parameters identified in the guidelines document so that the PDMP becomes a standard source of information for planning.

National Space Science Data Center (NSSDC)

The NSSDC was established in 1966 at GSFC, as the principal multidisciplinary data archive center for OSSA. The NSSDC supports each of the Discipline Divisions in their data management and archiving, although specific support varies depending upon the needs of the division. Table 9 summarizes the type of support provided by NSSDC for each division.

Table 9 *NSSDC support to each of the Discipline Divisions is tailored to their needs.*

	INFO SVCS. (NASA Master Directory, ETC.)	STANDARDS & TECHNOLOGY	DATA HANDLING		
			Offline Hold/ Dissem.	Online Access	Value-Added
Life Sciences Division	Y	Y	TBD (Offline Dissemination Maybe)		
Earth Sci & App Division	Y (1)	Y	Y (3)	GRID-TOMS	N
Solar Sys Expl Division	Y	Y	Y	N	N
Microgravity Sci & Ap Div	Y	Y	TBD		
Space Physics Division	Y	Y	Y	Y	Y (4)
Astrophysics Division	Y	Y (2)	Y	Y	Y (5)

(1) NSSDC Maintains/Operates "Global Change" Master Directory
(2) NSSDC/NOST Operates a FITS user support office
(3) NSSDC expects to shed most earth science data & responsibility within two years
(4) OMNI, COHO, SSC, CDAW, CD-ROM (partial POP support)
(5) Astronomical data center

In a recent reorganization at GSFC, the NSSDC was transferred to the Space Sciences Directorate as of 31 May 1992. The NSSDC was issued a new charter in the reorganization, as part of the Space Science Data Operations Office. The new charter is as follows:

- Maintain and operate NASA Master Directory and other OSSA-wide information services
- Standards and Technologies - Be pool of expertise for OSSA data environment; recommend OSSA-wide standards
- Data - Support the discipline divisions in discharging their data management, archiving, and dissemination responsibilities
- Discharge responsibilities of World Data Center-A for Rockets and Satellites

The Earth Science & Applications Division currently has the most data holdings in the NSSDC, but these data are in the process of being transferred to the EOS DAACs over the next several years. Other divisions with large amounts of holdings in the NSSDC include the Solar System Exploration, Astrophysics, and Space Physics Divisions. Table 10 summarizes the data holdings for each type of media (by discipline) at the NSSDC, as of 1/1/92.

Table 10 *Data holdings at NSSDC, by storage media for each discipline.*

	Planetary	Earth Science	Astronomy	Space Physics	Other
Magnetic Tapes	9,177	51,868	4,778	17,106	1,167
Optical Disks		210	20	11	
Floppy Disks		18		10	
CD-ROMS	56	1	1		
Microfilm	3,249	792	5,942	20,087	1,194
Microfiche	15,355	2	18,312	10,949	640
Slides	33	812	89	38,474	364
Film (Frames)	305,080	235,284	63,459	3,860	4,456
Film (Feet)	42,814	4,300		2,200	4,400

The NSSDC provides access to a variety of on-line services through the NSSDC On-Line Data and Information Services (NODIS). The number of sessions has more than doubled over the past year. This trend is evident in Figure 14.

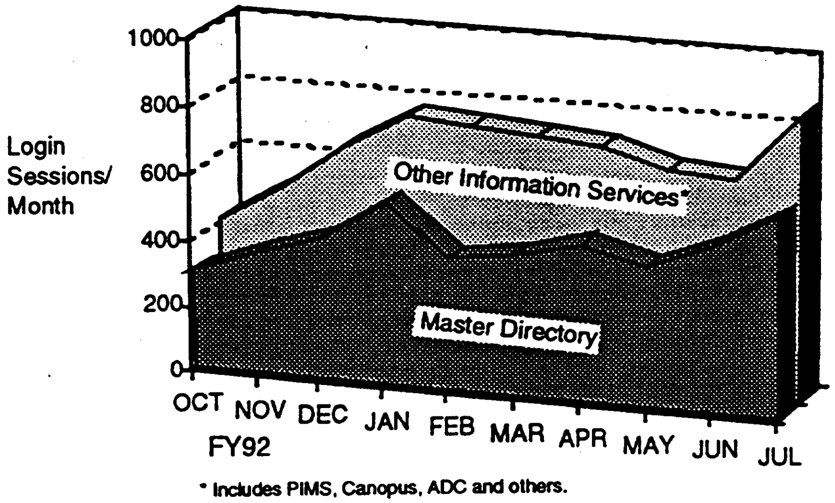


Figure 14 *The use of on-line services at NSSDC was steadily increasing in 1992.*

NODIS is a menu-driven utility that can be reached via dial-up or network. An array of individual services are available through NODIS, including the NASA Master Directory (MD), Personnel Information Management System (PIMS), the American Institute of Aeronautics and Astronautics (AIAA) Canopus newsletter, and the Astronomical Data Center (ADC) on-line information system for astronomical catalogs.

The NASA Master Directory is used more than any other information services through NODIS. It identifies, describes, and points to accessible data worldwide, that may be of interest to OSSA research activities. There are currently 1,600 entries included in the MD database. Included in this are many entries that are aggregated over multiple individual data sets. In addition to data sets, the directory also contains supplementary information about other data information systems and data archives, organized data collecting campaigns and projects, data sources such as spacecraft or Earth-based observing platforms, and data sensors that were used to acquire the data.

More than 90% of currently archived OSSA data has been identified in the MD, which is accessed nearly 10,000 times annually. The NASA Master Directory and the Global Change Master Directory are currently the same directory. The two may diverge in the future, pending development of greater differences in content and requirements. A new client-server architecture has been developed for the MD, as well as a new user interface. An International Directory Network is operational, which can provide directory access to an array of foreign users such as ESRIN, CNES, Canada, Russia, and the Chinese Academy of Science. The distribution of entries in the MD is shown in Figure 15, according to discipline.

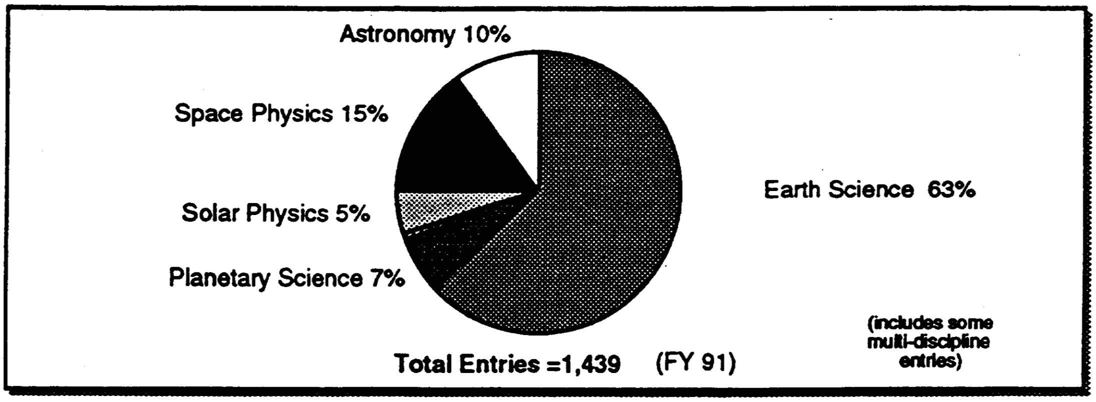


Figure 15 *The NASA Master Directory includes entries for many disciplines.*

In addition to the on-line services provided to the user community by NSSDC for data distribution, there is also hardcopy distribution. As the availability and speed of network access is increasing, more and more requests for services will be provided electronically. The number of data requests made to NSSDC for electronic and hardcopy distribution are shown in Figure 16 below.

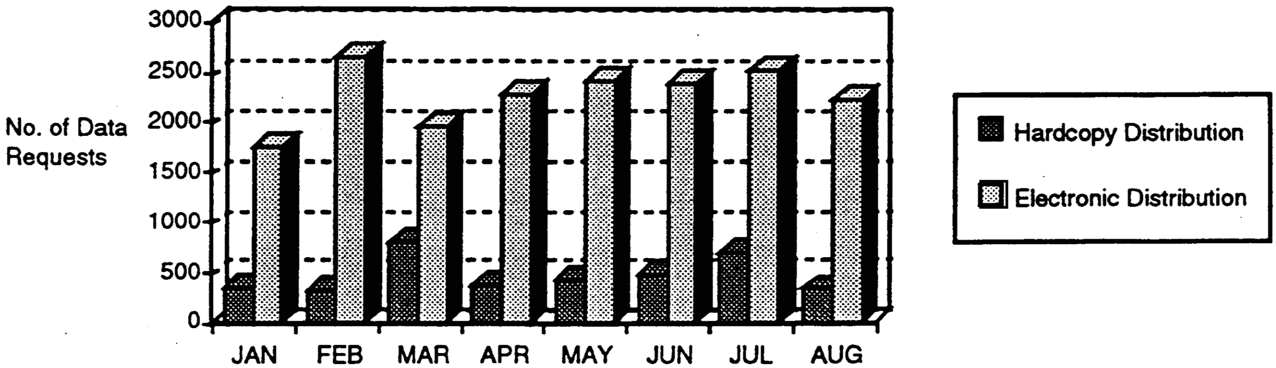


Figure 16 *Electronic distribution of NSSDC data in 1992 was four times as frequent as hardcopy distribution.*

There are a number of various media types being used by the NSSDC for storage of scientific data. The archive advanced technology task is exploring new data storage media and automated tools which will enable OSSA to archive the enormous quantities of expected data within limited budgets. The types of media and the associated future use for each are summarized in Table 11 below.

Table 11 *Storage media use at the NSSDC is changing as new technology is introduced.*

Media Type	Future Status
Round Magnetic 7 Track Tapes	To be eliminated
Round Magnetic 9 Track Tapes	Continued use expected
3480 tape cartridges	Use to increase as medium used internally to NSSDC
8 mm exabyte and 4 mm DAT	Use to increase as transfer medium
12 inch Write once read many (WORM)	SONY use up, OPTIMEM use down
Compact disk read-only memory (CD-ROM)	Increased use expected

The increased use of CD-ROM as a media type for distribution and archiving is shown dramatically in Figure 17. The high data storage density, ease of transport, and expanding use of CD technology have combined to make this dramatic growth in use possible. Technologies such as CD-ROM are making data much more accessible to scientists.

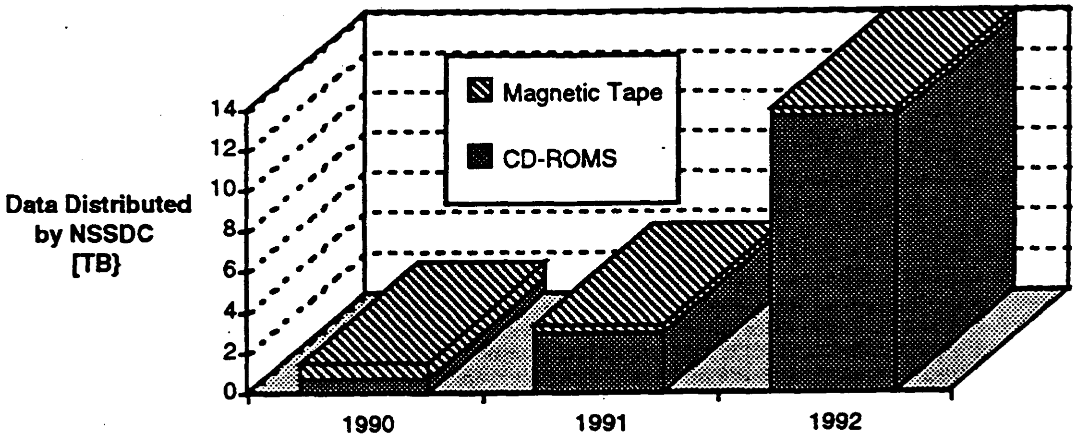


Figure 17 *Data distribution has increased dramatically with the introduction of CD-ROMs.*

In addition to storage media, techniques and tools of accessing those media are being investigated. The NSSDC Data Archive and Distribution Services (NDADS) provides an automated data retrieval request service. Using a robotic "jukebox", NDADS provides near-line access to selected project data. This means that data access approaches the speed of on-line systems, without the need for huge amounts of on-line storage capacity. Data for the robotic jukebox is currently written on up to 182 12-inch WORM disk platters, providing a total capacity of approximately 1.2 Terabytes. Software modifications and additional hardware will enable expansion of up to 8.6 TB storage in the NDADS near-line environment. The introduction of near-line technology through NDADS has dramatically increased the use of network data transfers in the last few years, over those transfers that were provided through the NSSDC computing facility (NCF). This is shown in Figure 18.

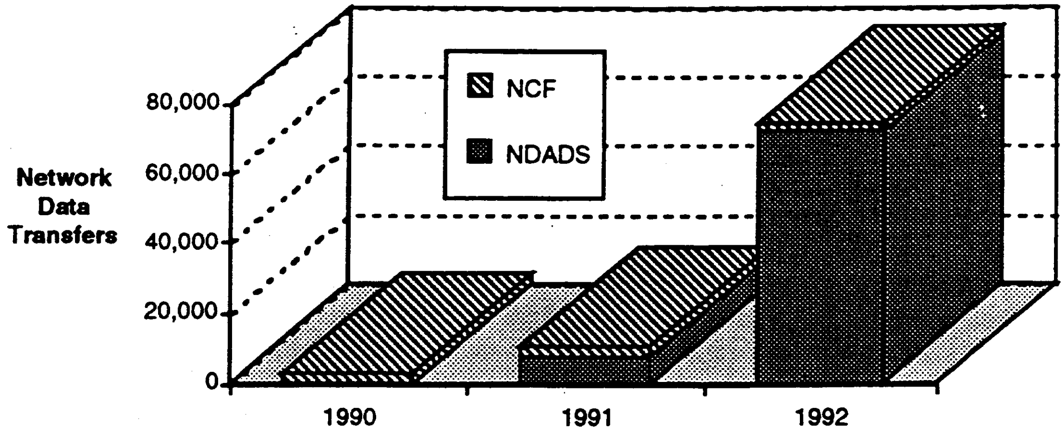


Figure 18 *The NDADS system has dramatically increased network data transfers.*

Standards

There is a NASA/OSSA Office of Standards and Technology (NOST) at GSFC that is responsible for providing a focal point for standards and new technology information. NOST takes an active role in promoting the use of standards, with the goal of improved interoperability among data systems, leading to increased data access by scientists. NOST participates in the development of new standards, assists the OSSA science community in the use of standards, and makes information on standards and new technologies available to the community.

NOST sponsored a workshop in June 1992 to address a variety of formats which are under development. In addition to the NASA/OSSA community, participants included other U.S. agencies such as NOAA and USGS, as well as international representatives from the Canadian Centre for Remote Sensing, and ESA. Ten formats were discussed as shown in Table 12, with proponents or developers giving presentations on each.

Table 12 *There are a number of standard data formats being proposed by the science community and considered by OSSA.*

BUFR	Binary Universal Form for the Representation of Meteorological Data
CDF	Common Data Format
CEOS SS	Committee on Earth Observing Satellites Superstructure
FITS	Flexible Image Transfer System
GRIB	Gridded Binary
HDF	Hierarchical Data Format
NETCDF	Network Common Data Format
PDS Labels	Planetary Data System Labels
SDTS	Spatial Data Transfer Standard
SFDU	Standard Formatted Data Units

The workshop was successful in increasing the NASA/OSSA community's understanding of the similarities and differences among various widely promoted formats. A workshop report and formats comparison document will be available soon to assist users in understanding and selecting appropriate formats.

NETWORKING

The changes in the data union towards a distributed system of interconnected nodes has made networking a critical component of OSSA science activities. Networking capability for the OSSA science community is provided by the NASA Science Internet (NSI). NSI is NASA's worldwide science communications network, as illustrated in Figure 19. The objectives of the NSI networking function are to provide computer networking services, management and operations support, and technical assistance to the OSSA science community. In addition, it provides rapid and reliable access to data resources, computing facilities and collaborators.

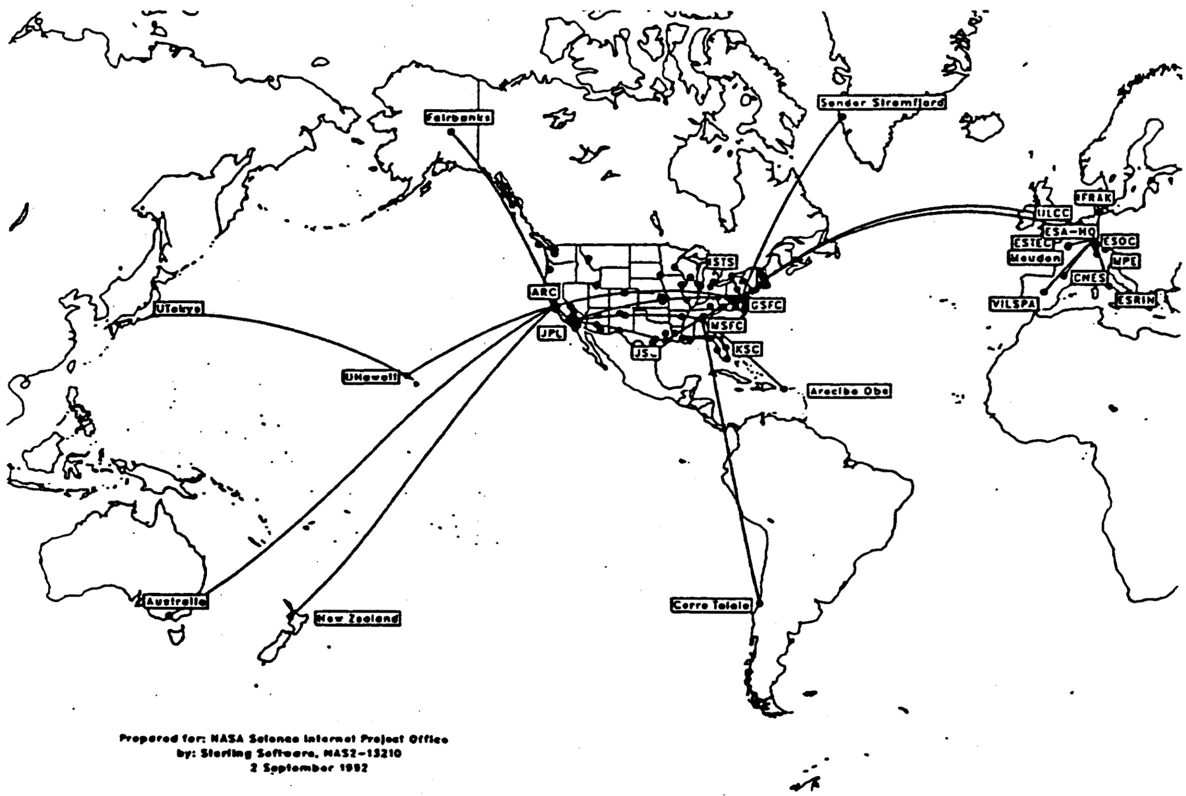


Figure 19 *The NSI is NASA's worldwide science communications network.*

NSI's approach to meet these objectives is to integrate various networks including the Office of Space Operations' Program Support Communications Network (PSCN), NASA Center networks, the NSFnet and Regional university research networks, and the research networks of Europe and the Pacific Rim. The NSI can then directly support NASA space missions and science discipline programs, as well as review and validate requirements through OSSA discipline managers. In addition, such connectivity enables the unified access to widely distributed information sources in support of the science community. NASA's NSI is a partner with the Department of Energy (DOE) ESNET and the National Science Foundation (NSF) NSFnet to establish the dominant federal partners in providing a national infrastructure serving US science research.

NSI has become a critical component of OSSA's information systems infrastructure, and is recognized by users as essential for NASA's continued successful leadership in space science research. NSI currently connects about 4,500 scientists at over 300 research institutions worldwide. Recent growth in the number of nodes and sites on NSI is shown in Figure 20.

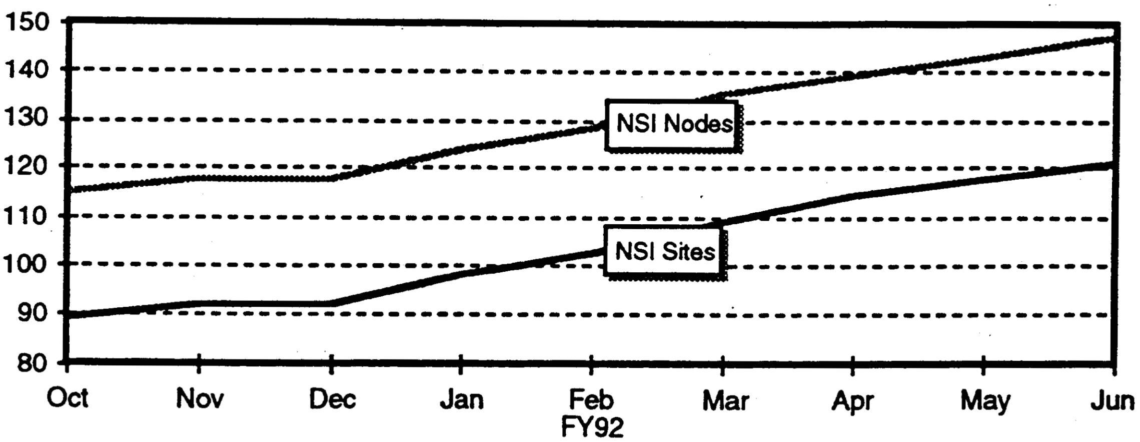


Figure 20 *NSI Nodes and Sites growth.*

Along with an increase in sites and users comes an increase in requirements for NSI services. The number of requirements has approximately doubled each of the past two years, with an increase of all requirements prior to FY90 of 329, to a total of 1,944 by the end of FY92. These trends can be seen in Figure 21. Of the 1,944 total requirements, 845 have been completed or processed, while 1,099 are active. Certain large programs place an unusually high number of requirements on the NSI, as EOSDIS did in FY91. However, there were still a significant number of additional requirements in FY92.

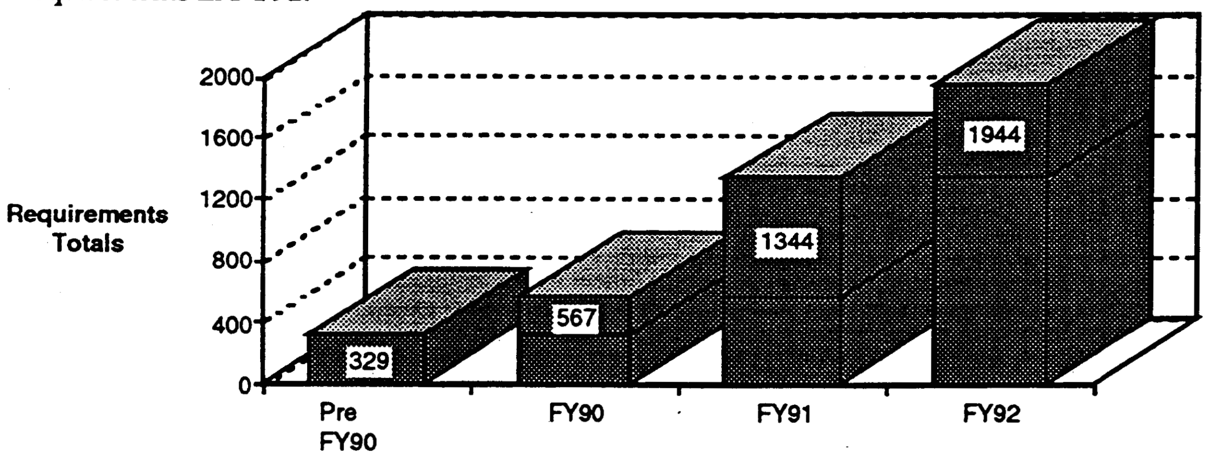


Figure 21 *NSI requirements have been significantly increasing.*

NSI provides quality service to science users, backed by nationally recognized technical excellence and leadership in networking to ensure high quality, reliable end-to-end service. NSI has adopted a continuous improvement methodology for achieving better cost and performance. Reductions in requirements implementation has dropped from 22 to 20 months for Internet and from 26 to 23.5 months for PSCN, in the last six months of FY92. In spite of the increased number of users and nodes being supported by NSI, the number of network problems being reported is decreasing.

High Performance Networking

OSSA is participating in the National Research and Education Network (NREN), an element of the High Performance Computing and Communications (HPCC) initiative. Through the NREN, the NSI community will have the benefits of T3 (45 Mbps) service and performance rather than the existing T1 (1.5 Mbps) capability. These improvements will maximize use of existing network resources, with initial deployment expected in March 1993. This will greatly enhance the data transmission capability of the existing NSI network, at an estimated cost savings to the science community of at least 50% per network access.

SCIENTIFIC COMPUTING

The objectives of OSSA scientific computing efforts are to provide the computational environment necessary to support the requirements of OSSA missions and the associated science community, and to develop the strategy and plans that will assure the continual evolution of that environment in consonance with emerging trends in science methodology and technology. The community of OSSA computer users is continuing to grow, and their demands for computational capability is growing as well. Although budgetary resources are constrained, application of advanced technology and leveraging other efforts have enabled computational resources to keep up with these increased demands. The growth in demands and plans to accommodate those demands for key resources over the next several years are shown in Figure 22.

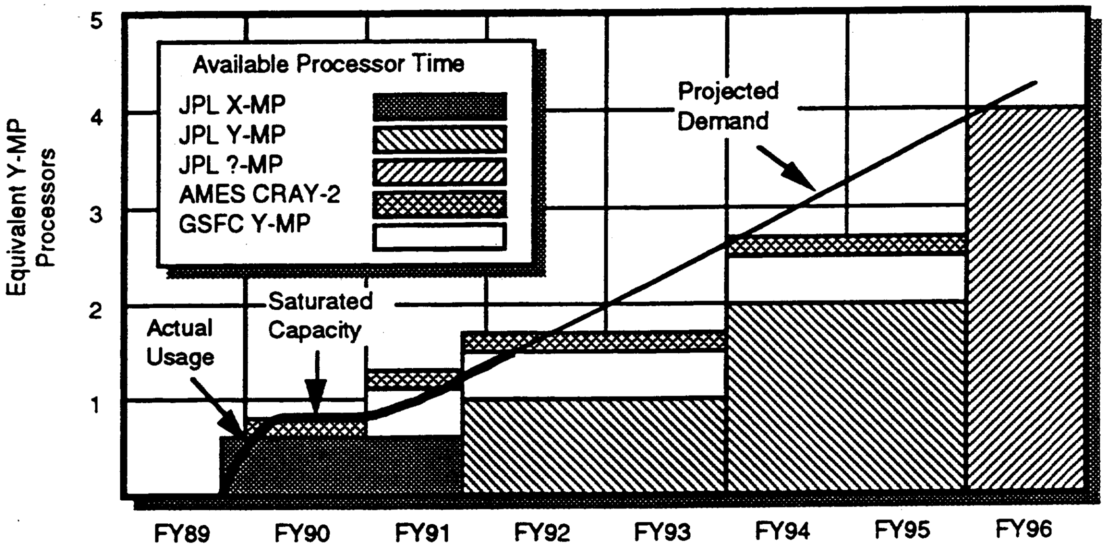


Figure 22 *Scientific computing capability must grow rapidly to meet increasing demands.*

Principal elements of scientific computing are the NASA Center for Computational Science (NCCS) at GSFC, the JPL Supercomputing Project at the Jet Propulsion Laboratory, and the Concurrent Computing Testbed Activity at the Jet Propulsion Laboratory.

The NCCS is a central scientific computing facility providing services to the Goddard science community as well as to the OSSA community in general. Principal elements of the facility are a Cray Y-MP 8/464 supercomputer and a 3 terabyte mass data storage and distribution system. The facility currently serves some 1,500 users annually, with remote usage accounting for some 25% of the cycles used. Plans are underway to enhance the OSSA supercomputing capacity.

The JPL Supercomputing Project includes a Cray Y-MP 2E/116 with limited on-line storage. This facility currently supports 450 members of the JPL research community and has been an enabler of science research and data analysis local to the JPL facility. Supplemental computing capacity is provided to users through the Ames' NAS facility and the NCCS.

The concurrent computing testbed activity is a small research activity examining effective utilization of loosely coupled heterogeneous computing systems in the solution of OSSA related problems. User interfaces for these environments are being examined as well as scientific research distributed over computing engines of different architectures.

Supercomputer utilization of the JPL and GSFC computing resources for FY92 is shown below in Figure 23.

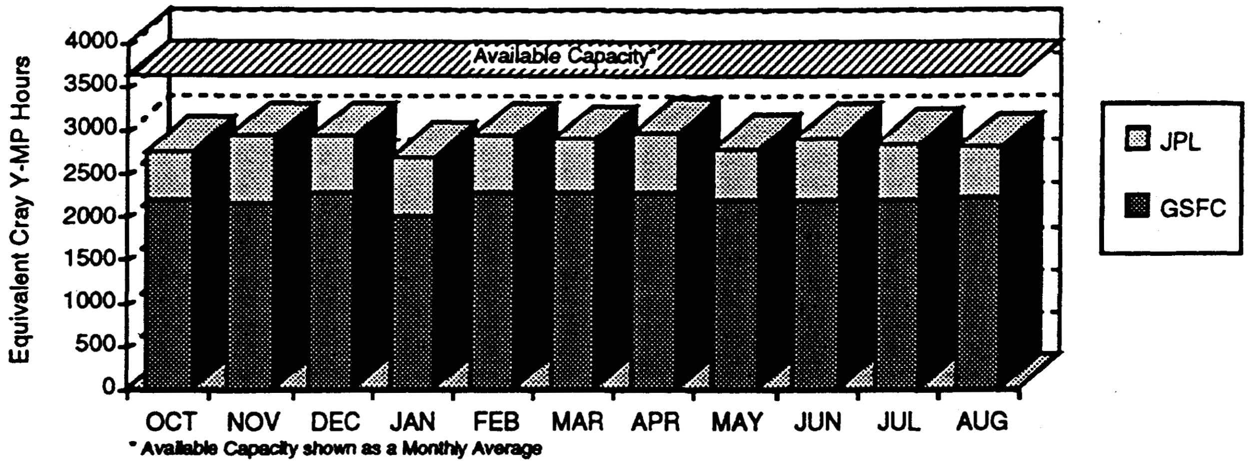


Figure 23 *Supercomputer utilization for FY92.*

High Performance Computing

OSSA is participating in the High Performance Computing and Communications (HPCC) Program. The goal of this program is to accelerate the development of application of high performance computing technologies to meet NASA science and engineering requirements. In earth and space science, the specific benefits are multidisciplinary modeling and monitoring of the earth and its global changes and assessments of their impact on the future environment. This will be realized through development of algorithms and architecture testbeds capable of fully utilizing massively-parallel concepts that are scalable to sustained teraFLOPS performance. In addition, the creation of a generalized software environment will be needed for massively parallel computing applications. The impact of these technologies will then be demonstrated and applied to NASA research on Earth and space sciences physical phenomena.

APPLIED RESEARCH & TECHNOLOGY

The objective of the applied research & technology area is to apply advanced information systems technology as appropriate to improve support to OSSA science programs in meeting the needs of science users. The trend in space science information systems has been higher data rates, greater data volumes, increased reliance on supercomputers, hierarchical management, development of tools to support coordinated science operations and analysis, development of master directories, increased need for onboard operations, and increased concern for security. Future needs in information systems will include interoperability with international systems, device independent system architectures, standard interfaces, development of tools to take advantage of standards, and testbeds.

Elements of the Applied Research and Technology effort addressing these trends include applied research to enhance science data management, analysis and visualization. JPL is leading efforts in visualization and animation of science data from the solar system. Development work in visualization is also underway at the Center of Excellence in Space Data and Information Sciences (CESDIS) at GSFC. NASA Research Announcements (NRA's) are being used in open solicitation to broaden participation in this area to universities and industry. An important role for the Information Systems Branch in this area is to provide an infrastructure for testing, evaluating, inserting, and maintaining new technologies that are being developed. In addition, efforts are being made to coordinate and leverage these research and development activities with NASA's Office of Aeronautics and Space Technology, the National Science Foundation, industry and others.

OSSA will accelerate the development and application of high performance computing technologies through the NASA High Performance Computing and Communications Program (HPCC) Earth and Space Science (ESS) applications project. The approach to HPPC in OSSA includes use of a NASA Research Announcement (NRA) to select Grand Challenge Applications and principal investigator teams that require teraFLOPS computing capability for addressing NASA science problems. Successive generations of scalable computing systems will be developed as testbeds for the Grand Challenge Applications. The investigators and testbeds will be interconnected through high speed network links, and a software development environment and computational techniques will be provided to support the investigators. In collaboration with the investigator teams, OSSA will conduct evaluations of the testbeds across applications and architectures, leading to a selection of the next generation of scalable teraFLOPS testbed.

Major programs and activities in the applied research & technology area include the following.

JPL Visualization Activities

- Visualization tools are being utilized effectively by several projects, including Magellan Venus flyovers, and UARS ozone results
- Successful demonstration of Explorer image rendering software, integrated with Hypercube testbed and Solar System Visualization tools (Explorer was renamed Surveyor)
- Several visualization tasks under development
  - Parallel Methods in Image Analysis
  - The Linked Windows Interactive Data System
  - Three Dimensional Interactive "Explorer"
  - Visiting the Planets

Applied Information Systems Research Program (AISRP)

- 22 Investigations have been selected and are underway via the initial solicitation under this program.

- Linkwinds was demonstrated, marking the first time a Multi-User System Environment (MUSE) capability has been shown cross continent
- Copies of Linkwinds have been installed at several test sites including UCSD, Univ. of Colorado, Oregon State University, and UARS investigators.
- Continuing research on software called DataHub for visualization and analysis using large distributed databases.

Center of Excellence in Space Data & Information Systems (CESDIS)

CESDIS brings together computer scientists from university, industrial, and government laboratories to conduct computer science research having application to Earth and space science, focus attention on accessing, processing, and analyzing data from space observing systems, and collaborate with NASA space and Earth scientists. The CESDIS accomplishes these goals by:

- Funding research projects
- Supporting research personnel for projects funded by NASA through other programs
- Providing a computer science research environment
- Conducting workshops and conferences
- Administering fellowships
- Developing areas for collaborative efforts
- Producing technical reports.

Some CESDIS projects are:

- Communication protocol research
- Highly concurrent synchronization mechanisms
- Multi-Resolution Common Data Format (MR-CDF)
- Adaptive storage management
- Computer Assisted Analysis of Auroral Images Obtained from high altitude Polar satellites
- Parallel compression of space and earth data

Appendix A

DATA MANAGEMENT INITIATIVE (DMI)

The NASA/OSSA Data Management Initiative (DMI) is a multi-year, multi-million dollar effort that will ensure archiving of appropriate data from past missions, and creation of an infrastructure to enable the orderly archiving of data from future missions. The program will also ensure that data are preserved, inventoried and documented to facilitate broad future access by the science community.

The DMI program, coordinated by OSSA's Information Systems Branch (ISB) was proposed as a $4M new start for FY92. The program was funded and began in FY92 at the $1.8M level despite the absence of "new" dollars in the budget. Future funding for this activity out of the ISB budget has been projected as $1.4M, $1.1M and $750k for FY93-95 respectively. The Science divisions are investing similar amounts in associated efforts to enhance the data environment.

The funding in FY92 allowed three types of activities associated with the DMI to begin, including:

1) Identification and community assessment and prioritization of data sets in need of "restoration"
2) Restoration and/or archiving of appropriate data sets
3) Creation/Improvement of the capabilities and capacities of the Discipline Data Systems (DDS) and of the NSSDC, and of the procedures and tools whereby those entities assure the routine flow of increasing volumes of the right data into the OSSA archive environment (and retrievability of there from that environment).

Initial efforts in the early years of the DMI will focus on identification and restoration/archiving of appropriate data sets. Funding has been provided in FY92 at the sites of four space physics groups and six astrophysics groups for restoration and reformatting. In addition, the restoration program at JPL is continuing. Improvements to data management systems and facilities will be the focus of the DMI once important data sets have been safely archived. However, definition and development of new DDS's in Life Science, Microgravity, and Space Physics has begun under the DMI in 1992.

Identification and Assessment

A comprehensive information base is being developed at NSSDC which will identify all extant OSSA-mission data sets. The information base is already populated with information concerning NSSDC-held data and many other OSSA data sets which were identified in the OSSA Data Census coordinated by NSSDC in 1990. A summary of the data in this information for each data set is as follows:

- Data Set Identification
- Suitability for archiving
- Community recommendations concerning data set archiving
- Archiving status
- Other related information

OSSA Discipline Divisions are each orchestrating efforts to identify potentially archive-desirable data sets not yet identified in the NSSDC information base. Each Division has identified one person to be responsible for coordination of the Division's DMI activities, including assessing and prioritizing data sets for restoration and archiving.

Restoration

Once data sets have been assessed and prioritized, the process of restoration and archiving can begin. The restoration process will address three principal activities:

- Ensuring the usability of the data once archived.

- Reformatting of data (to standard formats, adding labels, etc.)
- Migrating data bits to new media

To ensure usability, documentation and/or software may be required if and when persons having initial expertise with the data are no longer available to support correct use. No OSSA-wide standards currently exist for data format standards, and the Divisions will determine what reformatting is required. Migration of data bits from old media to new media will occur at central cites such as the NSSDC or DDS facilities, or at distributed PI or other sites if appropriate capabilities exist. Sources of data for the migration will include old data volumes already held at central sites and data sent there by PI's, as well as data held by PI's. A goal of the data restoration activity is to migrate data sets which are now held in the distributed OSSA community by PI's, to the public OSSA archive environment of the appropriate DDS, the NSSDC, or both.

The Science Digital Data Preservation task is a part of the DMI at JPL. The focus of Phase I has been on creating an inventory and assessing tapes that are at least five to fifteen years in age and degenerating. This has been done on 135,000 tapes that JPL has retrieved from the Federal Records Center. These 7-track and 9-track tapes include data from Viking (40,000 tapes), Voyager, Mariner, and other missions. Of these tapes, 50,000 have been identified as critical to save for future science use, under the guidance of SDEB, PDS and PSDSG. Other tapes are either duplicates, of lower priority, or can no longer be read. The Phase I Final Report will be published in October 1992. Phase II work will begin the process of converting 9-track tapes to CD write once media at the rate of about 3,000 tapes per year, with expected funding levels. Conversion of the 7-track tapes has been postponed.

Appendix B

EDUCATIONAL OUTREACH PROGRAMS

There are a number of educational outreach programs sponsored by OSSA to facilitate access to scientific data and increase minority participation in scientific research.

Minority University-Space Interdisciplinary Network (MU-SPIN)

The networking capability provided by the NSI enables increased University participation in OSSA science activities. The Minority University-Space Interdisciplinary Network (MU-SPIN) program is a networking and education initiative for Historically Black Colleges and Universities (HBCU), Minority Universities (MU), and other universities with large minority student enrollment. The program's main goal is to interconnect the computing facilities of HBCU's and MU's with the NSI, and to promote awareness and usage of wide area networking technology in support of collaborative interdisciplinary scientific research among faculty, students, and NASA scientists. The program consists of four major components:

1) Wide area networking
2) Faculty/student development
3) The residence program
4) User Working Groups

NASA/University Joint Venture (JOVE)

JOVE was initiated as a pilot program with six universities in 1989, to develop aerospace research capabilities and to promote science and engineering education. JOVE concentrates on institutions of higher education that have had little or no involvement in the Nation's aerospace program. JOVE is a capability building program, aimed at curriculum development, the enhancement of student research potential, and outreach programs to students and the broader community served by participating universities. Under this program, NASA makes space science data and NASA resources available to the university researchers in exchange for the university providing faculty and student support on a matching funds basis to carry out the research. Participation in JOVE has grown significantly since it began in 1989, as shown below.

Year	1989	1990	1991	1992
Participating Universities	6	15	30	55

Graduate Student Researchers Programs (GSRP)

In 1980, NASA initiated the Graduate Student Researchers Program (GSRP) to cultivate additional research ties to the academic community and to support promising students pursuing advanced degrees in science and engineering. Since then, approximately 1,200 students have completed the program's requirements. In 1987, the program was expanded to include the Underrepresented Minority Focus (UMF) Component. This program was designed to increase minority participation in graduate study and research and, ultimately, in space science and aerospace technology careers. Approximately 230 minority students have completed the program's requirements while making significant contributions to the nation's aerospace efforts. Continuing to expand fellowship opportunities, NASA announced in 1990 the Graduate Student Fellowships in Global Change Research (GSGCR). Designed to support the rapid growth in the study of Earth as a system, approximately 150 fellowships have been awarded since its inception. And, in 1992, NASA announced opportunities in the multiagency High Performance Computing and Communications (HPCC) Program designed to accelerate the development and applications of massively parallel processing. Approximately five new fellowships will be awarded yearly.

Appendix C
OSSA POLICY ON SCIENCE DATA MANAGEMENT

OFFICE OF SPACE SCIENCE AND APPLICATIONS PROGRAM DIRECTIVE

Responsible Offices:

Life Sciences Division
Earth Sciences and Applications Division
Solar Systems Exploration Division
Flight Systems Division
Microgravity Science and Applications Division
Space Physics Division
Astrophysics Division

Subject: Policy for the Management of the Office of Space Science and Applications' Science Data

1. Purpose

The purpose of this Program Directive is to establish NASA's policy for, and delineate responsibilities and authorities relative to, the continuing management of the Office of Space Science and Applications' science data. It replaces NASA Management Instruction (NMI) 8030.3A, "Policy Concerning Data Obtained from Space Science Flight Investigations", dated May 2, 1978, in satisfying this function which was first established in a NASA Policy Directive, dated January 7, 1967 (NPD 8030.3). Among other important modifications, NMI 8030.3A established the requirement for all space flight projects to develop Project Data Management Plans (PDMPs). As defined in NMI 8030.3A, the PDMP was essentially conceived as a data archiving plan. The increasing complexity of NASA science investigations and the volume of data that they generate (among other factors) emphasizes the need for increased emphasis and priority for data management planning early in the project's life. Additionally, these data management planning activities must address the total flow of research data not just archiving. This Program Directive expands the scope of the PDMP to include planning for data management throughout the project planning and implementation phases.

2. Scope

This program directive is applicable to the management of all science data resulting from Office of Space Science and Applications sponsored research missions and programs.

3. Policy

a. Science data generators and users shall serve as a primary source of requirements, as well as final judge of the quality and value of scientific data. Advice and guidance shall be obtained from the science and applications research community in the planning and implementation of NASA's data management systems.

b. NASA shall establish and maintain archives to preserve and make accessible all valuable NASA science data and information. This system of data archives shall include easily accessible information about NASA's data holdings, guidance, and aids for locating and obtaining the data. A review process, including scientific community representation, shall be established to determine what data should be archived and to assure conformance with completeness and quality standards.

c. National and international standards for media, formats, and communication of data sets shall be used to the greatest extent possible. NASA shall participate in the development and implementation of standards. NASA unique standards shall be used only if adequate national or international standards are lacking. The intent of this policy is to standardize the interfaces between the users and NASA's data and information systems, not to standardize the systems themselves.

d. Project, discipline, and OSSA-wide data management activities shall be reviewed periodically to assess status and progress relative to Agency and OSSA goals, objectives and standards, and the needs of the science community. Once archived, data sets and supporting information shall be periodically reviewed to assess their value for continued retention by NASA. This process shall also prevent the loss of important data sets.

e. All data being captured by NASA science projects and space flight missions shall be addressed in a Project Data Management Plan (PDMP) to assure the availability of data and supporting information on a timely basis for use by the science community. The formal definition (non advocate) review or equivalent mechanism conducted prior to a project receiving new start approval will assess data management plans as well as spacecraft development, instrument plans, operations plans, etc. After new start and budget approval a formal Project Data Management Plan will be prepared and approved coincident with the Project Plan signed by the Associate Administrator and Field Center Director. Project Data Management Plans must be updated as significant changes occur that impact the project's plans for data management, and PDMPs should be reviewed periodically to determine if updates are required. For programs in which selected investigators have initial periods of exclusive data use, data should be made openly available as soon as that period expires. In such cases, the duration of all exclusive use periods shall be explicitly defined.

f. NASA shall periodically conduct a review of its data repositories and archives to determine the state of data and to assure conformance with applicable government standards for data storage.

g. Recognizing the pivotal importance of technology in meeting its future needs for data and information systems, OSSA shall establish an active process to maintain an awareness of emerging applicable technologies, infuse them into its systems, and stimulate new technology development where warranted.

4. Responsibilities and Authorities

a. Associate Administrator for Space Science and Applications

The Associate Administrator for Space Science and Applications is responsible for maintaining and ensuring the implementation of NASA's data management policy, including issuing implementing instructions and guidelines.

b. Assistant Associate Administrator for Science and Applications

The Assistant Associate Administrator for Science and Applications shall serve as chairperson of the Information Systems Management Board, which is chartered to coordinate OSSA's data management activities, and to identify issues, set priorities, and provide recommendations to the Associate Administrator for Space Science and Applications on these activities.

c. OSSA Discipline Division Directors

The Directors of OSSA's Science Discipline Divisions are responsible for the overall administration of their Division's data management activities in accordance with this Program Directive and the decisions of the Information Systems Management Board. Data acquired from both flight projects and non-satellite programs will be addressed as part of this responsibility. The primary objective of this activity is to assure the continuing value of OSSA's science data by providing data management procedures, systems and services that are responsive to the needs of the project, discipline, NASA, and broad research communities.

d. OSSA Flight Systems Division Director

The primary responsibilities of the Information Systems Program within OSSA's Flight Systems Division are to formulate and coordinate OSSA wide data management policy and to provide the supporting infrastructure across the discipline efforts. This includes providing a broad range of data management capabilities which transcend discipline-specific data management activities and serving as OSSA's point of contact for data management activities.

Appendix D

STATUS OF DATA MANAGEMENT ISSUES RAISED BY GAO

There have been two recent reports issued by the United States General Accounting Office (GAO) which have addressed issues in NASA's management of space science data:

- Space Operations: NASA Is Not Properly Safeguarding Valuable Data From Past Missions, GAO/IMTEC-90-1, March 1990
- Space Operations: NASA Is Not Archiving All Potentially Valuable Data, GAO/IMTEC-91-3, November 1990

In general, NASA found that the reports provided a useful assessment of some of the key issues in data management, and agreed with many of the shortcomings identified in the reports. There was a concern about balance however, particularly in the first report, regarding recognition of on-going NASA initiatives already addressing the identified shortcomings.

A summary of the status of ongoing NASA data management activities relative to GAO recommendations from both reports was provided to GAO on 26 June 1991. Significant progress since that time has continued, within budgetary constraints, on all issues and recommendations in these reports. The following material is not a comprehensive description of the OSSA data management and archiving program, but reports on the current status of those elements which are particularly relevant to recommendations made by GAO in its two reports.

Those elements of the OSSA data management and archiving program which are relevant to the eight recommendations from the report published March 1990 will be discussed first.

1. *Conduct a through inventory of all NASA's space science data stored at NASA centers and contractors, universities, research institutions, and other federal agencies.*

   NASA has continued to conduct several data inventory activities resulting in a high level inventory of digital data sets. These activities have included the following:

   - OSSA Data Census Phase 1 and Phase ll
   - NSSDC Database
   - PSASS Survey
   - PDS Catalog
   - Science Digital Data Preservation Task

   The OSSA Data Census was an extensive two-phase census effort initiated in August 1989 with our principal investigator community. The objective was to identify data sets held from previous missions that should be included in archives and made available to the general research community. This recent census was an update to a previous census completed in March 1981. A report on Phase One was issued in March 1990 and Phase Two was issued October 1991. The census results confirm NASA's understanding that most extant data from inactive missions, which ought to be archived, are already archived.

   The information system at NSSDC has been upgraded to accommodate census information and to permit ongoing tracking of OSSA archiving status. This comprehensive information base will identify all extant OSSA-mission data sets. The information base is already populated with information concerning NSSDC-held data and many other OSSA data sets which were identified in the OSSA Data Census. A summary of the data in this information for each data set is as follows:

- Data Set Identification
- Suitability for archiving
- Community recommendations concerning data set archiving
- Archiving status
- Other related information

All new projects are tagged and updated for inclusion in the Master Directory which is now fully operational. The MD is providing on-line information to the research community about existing data sets, including archive locations, etc. It is populated with descriptions of at least 90 % of NASA mission data.

As Phase I of the Science Digital Data Preservation Task, JPL has inventoried and evaluated all of its 135,000 institutionally managed tapes.

The inventory of data is continuing through the DMI. Distributed data sets not currently in the OSSA archive environment are being collected and archived as appropriate.

2. *Assess, in cooperation with the scientific community, the inventoried data for its scientific value and integrity of its storage media.*

OSSA has now performed an institution-wide survey of its digital data holdings, which has provided the information necessary for an assessment of storage media and archive desirability.

In conjunction with the science community, OSSA is continuing to identify and assess the value of data products for inclusion in archives. As part of the Data Management Initiative, there is an active, ongoing effort with steering groups from each of the science disciplines to oversee and evaluate the quality and value of data sets within their discipline community. OSSA Discipline Divisions are each orchestrating efforts to identify potentially archive-desirable data sets not yet identified in the NSSDC information base. For each data set, this information base contains information as to the suitability for archiving, recommendations from the science community and archiving status. Each Division has identified one person to be responsible for coordination of the Division's DMI activities, including assessing and prioritizing data sets for restoration and archiving.

The Data Set evaluation performed by the PDS of the Solar System Exploration Division is a good example. This evaluation included :

- Sorting data sets by PDS Discipline Node, assigning distributed data sets relating to a specific node to that node for review.
- Each node was requested to furnish the following information:
  - High level review for correctness of node assignment, duplicates, or missing data sets
  - Detailed analysis by data set of disposition (archive, redundant), and priority for preservation/restoration

"Irreplaceable data" will be identified and priorities established for preservation and/or restoration.

3. *Copy valuable data from deteriorating tapes to archival quality magnetic tapes or other storage media suitable for long-term retention of digital data, and release unneeded tapes for reuse or disposal.*

There are a number of ongoing efforts to convert data stored on deteriorating tapes to other media such as Compact Disk Read Only Memory (CD-ROM) and optical disks. Principal data restoration programs are underway at NSSDC and at JPL, and will be widely pursued throughout the NASA data environment as part of the Data Management Initiative. As outlined in the Data Management Initiative, once data sets have been assessed and prioritized, the process of restoration and archiving can begin. The restoration process underway addresses three principal activities:

- Ensuring the usability of the data once archived.
- Reformatting of data (to standard formats, adding labels, etc.)
- Migrating data bits to new media

To ensure usability, documentation and/or software may be required if and when persons having initial expertise with the data are no longer available to support correct use. No OSSA-wide standards currently exist for data format standards, and the Division's will determine what reformatting is required. Migration of data bits from old media to new media will occur at central sites such as the NSSDC or DDS facilities, or at distributed PI or other sites if appropriate capabilities exist. Sources of data for the migration will include old data volumes already held at central sites and data sent there by PI's, as well as data held by PI's. A goal of the data restoration activity is to migrate data sets which are now held in the distributed OSSA community by PI's, to the public OSSA archive environment of the appropriate DDS, the NSSDC, or both.

Selected examples of data restoration for popular data sets include the Voyager encounter data on a series of CD-ROMS, and data from Dynamics Explorer, Coastal Zone Color Scanner and Total Ozone Mapping instruments on the Nimbus spacecraft which have been converted to optical disks. Not only do these new media ensure the permanent archiving of these data sets, but they also enable much more rapid and much broader access. In addition to these older data sets, the Magellan data has been stored on CD-ROM and is being widely distributed. We will continue and expand these efforts, guided by the needs and direction of the scientific community.

At NSSDC, approximately 20,000 tapes have had their data extracted and written on to new media (mostly 6250-bpi tape and 3480 tape cartridges). The recovery rate of data from these old tapes, which are 10 to 25 years old, is over 98%.

At JPL, a Science Digital Data Preservation task has been ongoing which addresses Data Preservation and Data Restoration.

The Science Digital Data Preservation task was a part of this portion of the DMI at JPL. The focus of Phase I has been on creating an inventory and assessing tapes that are at least five to fifteen years in age and degenerating. This has been done on 135,000 tapes that JPL has retrieved from the Federal Records Center. These 7-track and 9-track tapes include data from Viking (40,000 tapes), Voyager, Mariner, and other missions. Of these tapes, 50,000 have been identified as critical to save for future science use, under the guidance of SDEB, PDS and PSDSG. Other tapes are either duplicates, of lower priority, or can no longer be read. Principal efforts under Phase I were:

- Establishment of the Science Data Evaluation Board
- Publication of "Data Disposition Policy and Procedures", with approvals from ADLs
- Completed inventory and assessment of 135,000 tapes

- Identified and prioritized appropriate tapes for archive with integral participation of the science community
- Initiated OSSA-wide planetary data survey

The Phase I Final Report was published in October 1992. Phase II work will focus on the conversion of identified tapes to archival quality storage media, in order of priority. The process will convert 9-track tapes to CD write once media at the rate of about 3,000 tapes per year, with expected funding levels. Conversion of the 7-track tapes has been postponed.

4. *Archive valuable scientific data in facilities that meet National Archives and Records Administration (NARA) regulations.*

NASA has continued to make significant and affordable upgrades at several facilities, bringing them into better compliance with NARA regulations. More expensive options, including the leasing of NARA compliant storage facilities, are under study as part of the Data Management Initiative.

The following table summarizes compliance levels for selected facilities. This summary is an update to a table in the March 1990 report.

	NSSDC		TSSF		MIPL		IPAC	
NARA Regulations	11/90	9/92	11/90	9/92	11/90	9/92	11/90	9/92
Temperature Control	non	partial	non	partial	partial	partial	partial	full
Humidity Control	non	partial	non	partial	non	partial	partial	full
Test/certify media	non	full			non	partial	non	full
Off-site backup	partial	partial			partial	partial	full	full
Security	non	full	partial	partial	partial	partial	non	partial
Samples	non	full			non	non	non	non
NIST & Industry Guidelines								
Tape handling	partial	partial	non	partial	partial	partial	non	partial
Fire protection	partial	partial	partial	partial	partial	partial	partial	full
Water protection	non	partial	non	partial	partial	partial	non	non
Hardware maintenance	full	full			full	full	full	full
Tape maintenance	non	partial			non	non	non	full
Tape transportation	non	non	non	non	non	partial	non	partial

Levels of compliance: non, partial, full

Data Archive compliance with industry and government standards has improved significantly.

Specific examples of what has been done to improve compliance at the NSSDC and TSSF at GSFC are included as follows.

Goddard Space Flight Center (GSFC) - Tape Staging and Storage Facility (TSSF):

- An electronic card/key system was installed at the entrance to the TSSF
- Two temperature/humidity recorders installed

- One water-level sensor installed which is connected to the central security system
- Box Edge Protectors installed on all "boxed" tapes stored on pallets
- Two cameras, one video switcher, one monitor, and one VCR have been installed to observe and record activity at the loading dock
- Fourteen motion detectors were added
- Smoke and fire detectors increased from fifteen to sixty
- Door contact sensors were increased from ten to twenty-eight
- Strobe lights were added to fire alarm horns for the hearing impaired
- Building security was augmented with a guard on second shift.

The above equipment is tested monthly and calibrated, when required, every six months.

GSFC - National Space Science Data Center (NSSDC):

- Combustibles removed from tape storage areas
- Hydro-thermograph in tape archive area is calibrated monthly
- Plastic sheets are protecting tapes in the event of water leakage in the ceiling of archive area
- 25 % of archive area is cleaned, on a rotating basis, every two weeks
- A cardkey activated door was installed on the tape library at the NSSDC in May 1992
- Most NSSDC computers have been moved to an area controlled via key-card access in Building 28
- Backup copies are routinely generated for all incoming tapes and for all volumes created in the Data Restoration program
- Electronic/interactive system designed and implemented for NSSDC staff members to log in/out tapes from archive area
- The NSSDC is now buying more expensive tapes which are pre-certified by the supplier rather than using tapes out of NSSDC store stock to ensure data integrity
- Data sampling is regularly being conducted on a large portion of tapes as part of the data restoration process
- Tape maintenance is being performed as part of the data restoration process
- Temperature and humidity gauges are calibrated every six months
- Tapes are no longer stored in the hallway. All tapes are now under lock and humidity control. G-13 was set up as an FRC storage area complete with a separate humidity-chart recorder
- The number of tapes resident in the computer room has been reduced
- A "dual technology" approach for archiving data has been implemented, using the round and square tape method
- An effort has begun to store one copy of the data off-site
- An additional fire alarm bell was installed in the library
- The tape cleaner/certifier was recalibrated
- Transportation personnel were "educated" regarding the proper care and handling of magnetic tapes between GSFC and the FRC
- IDA is used to determine the age, location and usage of the data.

Advances in storage technology can ease burdens for data storage. An example is that higher storage density among storage media, leads to lower requirements for storage volume. A real world impact of this is that the Science Digital Data Preservation Task has reduced the need for large, costly tape storage facilities by reducing the volume of tapes through conversion to higher density media and disposing of duplicate data. Of 135,000 tapes which were archived at the Federal Records Center, only 50,000 really need to be archived. These 50,000 will be restored onto only 3,000 CD-WO disks and 17,000 analog tapes.

5. *Develop and Implement agency-wide tape management and maintenance standards which include all NARA regulations and NIST guidelines.*

NASA has completed a handbook on Records Management, titled "NASA Records Management Guide" which includes NASA-wide standards for tapes and other archive media. The guide on Records Management was completed in July, 1992 and distributed to NASA, GSA, and NARA. It contains an extensive section on electronic records and contains specific agency tape management and maintenance procedures. In addition, NASA is working with agencies and industry to develop management and maintenance standards for other types of media that are becoming part of NASA's data environment.

NARA published, in the Federal Register, its revised Electronic Records Management procedures as 36 Code of Federal Regulations (CFR) Part 1234 on May 8, 1990 and NASA announced these regulations to its field installations on May 18, 1990. In addition, the General Services Administration (GSA) published revised guidelines on tape management on January 30, 1991 in Federal Information Resources Management Regulation (FIRMR) Bulletin B-1 entitled, "Electronic Records Management." These publications from NARA and GSA were much more current than those from the National Institute of Standards and Technology (NIST) and were used by NASA until NASA's handbook on Records Management was completed.

6. *Ensure that the offices and officials responsible for managing science data are identified and their responsibilities clearly defined.*

The revised NASA/OSSA Science Data Management Directive which was issued in March 1992, explicitly addresses the roles and responsibilities of the offices and officials responsible for managing science data. This effort was coordinated by the Information Systems Branch with the members of the Associate Administrator's Office and the data management committees of each OSSA Discipline Division.

Excerpted from that document:

4. Responsibilities and Authorities

a. Associate Administrator for Space Science and Applications
The Associate Administrator for Space Science and Applications is responsible for maintaining and ensuring the implementation of NASA's data management policy, including issuing implementing instructions and guidelines.

b. Assistant Associate Administrator for Science and Applications
The Assistant Associate Administrator for Science and Applications shall serve as chairperson of the Information Systems Management Board, which is chartered to coordinate OSSA's data management activities, and to identify issues, set priorities, and provide recommendations to the Associate Administrator for Space Science and Applications on these activities.

c. OSSA Discipline Division Directors
The Directors of OSSA's Science Discipline Divisions are responsible for the overall administration of their Division's data management activities in accordance with this Program Directive and the decisions of the Information Systems Management Board. Data acquired from both flight projects and non-satellite programs will be addressed as part of this responsibility. The primary objective of this activity is to assure the continuing value of OSSA's science data by providing data management procedures, systems and services that are responsive to the needs of the project, discipline, NASA, and broad research communities.

d. OSSA Flight Systems Division Director
The primary responsibilities of the Information Systems Program within OSSA's Flight Systems Division are to formulate and coordinate OSSA wide data management policy and to provide the supporting infrastructure across the discipline efforts. This includes providing a broad range of data management capabilities which transcend discipline-specific data management activities and serving as OSSA's point of contact for data management activities.

7 *Ensure that NASA officials responsible for overseeing NASA IRM periodically review NASA's data management and archiving to ensure compliance with NARA regulations.*

In FY 1990, IRM reviews included some elements which addressed data management and archiving. In FY 1991, NASA formally incorporated tape archiving requirements as part of the NASA IRM Review program, making physical inspection of tape storage facilities part of the regularly scheduled IRM reviews at its field installations. In addition, NARA, as part of its visits to the field installations to validate record holdings, conducts inspections of tape storage facilities. To date, NASA Headquarters has conducted inspections at the Kennedy Space Center and at the Jet Propulsion Laboratory in September 1990 and December 1990, respectively. Kennedy Space Center was found to have an excellent tape storage facility and the Jet Propulsion Laboratory was found to have made substantial progress in correcting its tape storage deficiencies. The Marshall Space Flight Center was inspected by NASA Headquarters in September 1991 and four additional field installations were inspected in FY 92.

8. *Ensure that NASA's data management and archiving are allocated adequate resources to properly store and maintain NASA's space science data holdings.*

The NASA/OSSA Data Management Initiative (DMI) is a multi-year, multi-million dollar effort that will ensure archiving of appropriate data from past missions, and creation of an infrastructure to enable the orderly archiving of data from future missions. The program will also ensure that data are preserved, inventoried and documented to facilitate broad future access by the science community.

The DMI program, coordinated by OSSA's Information Systems Branch (ISB) was proposed as a $4M new start for FY92. The program was funded and began in FY92 at the $1.8M level despite the absence of "new" dollars in the budget. Future funding for this activity out of the ISB budget has been projected as $1.4M, $1.1M and $750k for FY93-95 respectively. The Science divisions are investing similar amounts in associated efforts to enhance the data environment.

The funding in FY92 allowed three types of activities associated with the DMI to begin, including:

1) Identification and community assessment and prioritization of data sets in need of "restoration"

2) Restoration and/or archiving of appropriate data sets

3) Creation/Improvement of the capabilities and capacities of the Discipline Data Systems (DDS) and of the NSSDC, and of the procedures and tools whereby those entities assure the routine flow of increasing volumes of the right data into the OSSA archive environment (and retrievability of there from that environment).

Initial efforts in the early years of the DMI will focus on identification and restoration/archiving of appropriate data sets. Funding has been provided in FY92 at the sites of four space physics groups and six astrophysics groups for restoration and reformatting. In addition, the restoration program at JPL is continuing. Improvements to data management systems and facilities will be the focus of the DMI once important data sets have been safely archived. However, definition and development of new DDS's in Life Science, Microgravity, and Space Physics has begun under the DMI in 1992.

Those elements of the OSSA data management and archiving program relevant to the five recommendations from the November 1990 report will be discussed in the following paragraphs.

1. *Require NSSDC to identify and, if warranted and cost effective, obtain all outstanding archival data from past missions not yet delivered to its archives.*

   NASA has completed its two-phase data census to identify all data products from previous missions that should be archived. The census was initiated through the NSSDC and conducted in conjunction with working groups from each of the science disciplines. An element of the working groups contribution was to develop criteria and procedures for reviewing and establishing priorities to move selected data sets either to the NSSDC or to the appropriate discipline data center. During the first phase, data held by scientists and facilities associated with JPL and GSFC were surveyed. Phase one of the census was summarized in a report dated March 12, 1990. This report identified 294 data sets from 72 spacecraft. Phase two of the census surveyed more than 200 former Principal Investigators in addition to those involved in Phase one, in an effort to identify data suitable for archiving. While the survey response was less than 100%, it was determined that the extant data from over 80 % of the inactive investigations for which there were responses were fully archived at NSSDC.

   Data sets suitable for archiving were identified from the following missions:

Mission	Data	Source
IMP 7&8	750 library tapes	CalTech
HEAO-3	600 tapes	CalTech
OGO-5	100 tapes	Univ. of Chicago
Spacelab-2	100 tapes	Univ. of Chicago
IMP 6&8	2,555 digital experimenter tapes, 11,000 analog tapes, film data	Univ. of Iowa
Viking Lander 1&2	Meteorology data	Univ. of Washington
OGO-4	50 books of strip charts	NRL
Mariner 4	Wind data report	MIT
Solrad-HI	30 tapes	MIT
Viking Orbiter 1&2	300 tapes	Stanford

   Additional activities to archive outstanding data are ongoing as part of the Data Management Initiative.

2. *Revise data management policy to (1) recognize the need to archive selected original data of potential long-term scientific value, and (2) specify archiving requirements for data produced by life science, microgravity, aircraft, balloon, and sounding rocket missions, and data from NASA instruments flown on Shuttle missions and foreign spacecraft.*

   A revised policy on science data management for the Office of Space Science and Applications (OSSA) was issued in March 1991. The need to archived selected original data of potential long-term scientific value is recognized in paragraph 3(b) of this policy:

"NASA shall establish and maintain archives to preserve and make accessible all valuable NASA science data and information. This system of data archives shall include easily accessible information about NASA's data holdings, guidance, and aids for locating and obtaining the data. A review process, including scientific community representation, shall be established to determine what data should be archived and to assure conformance with completeness and quality standards."

The scope and effect have been updated to deal with the full range of OSSA science programs, including life sciences, microgravity, and suborbital programs. This is reflected in Section 2 of the Policy Directive on Scope:

"This program directive is applicable to the management of all science data resulting from Office of Space Science and Applications sponsored research missions and programs."

3. *Ensure that all missions develop and submit approved PDMPs.*

The new OSSA Program Directive: "Policy for the Management of NASA Science Data" specifies that:

> *"All data being captured by NASA science projects and space flight missions shall be addressed in a Project Data Management Plan to assure the availability of data and supporting information on a timely basis for use by the science community...."*

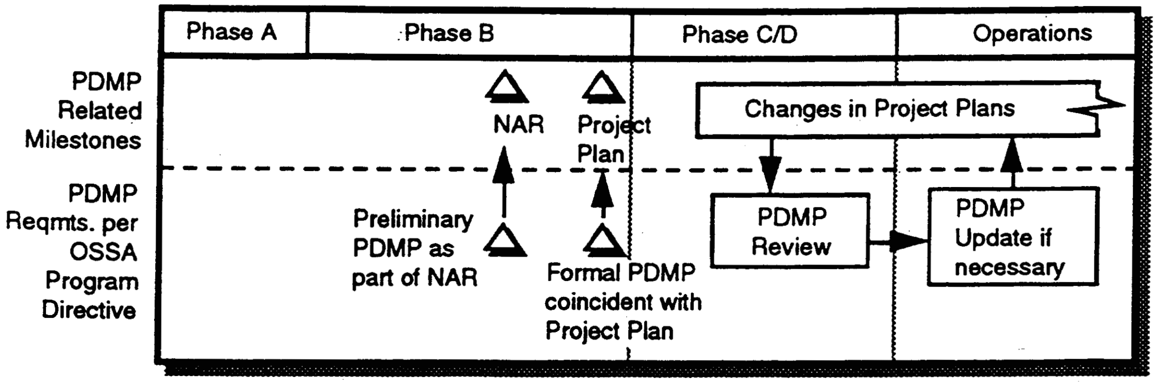
This directive emphasizes the importance of data archiving, but also addresses the broader problem of data management, with a strong emphasis on early planning. It calls for completion of PDMPs earlier in the project life cycle. The first version of the PDMP will be prepared in the same time frame as the Project Plan, shortly after new start approval for the project. It is envisioned that updates to the document will be made to reflect significant changes in data management planning throughout the period prior to launch, and throughout the mission operations and data analysis phase of the project. The formal definition (non advocate) review or equivalent mechanism conducted prior to a project receiving new start approval will assess data management plans as well as spacecraft development, instrument plans, etc.

PDMPs should be consistent with the framework established within this policy as well as with the data management plans of the relevant disciplines. Science discipline divisions are responsible for reviewing these plans as part of the new start approval, examine them on an on-going basis as projects develop, and, in the context of integrating project data plans, build toward a total research capability and for that discipline. Disciplines will be guided by the advice and counsel of their respective science communities to ensure the adequacy of plans for the flow of science data into discipline-oriented archives that serve the entire community. In addition, an OSSA-level review will be conducted annually to provide an integrated assessment of plans.

The essential functions of the PDMP are to:

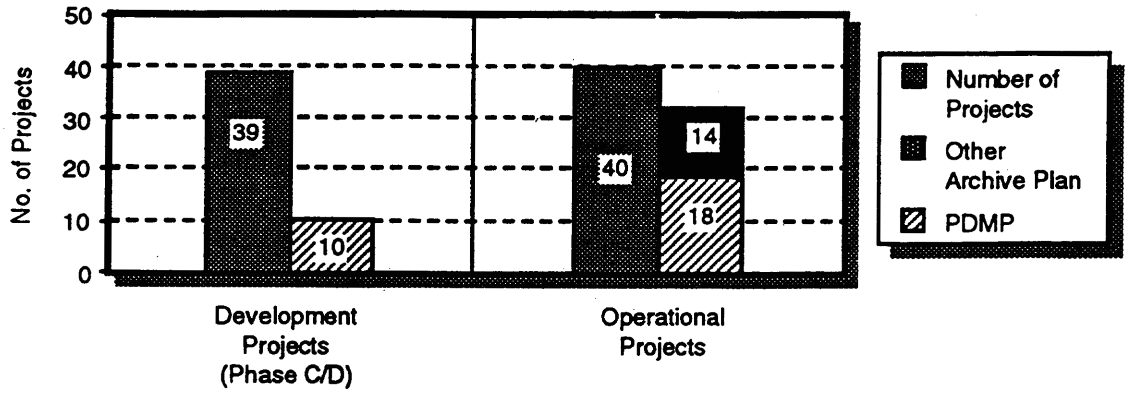
a. Provide consistent documentation to facilitate planning and implementation of science data management needs.
b. Identify and characterize all project data sets and indicate those which require archiving.
c Specify the time, location, and format for Project data and supporting documentation to flow into the OSSA archive environment.

The requirements for PDMP development over project phases are shown in the figure below.



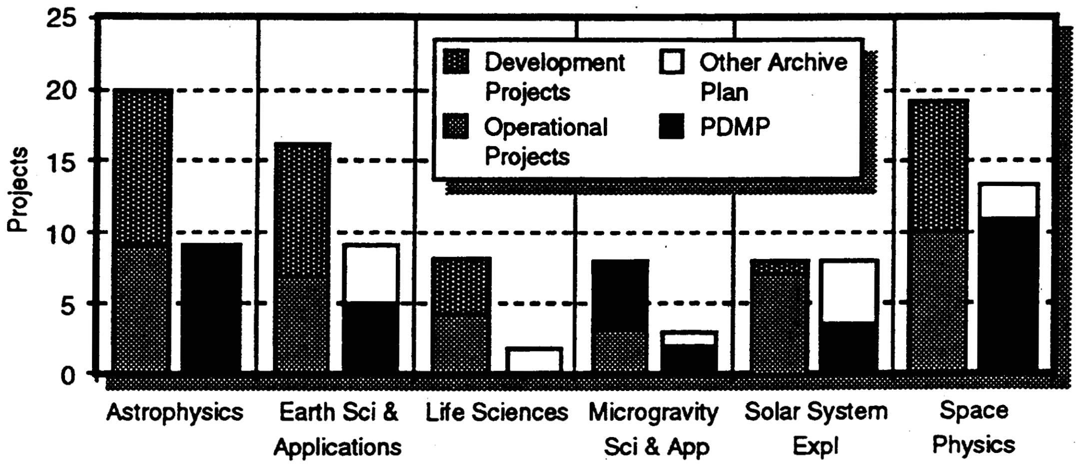
PDMP Requirements.

Current PDMP status for relevant OSSA missions, in the appropriate phase of development or operations is shown in Figure 12. From this information, it can be seen that there are currently 79 projects requiring PDMPs per OSSA policy. Of the projects requiring PDMPs, 28 projects have PDMPs while 14 projects have an alternative document that addresses archiving and data management plans. Many of these projects were in operation prior to the requirement for a PDMP.



Data Management Planning Status.

The status of PDMPs for each of the disciplines is shown below. The figure distinguishes between projects in Phase C/D and operational projects, although PDMPs are required for all these projects.



Current Data Management Planning Status by Discipline

OSSA is revising the "Guidelines for Developing a PDMP" as part of the overall update of data management policies. These guidelines, originally distributed to flight projects in 1988 to provide uniform guidance for developing plans, have contributed to the progress in generating effective plans. Based on experience to data, more specific guidance will be given in terms of key data management parameters to be addressed and tracked as the project develops. These parameters will provide a general overview of project data management requirements. The NIMS database at the NSSDC will be a primary resource for compiling data from all OSSA PDMPs. It incorporates parameters which can be used for planning at the spacecraft, experiment, and dataset levels. The PDMPs should address those parameters identified in the guidelines document so that the PDMP becomes a standard source of information for planning.

4. *Establish and enforce an internal controls system to ensure that original data are not destroyed until NSSDC has received all appropriate archival data.*

Procedures for assuring that lower level, "original" data products are retained until higher level data products are generated and archived have been evaluated in the context of the overall revision of data management policies. This procedure will be one of the key checklist items within the PDMP for flight projects (Note: In the architecture envisioned for future archives, data will flow to discipline archive centers as well as to the NSSDC.)

In addition, NASA is considering as agency policy to capture all "original" data (i.e., time-ordered experiment data with space network downlink artifacts removed) on a routine, production basis. This would serve as an institutional backup and provide a source outside individual project data systems to recover and reprocess data.

NASA, in conjunction with NARA, has updated NASA's Records Disposition Handbook, 1441JA, last published on December 1, 1970. This handbook contains all of NASA's record holdings, the length of their retention, and their disposition and destruction authorities. NARA archivists have conducted week long evaluations at each of NASA's field installations to validate record holdings, and schedules for retention, disposition and destruction.

NARA completed its review of NASA in June 1992. NASA expects to issue its printed Records Disposition Handbook in early 1993 after NARA approval (due by the end of 1992) . After approval by NARA it will be promulgated to all its field installations for implementation. Records management has been made an internal controls assessable unit, and enforcement will be through NASA's internal controls program.

5. *Determine what additional actions could be taken to (1) involve scientists more in the development and operation of mission data management systems, and (2) more strongly encourage missions to include participation of outside scientists on mission-level data management committees.*

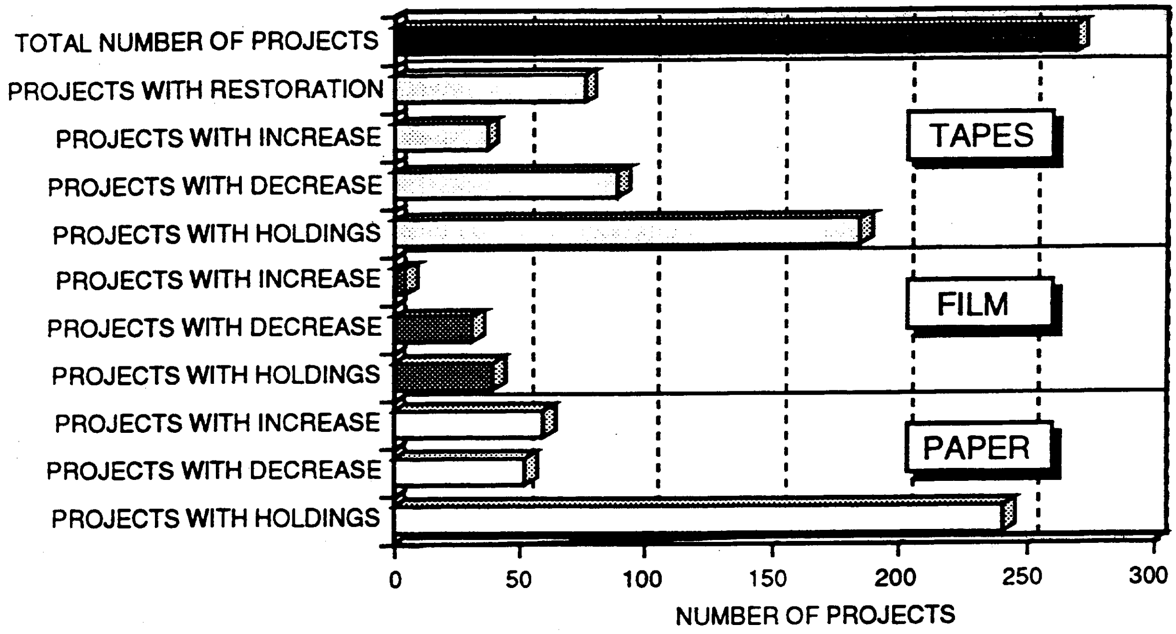
NASA recognizes science user involvement as a vital element for success and has implemented ways to strengthen that involvement. NASA is committed to maintaining an infrastructure for the preservation and distribution of data beyond the original mission science teams, and has involved the general science community in determining what data sets and products should be preserved and made accessible through open archives.

NASA currently has in place an advisory committee structure to drive specific data mission planning at all levels of program activity. There are broad advisory groups such as Space Science and Applications Advisory Committee (SSAAC), disciplinary advisory groups such as the Life Sciences Subcommittee (LSS) and mission-specific advisory groups. These advisory groups provide advice and guidance in all aspects of data management for all programs and projects within each discipline. Representation on these groups is reviewed to ensure the appropriate balance, and that the general science community interests are adequately represented.

Adequacy of the current groups, and the possibility of creating new groups or expanding the charters of current groups, to satisfy the requirements for community participation in the Data Management Initiative (assessing science value of census-identified data sets, etc.) is being discussed between the Information Systems Branch and OSSA Discipline Divisions.

NSSDC Holdings Summary

There are currently 269 science projects with holdings at the NSSDC. The status of the holdings for these projects was given in the table in Appendix IV of the November 1990 GAO report "Space Operations: NASA Is Not Archiving All Potentially Valuable Data." The figure below summarizes the changes in the holdings of these projects by three major media categories of tapes, film or paper. For each media, the number of projects with holdings in that media is provided, as well as the number of projects which have experienced an increase or decrease in holdings at the NSSDC since November 1990. For tapes, the number of projects which have undergone restoration of data from old tapes is shown as well.



Appendix E

GLOSSARY

Active Data Base	Subsets of data or complete data bases that are being actively used by the science community in ongoing research. Generally under the control of, and housed with the science community.
Ancillary Data	Non-science data needed to generate Level 1 data sets. Consists of instrument gains, offsets; pointing information for scan platforms, etc.
Correlative data	Other science data needed to interpret spaceborne data sets. May include ground-based data observations such as soil type or ocean buoy measurements of wind drift.
Data	Information of use to scientific investigations.
Data Acquisition	Process whereby basic data is received by a system.
Data Analysis	Process by which higher-level data products are derived from basic data acquired by instruments. Data analysis functions include modeling, manipulation, data interpretation, and data presentation.
Data Archive	Long-lived collections of science, operational and related ancillary data, maintained as a national resource at a data center, supported with adequate cataloging, protection, and distribution functions. It provides long-term access to data by the general space science community.
Data Base	The actual data, either part of an archive, repository, or active data base that is needed to do scientific research.
Data Catalog	Descriptions of data base in sufficient detail to retrieve subsets of data. Searchable by data fields or attributes, down to some level of granularity. Used to look or browse through a data base.
Data Directory	Top-level index containing information about location, ownership, contents of data. Used as first step in determining what types of data exist for given time, period, location, etc.
Data Handling	The process of data acquisition including onboard encoding and compression of data generated by flight sensors, data preprocessing on the ground to remove the artifacts of data transmission and conversion of raw data to Level 0 data, and management of this process to assure completeness and accuracy of
Data Retrieval	Process whereby data is transferred from a data storage center to a science user.
Data Retrieval System	Use of processing algorithms and software in order to access the archived/stored data.
Data Repository	Short-term data base that serves as a way station or clearinghouse for data - such as a mission data base to support operations and compilation of initial results. Temporary buffers for new data, usually existing only as long as the mission producing the data.
Data Set	The accumulation of data products, supplemental data, software, and documentation that will completely document and support the use of those data products. A data set can be part of a data set collection, can reside on a single physical volume or across multiple volumes.
Data Storage	Process whereby basic data or processed data is transferred to a stable medium prior to actual usage.
Data Storage Center	Archiving center where data is available for access by the science community.
Data Transfer	Process whereby data flows between systems/elements.
Decommutation	Process whereby the downlink data stream is split into data streams that contain data from only one or from select payloads or systems.
Element	Physical part of a system, which performs a function or functions.
Functions	Characteristic action of an element or group of elements of any system.

Level 0 Data	Reconstructed unprocessed instrument data at full resolution. Edited Data corrected for telemetry errors and split or decommutated into a data set for a given instrument. Sometimes called Experimental Data Record. Data are also tagged with time and location of acquisition.
Level 1A Data	Reconstructed unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information including radiometric and geometric calibration coefficients and geo-referencing parameters (i.e., platform ephemeris) computed and appended but not applied to the Level 0 data. Calibrated Data - Level 0 data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so Level 0 data can be reconstructed.
Level 1B Data	Level 1A data that have been processed to sensor units (i.e., radar backscatter cross section, brightness temperature, etc.). Not all instruments will have a Level 1B equivalent. Resampled Data - have been resampled in the time or space domains in such a way that the original edited data cannot be reconstructed. Could be calibrated in addition to be resampled (can also meet Level 1A definition).
Level 2 Data	Derived environmental variables (e.g., ocean wave height, soil moisture, ice concentration) at the same resolution and location as the Level 1 source data.
Level 3 Data	Variables mapped on uniform space-time grid scales, usually with some completeness and consistency (e.g., missing points interpolated, complete regions mosaiced together from multiple orbits)
Level 4 Data	Model output or results from analyses of lower level data (i.e., variables that are not measured by the instruments, but instead are derived from these measurements)
Metric	A quantitative parameter used to assess the performance of systems or functions/elements
Productivity	A metric relating output to the resources required for generating that output.
Raw Data	Telemetry data with data embedded
Secondary User	A researcher not involved with instrumentation design, development, or data acquisition. A secondary user would normally go to a data archive to obtain the required data set.
System	An integrated set of elements which performs the necessary functions to accomplish the desired operation.
Telemetry Services	Those activities required to convert the spacecraft downlink into data that is useful to the experimenter or investigator.
User Description	Description of why the data were acquired, any peculiarities with the data sets, and enough documentation to allow secondary user to extract information from the data.

Appendix F

ACRONYMS

ACE	Advanced Composition Explorer
ADC	Astronomical Data Center
	Affiliated Data Center
ADEOS	Advanced Earth Observation System
ADS	Astrophysics Data System
ARC	NASA Ames Research Center
ASP	Attached Shuttle Payload
ASTRO	Astronomical Laboratory
ATLAS	Atmospheric Laboratory for Applications and Science
AXAF	Advanced X-ray Astrophysics Facility
BBXRT	Broad Band X-ray Telescope
BUFR	Binary Universal Form for the Representation of Meteorological Data
CARB	Center for Advanced Research in Biotechnology
CASA	Center for Astronomy and Space Astrophysics
CDDIS	Crustal Dynamics Data Information System
CDF	Common Data Format
CDHF	Central Data Handling Facility
CD-ROM	Compact Disk Read-Only Memory
CEOS SS	Committee on Earth Observing Satellites Superstructure
CIESIN	Consortium for International Earth Sciences Information Network
COBE	Cosmic Background Explorer
COD-MAC	Committee on Data Management and Computation
COSTR	Collaborative Solar-Terrestrial Research
CRISTA	Cryogenic Infrared Spectrometer Telescope for Atmosphere
CRRES	Combined Release and Radiation Effects Satellite
DAAC	Distributed Active Archive Center
DDS	Discipline Data System
DIS	Data and Information System
DMI	Data Management Initiative
DXS	Diffuse X-ray Spectrometer
EDR	Experimental Data Record
EHIC	Energetic Heavy Ion Composition
EOC	Earth Observation Contrl
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ERBE	Earth Radiation Budget Experiment
EROS	Earth Resources Observation System
ESAD	Earth Science and Applications Division
ESDIS	Earth Science Data and Information System
EUVE	Extreme Ultraviolet Explorer
FAST	Fast Auroral Snapshot Explorer
FITS	Flexible Image Transfer System
FUSE	Far UV Spectroscopy Explorer
FY	Fiscal Year
GAO	Government Accounting Office
GGS	Global Geospace Science
GO	Guest Observer
GP-B	Gravity Probe B
GRIB	Gridded Binary
GRO	Gamma Ray Observatory
GSFC	NASA Goddard Space Flight Center
HDF	Hierarchical Data Format
HEAO	High Energy Astrophysics Observatory
HEAS-ARC	High Energy Astrophysics Science Archival Research Center
HNC	Heavy Nuclei Collector
HPCC	High Performance Computing and Communications
HST	Hubble Space Telescope
ICD	Interface Control Document
ICE	International Cometary Explorer
ICF	Instrument Control Facility
IEH	International Extreme-UV Far-UV (Hitchhiker)
IML	International Microgravity Laboratory
IMP-8	Interplanetary Monitoring Platform-8
IPAC	Infrared Processing and Analysis Center
IRAS	Infrared Astronomical Satellite
ISB	Information Systems Branch
ISO/OSI	International Standards Org./Open Systems Interconnection
ISSP	Information Systems Strategic Planning Project
ISTP	International Solar-Terrestrial Physics
IUE	International Ultraviolet Explorer
JPL	Jet Propulsion Laboratory
JSC	NASA Johnson Space Center
KPD	Key Parameter Data

LAGEOS	Laser Geodynamics Satellite
LaRC	NASA Langley Research Center
LeRC	NASA Lewis Research Center
MD	Master Directory
MIT	Massachusetts Institute of Technology
MO&DA	Mission Operations & Data Analysis
MSAD	Microgravity Science & Applications Div.
MSFC	NASA Marshall Space Flight Center
NAIF	Navigation Ancillary Information Facility
NASA	National Aeronautics and Space Administration
NCCS	NASA Center for Computational Sciences
NCDS	NASA Climate Data System
NDADS	NSSDC Data Archive and Distribution Services
NETCDF	Network Common Data Format
NEW-PIMS	Neutral Environment With Plasma Interaction Monitoring System
NIST	National Institute of Standards and Technology
NMI	NASA Management Instruction
NMSU	New Mexico State University
NODS	NASA Ocean Data System
NOST	NASA/OSSA Office of Standards and Technology
NRA	NASA Research Announcement
NSBF	National Scientific Balloon Facility
NSCAT	NASA Scatterometer
NSF	National Science Foundation
NSI	NASA Science Internet
NSP	NASA Support Plan
NSSDC	NASA Space Science Data Center
OAST	Office of Aeronautics and Space Technology
OCD	Operations Concept Document
ORFEUS-SPAS	Orbiting and Retrievable Far and Extreme UV Spectrometer
OSSA	Office of Space Science and Applications
PDMP	Project Data Management Plan
PDS	Planetary Data System
PDS Labels	Planetary Data System Labels
PI	Principal Investigator
PIP	Payload Integration Plan
PLDS	Pilot Land Data System
PSASS	Planetary Science Analysis Support System
PSCN	Program Support Communications Network
PSU	Pennsylvania State University
Radarsat	Radar Satellite
ROSAT	Roentgen Satellite
SAMPEX	Solar, Anomalous, and Magnetospheric Particle Explorer
SAO	Smithsonian Astrophysical Observatory
SAR	Synthetic Aperture Radar
S/C	Spacecraft
SDTS	Spatial Data Transfer Standard
SDU	State of the Data Union
SeaWiFS	Sea-Viewing Wide Field Sensor
SFDU	Standard Formatted Data Units
SIRD	Support Instrumentation Requirements Document
SIRTF	Space Infrared Telescope Facility
SLS	Space Life Sciences Laboratory
SMEX	Small Class Explorers
SOHO	Solar and Heliospheric Observatory
SPAN	Space Physics Analysis Network
SPD	Space Physics Division
SPDS	Space Physics Data System
SPDS/SC	SPDS/Steering Committee
SPTN	Shuttle Pointed Autonomous Research Tool For Astronomy
SRL	Space Radar Laboratory
SSBUV	Shuttle Solar Backscatter UV Instrument
STScI	Space Telescope Science Institute
SWAS	Submillimeter Wave Astronomy Satellite
SwRI	Southwest Research Institute
TDRSS	Tracking and Data Relay Satellite System
TOMS	Total Ozone Mapping Spectrometer
TOPEX	Ocean Topography Experiment
TRMM	Tropical Rainfall Measurement Mission
TSS	Tethered Satellite System
TSSF	Tape Staging and Storage Facility
UAF	University of Alaska / Fairbanks
UARS	Upper Atmosphere Research Satellite
UCLA	University of California - Los Angeles
UHRXS	Ultra High Resolution Extreme Ultra Violet Spectroheliograph
UMSOC	University of Maryland Space Operations Center
USGS	United States Geological Survey
USML	United States Microgravity Laboratory
USMP	United States Microgravity Payload
WISP	Waves in Space Plasma
WORM	Write Once, Read Many
XTE	X-Ray Timing Explorer

Appendix G

REFERENCES

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MAR - 5 1992

SMI

TO: Distribution

FROM: S/Associate Administrator for Space Science and Applications

SUBJECT: Science Data Management Policy

Enclosed is an OSSA Program Directive establishing the policies for management of science data. It replaces NMI 8030.3A, "Policy Concerning Data Obtained from Space Science Flight Investigations."

This revised policy reflects increased emphasis and priority for managing our science data assets, from acquisition, through science processing and analysis, to archiving and preservation. It also stresses the need to address data issues early and continuously throughout flight project planning and implementation.

The primary responsibility for data management planning and implementation will continue to be placed in the science discipline divisions, in conjunction with the advice and counsel of their scientific communities. I will also continue to look to the Information Systems Management Board to coordinate data management efforts across divisions.

I appreciate your care and attention to this important topic.

Original signed by:
L. A. Fisk

L. A. Fisk

Enclosure

Distribution:

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OFFICE OF SPACE SCIENCE AND APPLICATIONS
PROGRAM DIRECTIVE

Responsible Offices:

Life Sciences Division
Earth Sciences and Applications Division
Solar Systems Exploration Division
Flight Systems Division
Microgravity Science and Applications Division
Space Physics Division
Astrophysics Division

Subject: Policy for the Management of the Office of Space Science and Applications' Science Data

1. Purpose

The purpose of this Program Directive is to establish NASA's policy for, and delineate responsibilities and authorities relative to, the continuing management of the Office of Space Science and Applications' science data. It replaces NASA Management Instruction (NMI) 8030.3A, "Policy Concerning Data Obtained from Space Science Flight Investigations", dated May 2, 1978, in satisfying this function which was first established in a NASA Policy Directive, dated January 7, 1967 (NPD 8030.3). Among other important modifications, NMI 8030.3A established the requirement for all space flight projects to develop Project Data Management Plans (PDMPs). As defined in NMI 8030.3A, the PDMP was essentially conceived as a data archiving plan. The increasing complexity of NASA science investigations and the volume of data that they generate (among other factors) emphasizes the need for increased emphasis and priority for data management planning early in the project's life. Additionally, these data management planning activities must address the total flow of research data not just archiving. This Program Directive expands the scope of the PDMP to include planning for data management throughout the project planning and implementation phases.

2. Scope

This program directive is applicable to the management of all science data resulting from Office of Space Science and Applications sponsored research missions and programs.

Mr. Joseph Bredekamp, Chief
Information Systems Branch

Mr. Robert Benson, Director
Flight Systems Division

Dr. Arnauld Nicogossian, Director
Life Science Division

Dr. Shelby Tilford, Director
Earth Science and Applications
Division

Dr. Wesley Huntress, Jr., Director
Solar System Exploration Division

Mr. Robert Rhome, Director
Microgravity Science and
Applications Division

Dr. Charles Pellerin, Director
Astrophysics Division

Dr. George Withbroe, Director
Space Physics Division

Mr. Joseph Alexander
Asst. Associate Administrator
(Science and Applications)

Ms. Kathryn Schmoll
Asst. Associate Administrator
(Institutions)

3. Policy

a. Science data generators and users shall serve as a primary source of requirements, as well as final judge of the quality and value of scientific data. Advice and guidance shall be obtained from the science and applications research community in the planning and implementation of NASA's data management systems.

b. NASA shall establish and maintain archives to preserve and make accessible all valuable NASA science data and information. This system of data archives shall include easily accessible information about NASA's data holdings, guidance, and aids for locating and obtaining the data. A review process, including scientific community representation, shall be established to determine what data should be archived and to assure conformance with completeness and quality standards.

c. National and international standards for media, formats, and communication of data sets shall be used to the greatest extent possible. NASA shall participate in the development and implementation of standards. NASA unique standards shall be used only if adequate national or international standards are lacking. The intent of this policy is to standardize the interfaces between the users and NASA's data and information systems, not to standardize the systems themselves.

d. Project, discipline, and OSSA-wide data management activities shall be reviewed periodically to assess status and progress relative to Agency and OSSA goals, objectives and standards, and the needs of the science community. Once archived, data sets and supporting information shall be periodically reviewed to assess their value for continued retention by NASA. This process shall also prevent the loss of important data sets.

e. All data being captured by NASA science projects and space flight missions shall be addressed in a Project Data Management Plan (PDMP) to assure the availability of data and supporting information on a timely basis for use by the science community. The formal definition (non advocate) review or equivalent mechanism conducted prior to a project receiving new start approval will assess data management plans as well as spacecraft development, instrument plans, operations plans, etc. After new start and budget approval a formal Project Data Management Plan will be prepared and approved coincident with the Project Plan signed by the Associate Administrator and Field Center Director. Project Data Management Plans must be updated as significant changes occur that impact the project's plans for data management, and PDMPs should be reviewed periodically to determine if updates are required. For programs in which selected investigators have initial periods of exclusive data use, data should be made openly available as soon as that period expires. In such cases, the duration of all exclusive use periods shall be explicitly defined.

f. NASA shall periodically conduct a review of its data repositories and archives to determine the state of data and to assure conformance with applicable government standards for data storage.

g. Recognizing the pivotal importance of technology in meeting its future needs for data and information systems, OSSA shall establish an active process to maintain an awareness of emerging applicable technologies, infuse them into its systems, and stimulate new technology development where warranted.

4. Responsibilities and Authorities

a. Associate Administrator for Space Science and Applications

The Associate Administrator for Space Science and Applications is responsible for maintaining and ensuring the implementation of NASA's data management policy, including issuing implementing instructions and guidelines.

b. Assistant Associate Administrator for Science and Applications

The Assistant Associate Administrator for Science and Applications shall serve as chairperson of the Information Systems Management Board, which is chartered to coordinate OSSA's data management activities, and to identify issues, set priorities, and provide recommendations to the Associate Administrator for Space Science and Applications on these activities.

c. OSSA Discipline Division Directors

The Directors of OSSA's Science Discipline Divisions are responsible for the overall administration of their Division's data management activities in accordance with this Program Directive and the decisions of the Information Systems Management Board. Data acquired from both flight projects and non-satellite programs will be addressed as part of this responsibility. The primary objective of this activity is to assure the continuing value of OSSA's science data by providing data management procedures, systems and services that are responsive to the needs of the project, discipline, NASA, and broad research communities.

d. OSSA Flight Systems Division Director

The primary responsibilities of the Information Systems Program within OSSA's Flight Systems Division are to formulate and coordinate OSSA wide data management policy and to provide the supporting infrastructure across the discipline efforts. This includes providing a broad range of data management capabilities which transcend discipline-specific data management activities and serving as OSSA's point of contact for data management activities.

Approved by:
L.A. Fisk
Associate Administrator for
Space Science and Applications

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of:

SMI

22 January 1993

To: Distribution

From: Jim Harris

Subject: Revised PDMP Guidelines Document

In order to make the PDMP guidelines more useful to project managers, and to reflect changes in PDMP utilization directed in OSSA data management policy, the PDMP guidelines document has undergone major revisions to format and structure. The focus of this document is on the project manager, to make the guidelines better organized and more understandable. The format is focused on utility of the information contained in the PDMP's.

These revisions are intended to accomplish the following:

- Enable easier entry of information into the PDMP
- Make all PDMP's more consistent and useful
- Focus the content of the guidelines document

Please review these guidelines and provide comments by 12 February. Comments received will be considered for incorporation in the final version of this document, which will be completed and distributed by the end of February.

Your assistance in reviewing these revised guidelines will be very helpful in providing a more useful document for all.

DRAFT

Guidelines for Development of a
PROJECT DATA MANAGEMENT PLAN (PDMP)

NASA Office of Space Science and Applications

December 1992

National Aeronautics and Space Administration
Office of Space Science and Applications
Information Systems Branch

Prepared by Futron Corporation under Contract NASW-4493

Contents

Figures and Tables

Preface

In principle, the PDMP is intended to address all aspects of data from OSSA investigations, from the point of their coming out of sensors, through their various transmissions and processing, to their entry into the OSSA archives. In practice, it is expected that data will flow from the project's sensors through "institutional facilities" not "owned" by the project (e.g., Code O telemetry acquisition systems, generic low level data processing systems) to "project-owned" systems and project-funded scientists, and finally from project systems/scientists into OSSA archives. During this data flow, data will be transformed at multiple steps, and not all data may be appropriate for the archives.

In practice, the PDMP will be used primarily to support the readiness of the institutional facilities, including Code O front end systems, Code O and/or OSSA networks used during the "project data use" phase, and OSSA archives at the back end, to discharge their responsibilities relative to the project's data. The PDMP also serves as the record of what data products the project will create.

The effectiveness of the data management and archiving process depends on a well-defined relationship between the project, investigators, and the archive facility. With cooperation, NASA's data management infrastructure 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.

The requirement for all OSSA projects to complete a PDMP was clearly defined in the recent OSSA data management policy. The relevant PDMP requirements are summarized below, and a full copy of the policy statement is included in Appendix B.

- All OSSA data being captured shall be addressed in a PDMP
- The NAR (or equivalent) will include early assessment of data management plans
- A formal PDMP will be prepared and approved coincident with the Project Plan
- PDMPs should be reviewed periodically and updated as required
- The duration of all exclusive use periods shall be explicitly defined

The purpose of this document is to provide guidelines to assist NASA Project personnel in the preparation of their Project Data Management Plans (PDMPs). **The outline of this document is the recommended outline for all PDMPs.** In each section, the text describes the type of material which should be included, and recommended table formats are provided which summarize relevant data management parameters. The format provided should be general enough to be applied to all science investigations within OSSA. These formats should be modified as appropriate, depending upon the specifics of any particular discipline or project requirements.

Summary tables of all project, instrument, and data set parameters should be included as an appendix to each PDMP. This will provide a concise summary of relevant data management parameters for each project. Recommended formats for these tables are provided in Appendix A of this document.

The intent of these guidelines is to make the assembly of PDMP's easier for the projects, and to ensure that PDMP's be in a consistent and useful format. Any comments regarding the utility of these guidelines, or suggestions for improvement would be appreciated.

1.0 Introduction

The introduction should include the name of the project, the current status of the project.

1.1 Purpose and Scope

This section should briefly summarize the purpose of the PDMP for this project, highlighting specific purposes and applications for the plan.

1.2 PDMP Development, Maintenance, and Management Responsibility

This section should identify the organization(s) responsible for the development, maintenance and management of the PDMP document. In addition, the individuals within those organizations who are currently accountable should be identified including locations and phone numbers. 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.

1.3 Change Control

This section should illustrate the plans for modifications and updates to this document over time, and how those changes will be controlled. Such changes could be the result of updates as the project progresses in its development cycle, or from changes to operations plans or hardware capabilities once operational. If there are planned updates, estimated release dates should be given.

1.4 Relevant Documents

All currently available documents with information relevant to data management for the project should be referenced here, including name and location of source for documents, if not readily available. Such documents should at least include ICD's, Project Plan, and relevant documents for each instrument. If some documents are not yet available but planned, this should be indicated, with expected availability dates and organization that will be producing document.

2.0 Project Overview

An overview of the project should be provided in this section. It should specifically include a summary of the history of the project to its current status, including predecessor or related missions.

2.1 Project Objectives

The overall objectives of the project should be briefly described here. This should include how the goals of the project, and how the expected results of the project may contribute to some larger goals or objectives.

2.2 Science Objectives

The specific science objectives of the project should be briefly described here. This would include expected results to be gained in certain scientific areas, and could be related to specific instruments.

Also addressed here should be who the primary science users are expected to be, and which science objectives are expected to be met initially in the project, as opposed to those which may be met through continued accessibility by secondary investigators.

2.3 Spacecraft Description

A brief summary of the spacecraft should be provided here. It should include physical characteristics such as weight and dimensions, and a diagram illustrating the spacecraft and principal subsystems and instruments.

2.4 Mission Summary

A mission summary should be provided in this section, addressing significant schedule and operational characteristics of the project.

The information shown in Table 1 should be provided as a minimum.

Table 1 *Mission summary parameters.*

Mission Summary Parameters	Values
Project Name	
Orbit Description	inclination, apoapsis, periapsis, period
Launch Date	
Launch Vehicle	
Nominal Mission Duration	
Potential Mission Life	
Spacecraft Mass	
Attitude Control	
Propulsion type/capacity	

Detailed information regarding overall mission summary should be included in the write-up rather than the table. Information regarding principal data acquisition characteristics of the overall mission should also be included in this section. The type of information to be included is shown in Table 2.

Table 2 *Mission data acquisition parameters.*

Data Acquisition	Values
On-Board Data Storage Capacity	
Continuous Data Acquisition Rate	
On-Board storage saturation	
Target pointing duration	
Target re-orientation period	
Attitude control accuracy	
Attitude determination accuracy	

Detailed information and descriptions should be included in the write-up.

3.0 Instrument Overview

A brief overview of the project instruments should be provided here. This should include any relevant interactions between the instruments, and how the instruments combine to meet the overall science objectives of the project.

3.1 Instrument "A"

The following information should be provided for each of "n" instruments of the project, resulting in sections 3.1 through 3.n..

3.1.1 Instrument Description

A description of the instrument should be provided in this section. This description should include the experimental objectives of the instrument, the instrumentation involved, and the operational aspects of the instrument and the data modes involved in its operation.

3.1.2 Capabilities and Requirements

The capabilities and requirements of each instrument should be summarized in this section in tabular form. These should include those capabilities and requirements which are relevant to data management. The parameters for each instrument of a project should be consistent, to the extent possible. The parameters shown in Table 3 should be included for each instrument as appropriate.

Table 3 *Instrument summary parameters.*

Data Acquisition	Values
Geophysical Phenomenon/Parameters Measured/Derived	
Number and Type of Detectors	
Sensitive Area	
Field of View	
Energy/Wavelength Range	
Energy/Wavelength Resolution	
Time Resolution	
Positioning	
Sensitivity	
Instrument Weight	
Dimensions	
Average Power	
Data Rate	

Comments on the specifics of an instrument which do not conform to standard parameters listed above could be added, or discussed in the text.

3.1.3 Data Acquisition

The types of data to be acquired by the instrument should be addressed in this section. In addition, the data acquisition modes for each instrument should be addressed. A good example of data acquisition descriptions can be found in the appendices of the GRO PDMP.

4.0 Project Data Flow

An overview of the Project Data Flow should be given here including an overall functional Data Flow Diagram. This diagram should identify those facilities performing various functions as the project progresses through its various mission phases. The diagram should distinguish between those facilities which are specific to the project and those which are discipline or institutional facilities. In addition, an overall project timeline should be developed and included, summarizing key milestones and events relevant to data management over the life cycle of the project.

Though each mission is unique, there are fundamental elements, functions, and services that are common. In general, space science investigations can be divided into three segments of operation: mission operations, science operations, and continued accessibility. During each segment of the project, fundamental functions and services are performed as part of the integrated investigation. Those functions which are project specific should be distinguished from those that are not.

A diagram depicting a generalized architecture for Mission Operations and Data Analysis (MO&DA) is shown in Figure 1. The overall project data flow diagram included in the PDMP should include each of these elements as appropriate, identifying which facilities are expected to perform basic functions.

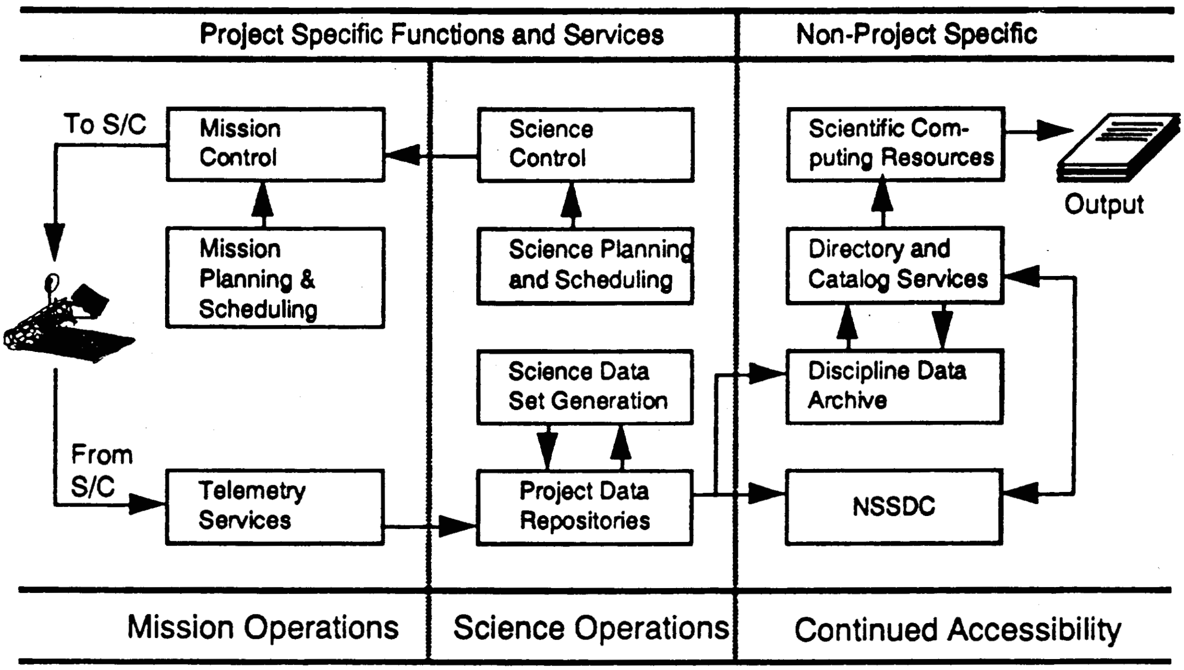

Figure 1 *OSSA MO&DA generalized architecture.*

In additional to a top-level functional flow, a timeline of activities and milestones related to data management over the life cycle of the project should be provided. An example timeline, shown in Figure 2 below, indicates the type of milestones that should be included.

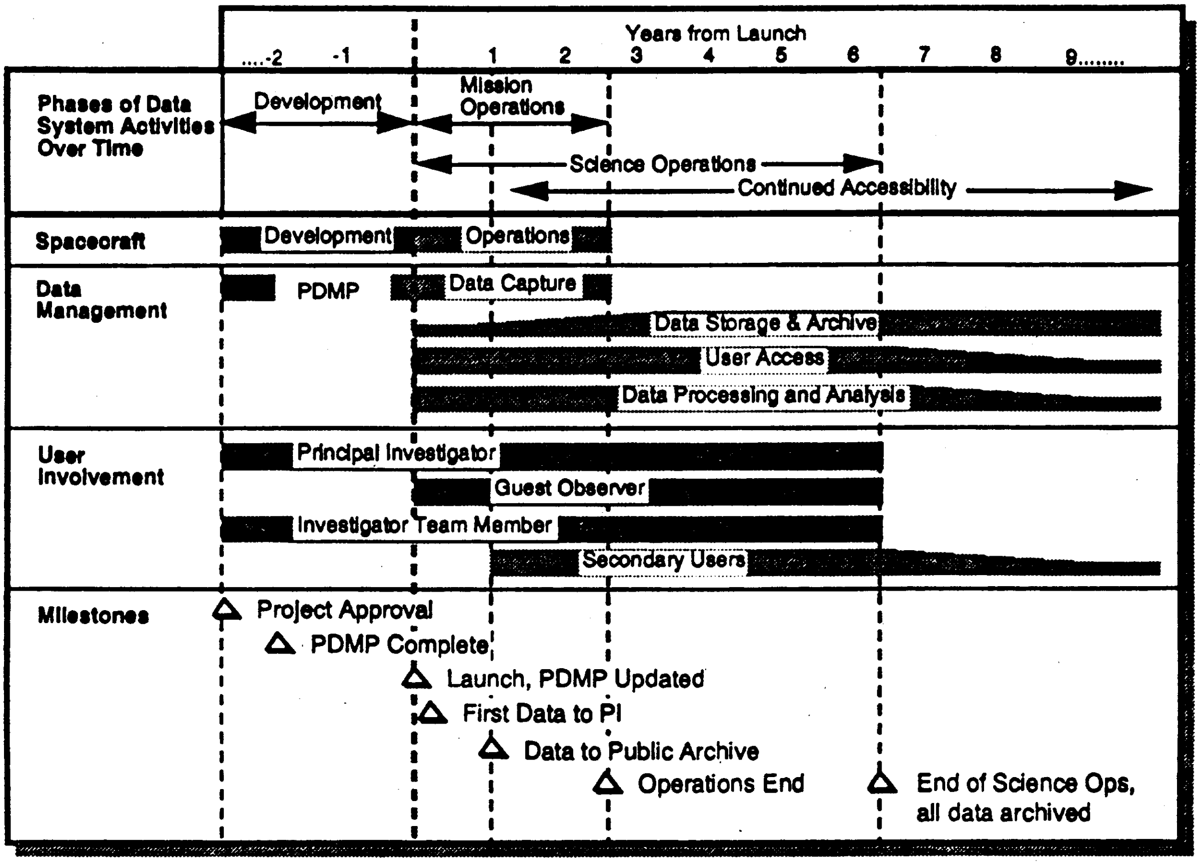

Figure 2 *Overall project timeline.*

4.1 Mission Operations

A summary of the projects Mission Operations concept would be given in this section, including a more detailed functional flow of the mission operations portion of Figure 1. This flow should address the space to ground communications and initial processing of telemetry, as well as the mission control and mission planning and scheduling. The facilities associated with each function of these processes should be identified in the diagram, and the distinction made as to which are project specific and which are not.

In addition to the functional flow, a detailed timeline of the mission operations phase shown in Figure 2 should be included. Specifically, the timeline should address the time from mission planning and scheduling to implementation. Issues such as real time or playback data, quick-look data processing, and real-time experimental control should be addressed as appropriate.

4.1.1 Telemetry Services

This section of the PDMP should address the overall approach to telemetry services, from the space to ground communications to the initial data processing once received. Diagrams illustrating these functions and timelines should be provided in this section in greater detail than in higher level diagrams, as appropriate. The organization of the telemetry format should be illustrated in this section, including frame and packet descriptions.

4.1.1.1 Space to Ground Communications

Discussion of space to ground communications should include the data acquisition mode (whether real-time, playback, etc.) and any specific characteristics of project requirements due to this mode. In addition, the name and location of the ground based facilities involved should be provided. Any operational or mechanical constraints on the telemetry services of the project should be briefly summarized. This could include such things as coordination with other missions.

The parameters shown in Table 4 should be provided as appropriate for the spacecraft. If there is a single communication system for the spacecraft, then one system should be described. If there are multiple communication systems (associated with different instruments for example) then all should be identified.

Table 4 *Space to ground communications parameters.*

Parameter			Values
S/C Link		Frequency	
		Polarization	
		Path	
Data Rates [kbps]			
	Forward	Peak	(kpbs)
		Average	(kpbs)
		Contact Frequency	(times/day, orbital, etc.)
	Return	Peak	(kbps)
		Average	(kbps)
		Bit Error Rate	
		Contract Frequency	(times/day, orbital, etc.)
		Average Duration	(minutes)

If there are sources with specific information on space to ground communications available, they should be included in Section 1.4. A pointer to the document could be included in this section as well, as appropriate.

4.1.1.2 Telemetry Processing

The data capture strategy including requirements for special capabilities such as quick look capability should be addressed in the write-up. If the telemetry processing will be occurring over multiple years at different volume levels or rates, these should be identified by year. The parameters shown in Table 5 should be included in this section.

Table 5 *Telemetry processing parameters.*

Parameter	Values
Annual Volume Input	Gbytes
Throughput [kbps] Peak Average	
Annual Volume Output	Gbytes
Data Distribution Time	(from on-ground to PI)

The write-up should also identify the location and name of the processing facilities, as well as the anticipated rate (percentage) of effective data capture.

4.1.2 Mission Control

This section should address the approach to spacecraft command and control for the project. This includes the overall spacecraft health and safety monitoring, and identification and location of facilities involved.

4.1.3 Mission Planning & Scheduling

The overall spacecraft approach to mission planning and scheduling should be addressed in this section. This should include the identification and location of facilities involved.

4.2 Science Operations

This section should consist of a brief discussion of the project science operations style. The style should be described relative to being principal investigator, guest observer, or other. If other than PI or GO, the style should be specified and described in the write-up. The relationship between the individual scientists and their payloads should be described also.

A more detailed diagram of the science operations functional flow shown in Section 4.0 should be included in this section. In addition, a more detailed timeline of the science operations phase shown in Section 4.0 should be presented. This should address the responsiveness of the system to the instrument control needs of the scientist.

4.2.1 Science Control

This section should address the following aspects of science control for the project:

- Overall payload Command & Control approach
- Overall payload Health & Safety Monitoring
- Location of facilities

4.2.2 Science Planning and Scheduling

The overall approach to science planning and scheduling for the project should be described in this section. If the approach is a distributed system by instrument, then each instrument should be addressed. The write-up should include the location and description of facilities involved..

4.2.3 Science Data Set Generation

This section should address the computing and analysis resources required to produce mission specific data products for PI's, GO's, and the general research community. The resources required to support decisions regarding the real-time or near real-time operation of payloads or instruments should be described as well. The discussion should address facilities which provide support across all instruments, as well as instrument specific support.

Table 6 as shown below, provides a format for summarizing this information.

Table 6 *Science data set generation parameters.*

	Description	Location	Functions	Capabilities
Project Resources				
Instrument "A" Resources				
Instrument "N" Resources				

In addition, the analysis software that may be used to generate the data sets, and any analysis support used should be identified.

4.3 Continued Accessibility

Those activities and functions that are required to ensure the continued availability of data and supporting information on a timely basis for use by the science community should be addressed in this section. This includes a more detailed diagram of the continued accessibility portion of Figure 1, and a more detailed timeline of the continued accessibility phase shown in Figure 2.

Any agreements regarding exclusive rights to data for the PIs should be stated here, with summary timelines for when the data will be released to the public. All data sets to be permanently archived should be identified in this section. They will be described in more detail in Section 5.0.

4.3.1 Data Repositories

There are three general types of data repositories which should be addressed in this section. Project data repositories are project specific, providing temporary storage for active data as it is being processed and analyzed. The other two types are for permanent storage of data. These can be specific to a particular discipline as part of the discipline data system (DDS), or part of the OSSA institutional infrastructure such as the NSSDC.

All data repositories to be used by the project should be identified, including the place where the data enters the archive.

4.3.1.1 Project Data Repositories

This section should address the requirements placed on the project data repositories. These requirements should address the needs of PI's and GO's for active storage using project specific facilities. These requirements are not for permanent archiving, and are not for the general science community, as project data repositories are not open to public use.

Table 7 below provides a format for summarizing storage requirements by data set, over the years the project will be using project data repositories. The data sets should be identified as Level 0, Level 1, etc. This format allows for aggregation of requirements at the data set level to instrument and overall project requirements. The table shows the requirements on a yearly basis, but the information could be provided as "annual" if it remains relatively constant from year to year. The yearly requirements are not aggregated, as the storage requirements are not permanent. All project data repositories to be used should be identified. If multiple project data repositories are to be used, their individual requirements should be identified using separate summary tables as appropriate.

Table 7 *Project data repository parameters.*

	Year "1"	Year "2"	Year "n"
Project Summary			
Instrument "A" Summary			
Level 0 Data Data Set "A-1"			
Level 1 Data Data Set "A-n"			
Instrument "N" Summary			
Level 0 Data Data Set "N-1"			
Level 1 Data Data Set "N-n"			

4.3.1.2 Discipline Archives

This section should address how data will transition from project to permanent discipline archives. Table 8 below provides a format for summarizing storage requirements by data set, over the years the project will be providing data to discipline archives for permanent storage. This format allows for aggregation of requirements at the data set level to instrument and overall project requirements. The table shows the requirements on a yearly basis, but the information could be provided as "annual" if it remains relatively constant from year to year. The yearly requirements are aggregated as well, since the storage requirements are permanent and accumulate over time. All discipline archive facilities to be used should be identified. If multiple discipline archives are to be used, their individual requirements should be identified using separate summary tables as appropriate.

Table 8 *Discipline archive parameters.*

	Total	Year "1"	Year "n"
Project Summary			
Instrument "A" Summary			
Level 0 Data Data Set "A-1"			
Level 1 Data Data Set "A-n"			
Instrument "N" Summary			
Level 0 Data Data Set "N-1"			
Level 1 Data Data Set "N-n"			

4.3.1.3 NSSDC

This section should address how data will transition from project to the NSSDC. Table 9 below provides a format for summarizing storage requirements by data set, over the years the project will be providing data to cross-discipline archives for permanent storage. This format allows for aggregation of requirements at the data set level to instrument and overall project requirements. The table shows the requirements on a yearly basis, but the information could be provided as "annual" if it remains relatively constant from year to year. The yearly requirements are aggregated as well, since the storage requirements are permanent and accumulate over time.

Table 9 *NSSDC parameters.*

	Total	Year "1"	Year "n"
Project Summary			
Instrument "A" Summary			
Level 0 Data Data Set "A-1"			
Level 1 Data Data Set "A-n"			
Instrument "N" Summary			
Level 0 Data Data Set "N-1"			
Level 1 Data Data Set "N-n"			

4.3.2 Directories and Catalogs

This section should address the mechanisms for the identification and location of data sets and data analysis tools. The format of multiple catalogs and any Browse products should also be addressed in addition to the type of information that can be obtained.

This section should also define the commitment of the project to deliver the required information for inclusion in the NASA Master Directory (MD) or other directories and catalogs. For each directory or catalog identified, the degree of access should be identified, as well as the degree of tools availability for data browse and manipulation, including software.

4.3.3 Standards

Projects and investigators should archive data conforming to those standards which will facilitate subsequent data access and use. This section of the PDMP should describe which standards for documentation, formats, and media will be used for the data to be archived on an overall basis. The specifics of each data set will be provided in section 5.1.

4.3.4 Scientific Computing Resources

NASA resources such as those provided by the NASA Center for Computational Sciences (NCCS) at the Goddard Space Flight Center (GSFC), the (proposed) Planetary and Space Sciences Center at the Jet Propulsion Laboratory (JPL), and non-NASA resources such as those available from the National Science Foundation and the Department of Energy are examples of the capabilities available to projects and individual researchers.

4.3.5 Networking Requirements

Networking requirements of the project should be summarized in this section, including those placed on the NASA Science Internet (NSI), and other non-project specific support.

5.0 Products

Products resulting from the project may include science data sets, and other associated archive products such as samples or hardware. This section should describe what the project is going to save, and when and where it is going to be saved.

5.1 Science Data Product Summary

Science data products include data sets generated by the project. This section of the PDMP should identify and describe all data sets expected to be generated. This includes the science data itself, associated ancillary data and orbit/attitude data of the spacecraft. The basics to be covered include what data is going to be generated, when it is to be generated, and when it is to be archived.

The science data products for each of "n" instruments should be summarized in the following sections 5.1.1 through 5.1.n.

5.1.1 Instrument "A"

This section should summarize all science data products to be generated from instrument "A". Included in the products should be documentation for correct and independent use of the data. The expected range of use to be supported by this documentation should be indicated in the write-up, as well as any expected limitations. The following types of data sets should be included:

- Meta Data
- Low-level Processed Data
- High-level Processed Data
  - Intermediate Analysis
  - Scientific Results
- Derivative Products such as Source Catalogs
- Documentation

Each data product should be discussed briefly in the write-up, with a description of the observation phenomena and other relevant characteristics not included in the summary table. This includes relationships to other higher or lower level data sets.

A summary table should be provided for each instrument, including all planned data products. The products could be grouped by the types listed above. The GRO PDMP is a good example of this. Suggested content and format for the summary table is shown in Table 10.

Table 10 *Science data product summary parameters for Instrument "A".*

Data Product	Data Format	Logical granules	Data granules per Year	Data Volume per granule	Data Volume per Year	Public Release
Level 0 Data Set "A-1"						
Level 1 Data Set "A-n"						

5.2 Associated Archive Products

Should include descriptions of archive products which are not included in the science data products of section 5.1. Discussion should include what is going to be saved, when it is going to be saved, where it will be saved etc. If these products are associated with particular instruments or data sets, that information should be provided. The types of products which may be included in this section include the following:

- Operations Histories
- Analysis Software
- Hardware
- Samples

All products which are expected to be archived should be identified.

6.0 Special Considerations

This section is available to address special considerations not covered in the standard structure provided in these guidelines. Such special considerations could include Multi-Division Flights, repeated flights such as Spacelab flights, other types of Shuttle flights, etc.

Glossary

The terms in this glossary reflect terminology in the PDMP guidelines document. Each PDMP should have a glossary terms relevant to that project.

Ancillary Data	Non-science data needed to generate Level 1 data sets. Consists of instrument gains, offsets; pointing information for scan platforms, etc.
Catalog	The instrument source catalog is a compilation of derived parameters and scientific results about observed sources.
Continued accessibility	The derivation and dissemination of useful science knowledge and insight resulting from the data collected. The functions and services provided during continued accessibility include directory and catalog services, scientific computing resources, discipline data archives, and other archives and databases.
Correlative data	Other science data needed to interpret spaceborne data sets. May include ground-based data observations such as soil type or ocean buoy measurements of wind drift.
Data Analysis	Process by which higher-level data products are derived from basic data acquired by instruments. Data analysis functions include modeling, manipulation, data interpretation, and data presentation.
Data Directory	Top-level index containing information about location, ownership, contents of data. Used as first step in determining what types of data exist for given time, period, location, etc.
Data Handling	The process of data acquisition including onboard encoding and compression of data generated by flight sensors, data preprocessing on the ground to remove the artifacts of data transmission and conversion of raw data to Level 0 data, and management of this process to assure completeness and accuracy of
Decommutation	Process whereby the downlink data stream is split into data streams that contain data from only one or from select payloads or systems.
Discipline Data Archive	Long-lived collections of science, operational and related ancillary data, maintained as a national resource at a discipline data center, supported with adequate cataloging, protection, and distribution functions. It provides long-term access to data by the general space science community.
Guest Observer	Has access to observation, to generate specific space science data to conduct independent investigations, although seldom participate in initial mission planning or instrument design.
High-Level Processed Data	Products of detailed processing including instrumental calibrations and background corrections.
Level 0 Data	Reconstructed unprocessed instrument data at full resolution. Edited Data corrected for telemetry errors and split or decommutated into a data set for a given instrument. Sometimes called Experimental Data Record. Data are also tagged with time and location of acquisition.

Level 1A Data	Reconstructed unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information including radiometric and geometric calibration coefficients and geo-referencing parameters (i.e., platform ephemeris) computed and appended but not applied to the Level 0 data. Calibrated Data - Level 0 data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so Level 0 data can be reconstructed.
Level 1B Data	Level 1A data that have been processed to sensor units (i.e., radar backscatter cross section, brightness temperature, etc.). Not all instruments will have a Level 1B equivalent. Resampled Data - have been resampled in the time or space domains in such a way that the original edited data cannot be reconstructed. Could be calibrated in addition to be resampled (can also meet Level 1A definition).
Level 2 Data	Derived environmental variables (e.g., ocean wave height, soil moisture, ice concentration) at the same resolution and location as the Level 1 source data.
Level 3 Data	Variables mapped on uniform space-time grid scales, usually with some completeness and consistency (e.g., missing points interpolated, complete regions mosaiced together from multiple orbits)
Level 4 Data	Model output or results from analyses of lower level data (i.e., variables that are not measured by the instruments, but instead are derived from these measurements)
Low-Level Processed Data	Data products of "automatic" pipeline processing. These data are generally produces within a few months of acquisition.
Metadata	Descriptions of database contents in sufficient detail to allow retrieval of subsets of data.
Mission Operations	The safe and efficient operation of the spacecraft and associated payloads during the active flight portion of the investigation. The principal functions and services associated with mission operations include telemetry services, mission planning and scheduling, and mission control.
Non-Science User	General public, Public Affairs/Outreach or curious individuals seeking data for information purposes rather than further scientific investigation.
Primary User	Includes science investigators who plan and design the experiments, and have an immediate need for access to the data being generated. This includes principal investigators, guest observers, and investigator team members. They represent the first scientists with access to the data.
Principal Investigator (PI)	Often work with co-investigators, are responsible for planning, development, and integration of experiments and instruments, data analysis, and the selection and preparation of the analyzed data for archiving. Principal Investigators are usually tied to a particular instrument.
Production Time	This is the processing time required to generate a data product in usable form after data acquisition.
Project Data Repository	Short-term data base that serves as a way station or clearinghouse for data - such as a mission data base to support operations and compilation of initial results. Temporary buffers for new data, usually existing only as long as the mission producing the data.
Public Release Time	This is the time when a data product becomes public domain after its production and can be accessed by a researcher exclusive rights to the data.
Raw Data	Telemetry data with data embedded

Science Operations	The functions and services required to ensure the production of valuable science data or samples during the active flight portion of the investigation. Principal functions and services provided as science operations include science planning and scheduling, science control, project data archive, and science data analysis.
Secondary User	General science community could include discipline peers, or interdisciplinary scientists. Usually conduct their analysis using data that has been archived, as well as data provided or published by the PI. Secondary users also work in collaboration with primary users. A researcher not involved with instrumentation design, development, or data acquisition. A secondary user would normally go to a data archive to obtain the required data set. Also referred to as retrospective investigator.
Telemetry Services	Those activities required to convert the spacecraft downlink into data that is useful to the experimenter or investigator.

Acronyms

The acronyms provided in this list reflect terminology in the PDMP guidelines document. Each PDMP should have an acronym list of terms relevant to that project.

CODMAC	Committee on Data Management and Computation
DDS	Discipline Data System
EOS	Earth Observing System
GO	Guest Observer
GRO	Gamma Ray Observatory
GSFC	Goddard Space Flight Center (NASA)
ICD	Interface Control Document
ISB	Information Systems Branch
ISSP	Information Systems Strategic Planning Project
JPL	Jet Propulsion Laboratory (NASA)
kbps	Thousand bits per second
MD	Master Directory
MO&DA	Mission Operations & Data Analysis
NAR	Non-Advocate Review
NASA	National Aeronautics and Space Administration
NCCS	NASA Center for Computational Sciences
NMI	NASA Management Instruction
NSF	National Science Foundation
NSI	NASA Science Internet
NSSDC	National Space Science Data Center
OSO	Office of Space Operations
OSSA	Office of Space Science and Applications
PDMP	Project Data Management Plan
PDS	Planetary Data System
PI	Principal Investigator
PSCN	Program Support Communications Network
S/C	Spacecraft
SIRD	Support Instrumentation Requirements Document

References

The references shown here are relevant to the PDMP guidelines document. Each PDMP should have a list of references relevant to that project.

1) "Guidelines for the Development of a Project Data Management Plan," James L. Green and Joseph H. King, NSSDC 88-16, July 1988

2) "Report of the Information Systems Strategic Planning Project", NASA OSSA/OSO, January, 1990

3) "Data Management and Computation, Volume 1: Issues and Recommendations", COD-MAC, 1982

4) "Issues and Recommendations Associated with Distributed Computation and Data Management Systems for the Space Sciences", COD-MAC, 1986

5) " Space and Earth Sciences Information Systems: Issues and Opportunities for the 90's", January, 1992

6) "Office of Space Science and Applications Strategic Plan 1991", April, 1991

7) "Gamma Ray Observatory (GRO) Project Data Management Plan", July 1990

8) "Office of Space Science and Applications Strategic Plan 1990", May 1990

9) "A Guide to the National Space Science Data Center", NSSDC 90-07, June 1990

Appendix A: Project Summary Tables

The following tables are the recommended formats for presenting summary data of the project. They are organized into three tables, one each for parameters for the overall project, for each instrument, and for each data set. For an example of data entered in these tables for an existing project, refer to Appendix C. Table A-1 presents the suggested format for overall summary of parameters at the project level.

Table A-1 *Project summary parameters.*

Mission Summary	**Parameter Values**
Project Name	
Orbit Description	inclination, apoapsis, periapsis, period
Launch Date	
Launch Vehicle	
Nominal Mission Duration	
Potential Mission Life	
Weight	
Attitude Control	
Propulsion type/capacity	
Data Acquisition	
On-Board Data Storage Capacity	
Continuous Data Acquisition Rate	
On-Board storage saturation	
Target pointing duration	
Target re-orientation period	
Attitude control accuracy	
Attitude determination accuracy	
Space to Ground Communications	
S/C Link Frequency Polarization Path	
Data Rates [kbps] **Forward** Peak Average Contact Frequency **Return** Peak Average Bit Error Rate Contact Frequency Average Duration	
Telemetry Processing	
Annual Volume Input	
Throughput [kbps] Peak Average	
Annual Volume output	
Data Distribution Time	
Support Facilities	
Identification	Description

A recommended format for summarizing parameters relevant to all instruments for the project is shown in Table A-2 below. This includes summaries of the instruments themselves, and the science resources required for each instrument.

Table A-2 *Instrument summary parameters.*

Instrument Summary	Instrument "A"	Instrument "N"
Detectors Geophysical Phenomenon/ Parameters Measured/Derived		
Number and type of Detectors		
Total Sensitive Area		
Field of View		
Energy/Wavelength Range		
Energy/Wavelength Resolution		
Time Resolution		
Positioning		
Sensitivity		
Instrument/Project Interface Instrument Weight		
Dimensions		
Average Power		
Data Rate		
Science Resources	**Instrument "A"**	**Instrument "N"**
Facility		
Organization		
Location		
Functions/Capabilities		

The recommended format for summary of data products, which can be aggregated as appropriate to the instrument and project levels, is shown below in Table A-3.

Table A-3 *Data product summary parameters.*

	Data Format	Logical Granules	Data Granules/ year	Data vol/ Granule	Annual Data Volume	Public Release	Annual Vol Arch'd at NSSDC	Annual Storage at DDS Fac.	Annual Storage at Proj Fac.
Overall Project									
Instrument "A"									
Level 0 Data Data Set "1"									
Level 1 Data Data Set "n"									
Instrument "N"									
Level 0 Data Data Set "1"									
Level 1 Data Data Set "n"									

Appendix B: OSSA Policy on Science Data Management

OFFICE OF SPACE SCIENCE AND APPLICATIONS PROGRAM DIRECTIVE

RESPONSIBLE OFFICES:

Life Sciences Division
Earth Sciences and Applications Division
Solar Systems Exploration Division
Flight Systems Division
Microgravity Science and Applications Division
Space Physics Division
Astrophysics Division

SUBJECT: POLICY FOR THE MANAGEMENT OF THE OFFICE OF SPACE SCIENCE AND APPLICATIONS' SCIENCE DATA

1. PURPOSE

The purpose of this Program Directive is to establish NASA's policy for, and delineate responsibilities and authorities relative to, the continuing management of the Office of Space Science and Applications' science data. It replaces NASA Management Instruction (NMI) 8030.3A, "Policy Concerning Data Obtained from Space Science Flight Investigations", dated May 2, 1978, in satisfying this function which was first established in a NASA Policy Directive, dated January 7, 1967 (NPD 8030.3). Among other important modifications, NMI 8030.3A established the requirement for all space flight projects to develop Project Data Management Plans (PDMPs). As defined in NMI 8030.3A, the PDMP was essentially conceived as a data archiving plan. The increasing complexity of NASA science investigations and the volume of data that they generate (among other factors) emphasizes the need for increased emphasis and priority for data management planning early in the project's life. Additionally, these data management planning activities must address the total flow of research data not just archiving. This Program Directive expands the scope of the PDMP to include planning for data management throughout the project planning and implementation phases.

2. SCOPE

This program directive is applicable to the management of all science data resulting from Office of Space Science and Applications sponsored research missions and programs.

3. POLICY

a. Science data generators and users shall serve as a primary source of requirements, as well as final judge of the quality and value of scientific data. Advice and guidance shall be obtained from the science and applications research community in the planning and implementation of NASA's data management systems.

b. NASA shall establish and maintain archives to preserve and make accessible all valuable NASA science data and information. This system of data archives shall include easily accessible information about NASA's data holdings, guidance, and aids for locating and obtaining the data. A review process, including scientific community representation, shall be established to determine what data should be archived and to assure conformance with completeness and quality standards.

c. National and international standards for media, formats, and communication of data sets shall be used to the greatest extent possible. NASA shall participate in the development and implementation of standards. NASA unique standards shall be used only if adequate national or international standards are lacking. The intent of this policy is to standardize the interfaces between the users and NASA's data and information systems, not to standardize the systems themselves.

d. Project, discipline, and OSSA-wide data management activities shall be reviewed periodically to assess status and progress relative to Agency and OSSA goals, objectives and standards, and the needs of the science community. Once archived, data sets and supporting information shall be periodically reviewed to assess their value for continued retention by NASA. This process shall also prevent the loss of important data sets.

e. All data being captured by NASA science projects and space flight missions shall be addressed in a Project Data Management Plan (PDMP) to assure the availability of data and supporting information on a timely basis for use by the science community. The formal definition (non advocate) review or equivalent mechanism conducted prior to a project receiving new start approval will assess data management plans as well as spacecraft development, instrument plans, operations plans, etc. After new start and budget approval a formal Project Data Management Plan will be prepared and approved coincident with the Project Plan signed by the Associate Administrator and Field Center Director. Project Data Management Plans must be updated as significant changes occur that impact the project's plans for data management, and PDMPs should be reviewed periodically to determine if updates are required. For programs in which selected investigators have initial periods of exclusive data use, data should be made openly available as soon as that period expires. In such cases, the duration of all exclusive use periods shall be explicitly defined.

f. NASA shall periodically conduct a review of its data repositories and archives to determine the state of data and to assure conformance with applicable government standards for data storage.

g. Recognizing the pivotal importance of technology in meeting its future needs for data and information systems, OSSA shall establish an active process to maintain an awareness of emerging applicable technologies, infuse them into its systems, and stimulate new technology development where warranted.

4. RESPONSIBILITIES AND AUTHORITIES

a. Associate Administrator for Space Science and Applications

The Associate Administrator for Space Science and Applications is responsible for maintaining and ensuring the implementation of NASA's data management policy, including issuing implementing instructions and guidelines.

b. Assistant Associate Administrator for Science and Applications

The Assistant Associate Administrator for Science and Applications shall serve as chairperson of the Information Systems Management Board, which is chartered to coordinate OSSA's data management activities, and to identify issues, set priorities, and provide recommendations to the Associate Administrator for Space Science and Applications on these activities.

c. OSSA Discipline Division Directors

The Directors of OSSA's Science Discipline Divisions are responsible for the overall administration of their Division's data management activities in accordance with this Program Directive and the decisions of the Information Systems Management Board. Data acquired from both flight projects and non-satellite programs will be addressed as part of this responsibility. The primary objective of this activity is to assure the continuing value of OSSA's science data by providing data management procedures, systems and services that are responsive to the needs of the project, discipline, NASA, and broad research communities.

d. OSSA Flight Systems Division Director

The primary responsibilities of the Information Systems Program within OSSA's Flight Systems Division are to formulate and coordinate OSSA wide data management policy and to provide the supporting infrastructure across the discipline efforts. This includes providing a broad range of data management capabilities which transcend discipline-specific data management activities and serving as OSSA's point of contact for data management activities.

Appendix C: Examples of Project Summary Tables

This appendix provides examples of actual data entered into the project summary tables. The project summary tables shown are for the Gamma Ray Observatory (GRO). The overall project summary table will be shown first, followed by the instrument summary, then data set summary.

Table C-1 *GRO project summary parameters.*

Mission Summary		**Parameter Values**
Project Name		Gamma Ray Observatory (GRO)
Orbit Description		28.5° inc., 450 km alt, 93.6 min. period
Launch Date		5-Apr-91
Launch Vehicle		Shuttle
Nominal Mission Duration		6 years
Potential Mission Life		10 years (longer if refueled/reboosted)
Weight		36,000 lb
Attitude Control		3-axis stabilized
Propulsion type/capacity		Hydrazine/4,000 lb
Data Acquisition		
On-Board Data Storage Capacity		900 Mbits
Continuous Data Acquisition Rate		32 kbps
On-Board storage saturation		7 hr 48 min
Target pointing duration		14 days per target
Target re-orientation period		<36 hours
Attitude control accuracy		0.5°
Attitude determination accuracy		0.033°
Space to Ground Communications		
S/C Link	Frequency	S-Band Single Access (SA) Link
	Polarization	
	Path	TDRSS
Data Rates [kbps]		
Forward	Peak	1 kbps
	Contact Freq.	once per day
Return	Peak	512 kbps
	Average	32.89 kbps
	Bit Error Rate	<1.1 per 100,000 bits
	Contact Freq.	every other orbit
	Avg. Duration	12 minutes
Telemetry Processing		
Annual Volume input		1.035 Terabits
Throughput [kbps]		
	Peak	TBD
	Average	TBD
Annual Volume output		TBD
Data Distribution from on-ground to PI		<48 hours
Support Facilities		
NSSDC		Principal Archiving Facility
Science Support Center (SSC) (ADS Node)		Support Guest Investigators use of GRO, selected Archiving

Table C-2 *GRO instrument summary parameters.*

Instrument Summary	OSSE	COMPTEL	EGRET	BATSE
Detectors Geophysical Phenomenon/ Parameters Measured/Derived	Astrophysical γ–Ray Sources, Fast Pulsars, Solar Flare Studies, γ–Ray Bursts	Galactic and Extragalactic Point Sources, Diffuse Emission from the Galaxy, Cosmic Diffuse Flux, Broadened Line Emission	γ–Ray Point Sources, Diffuse Galactic Plane γ–Ray Emissions	γ–Ray Bursts, other Transient γ–Ray Sources
Number and Type of Detectors	4 identical NaI-CsI phoswiches, actively-shielded, passively collimated	D1(Upper): Liquid scintillator NE 213A; 7 cylindrical modules @ 28 cm dia x 8.5 cm deep; 4,310 cm^2 total geometrical area D2(Lower): NaI(Tl); 14 blocks @ 28 cm dia x 7.5 cm deep; 8,620 cm^2 total geometrical area	Spark chambers with NaI total energy counter	8 Large Area (*) 8 Spectroscopy (**)
Total Sensitive Area	Total Aperture Area 2,620 cm^2 Eff. Area of 1,950 cm^2 at 0.51 MeV	25.8 cm^2 at 1.27 MeV 29.3 cm^2 at 2.75 MeV 29.4 cm^2 at 4.43 MeV	Total Detector Area of 6,400 cm^2 Area Efficiency Factor energy dependent with max of 1,600 cm^2 at ~500 MeV	16,000 cm^2(*) 1,800 cm^2 (**)
Field of View	3.8° x 11.4° FWHM	~1 ster Angluar resolution : 1.7°-4.4° (FWHM) Geometrical factor: 5-30 cm^2 ster	~0.6 sr	Full unocculted sky
Energy Range	0.1 - 10 MeV γ-rays (primary obj) 10-150 MeV γ-rays (sec. obj) >10 MeV solar neutrons (sec obj)	1-30 MeV	20 to 3 x 10^4 MeV	30 keV - 1.0 MeV (*) 15 keV - 110 MeV (**)
Energy Resolution	8.0% at 0.661 MeV 3.2% at 6.13 MeV	5-10% (FWHM)	20% in the central part of the energy range	
Time Resolution	4 sec in normal mode 0.125 msec in pulsar mode 4 msec in burst mode	0.125 msec for events 15 msec for bursts	Timing Accuracy 0.1 ms absolute, 7μs relative	2 μs, Minimum
Positioning	Position Localization 10 arc min square error box (spec. mode; 0.1 x Crab spectrum)	Source Pos. Acc'y ≈5-30 arc min Pos'n Localization (strong source) ≈ 8.5 arc min (90% confidence at 2.75 MeV for 20σ source)	Source Position Accuracy (strong source) 5 to 10 arc min	Burst Location Accuracy 1.0° - 10° (depending on intensity)
Sensitivity	0.1-10 MeV Line γ-rays (10^6 sec) : 2-5x10^{-5} γ $cm^{-2}s^{-1}$ 0.1-1 MeV Continuum γ-rays : 0.005 x Crab 1-10 MeV Continuum γ-rays : 0.02 x Crab γ-ray Burst : 1x10-7 erg cm-2 Solar Flare Line γ-rays (10^3sec flares) : 5x10^{-4} γ $cm^{-2}s^{-1}$ Solar Flare Neutrons (>10 MeV) : 5x10^{-3} n $cm^{-2}s^{-1}$	Minimum source detectability at 5σ above 1 MeV (1.3 x 10^6 sec obs time) : 5x$10^{-5}cm^{-2}s^{-1}$ (≈2% of the expected total Crab emission) Line Sensitivity : 3x10^{-5} to 3x10^{-6} $cm^{-2}s^{-1}$	Threshold Point Source : 5x$10^{-8}cm^{-2}s^{-1}$ (E>100 MeV)	Burst: 6x10^{-8} erg cm^{-2} for a 10 sec burst Discrete Source: 0.1 Crab (for Crab-like spectrum) Pulsed Source: 0.02 Crab (for Crab-like light curve, two week observation period)

Instrument Summary	OSSE	COMPTEL	EGRET	BATSE
GRO-Experiment Interface Instrument Weight	1,814 kg	1,460 kg	1,815 kg	976 kg
Dimensions		2.61 m x 1.76 m diameter	2.25 m x 1.65 m diameter	.7m x.6m x.7m each detector module
Average Power	192 Watts average	206 Watts	190 Watts	117 watts
Data Rate	6,492 Bits/sec	6,125 Bits/sec	6,859 Bits/sec	3,555 bits/sec
Science Resources Facility	OSSE PI Facility	COMPTEL PI Facility	EGRET PI Facility	BATSE PI Facility
Organization	Naval Research Laboratory (NRL)	Max-Planck-Institut fur Extraterrestrische Physik (MPE)	NASA Goddard Space Flight Center (GSFC)	NASA Marshall Space Flight Center (MSFC)
Location	Washington, DC	Garching, Germany	Grennbelt, MD	Huntsville, AL
Functions/ Capabilities	Develop/maintain data set catalogs, process & archive raw data, produce low-level & high-level processed data products, maintain internal archive of data & software.	Develop/maintain data set catalogs, process & archive raw data, produce low-level & high-level processed data products, maintain internal archive of data & software.	Develop/maintain data set catalogs, process & archive raw data, produce low-level & high-level processed data products, maintain internal archive of data & software.	Develop/maintain data set catalogs, process & archive raw data, produce low-level & high-level processed data products, maintain internal archive of data & software.

Table C-3 *GRO data set summary parameters.*

Gamma Ray Observatory (GRO)
Data Set Summary Table

	Data Format	Logical Granules	Data Granules per Year	Data Vol per Granule	Unit	Ann Data Volume [Gbytes]	Production Time	Public Release	Annual Data Vol. Archived at NSSDC	Annual Data Vol. Stored at GRO SSC	Annual Data Vol. Stored at PI Site
Gamma Ray Observatory (GRO)						90.35 +TBD ~300	Gbytes/Year		~300 Gbytes		
OSSE						86.0973	+TBD		86.0973	TBD	TBD
Low-Level Processed Data											
1 Augmented telemetry packets	FITS	Observ'n	26	75	Mbytes	1.95	24 hrs	1 yr	1.95		
2 2-minute spectra	SDB/FITS	Observ'n	26	150	Mbytes	3.9	24 hrs	1 yr	3.9		
3 TSAC det ct spectra at max. time res	SDB/FITS	Observ'n	26	2	Gbytes	52	2 wks	1 yr	52		
4 Background sub'd 2-minute spectra	SDB/FITS	Observ'n	26	150	Mbytes	3.9	3.5 mon	1 yr	3.9		
5 Pulsar data	FITS	Observ'n	26	900	Mbytes	23.4	2 wks	1 yr	23.4		
6 Burst data	SDB/FITS	Burst	500	20	kbytes	0.01	24 hrs	1 yr	0.01		
7 Observatory history	FITS	Observ'n	26	50	kbytes	0.0013	24 hrs	1 wk	0.0013		
High-Level Processed Data											
8 Integrated count spectra	SDB/FITS	Observ'n	26	3	Mbytes	0.078	6.5 mon	1 yr	0.078		
9 Integrated incident photon spectra	SDB/FITS	Observ'n	26	3	Mbytes	0.078	9.5 mon	1 yr	0.078		
10 Sky maps	FITS	Observ'n	26				TBD	1 yr			
11 Time-integrated pulsar light curves	SDB/FITS	Observ'n	26				6.5 mon	1 yr			
12 Energy band rate histories	on mfiche	Observ'n	26				2 wks	1 yr			
13 Spectral Response Matrices	SDB/FITS	Observ'n	26	30	Mbytes	0.78	2 wks	1 yr	0.78		
14 Source Catalogs	FITS						TBD	TBD			
15 Documentation	ASCII						Available with data products				
COMPTEL						1.6638	+TBD		1.6638	TBD	TBD
Metadata											
1 Data set catalog	Oracle	record		200	bytes		Cont u/d	as soon as bulk data available and checked			
		record		20	elements						
		Observ'n		100	datasets						
Low-Level Processed Data											
2 Processed event matrices	FITS	Observ'n	26	3	Mbytes	0.078	1 day	1 yr	0.078		
3 Calib count rate spectra for sel regions	special	Observ'n	26	3	Mbytes	0.078	1 day	1 yr	0.078		
4 Calib count rate spectra for bursts	special	Burst	500	3	Mbytes	1.5	1 week	1 yr	1.5		
5 Calib event message lists - sel regions	special	Burst	500				1 day	1 yr			
6 Barycentric vector list	special	Observ'n	26				1 week	1 yr			

Gamma Ray Observatory (GRO)
Data Set Summary Table

	Data Format	Logical Granules	Data Granules per Year	Data Vol per Granule	Unit	Ann Data Volume [Gbytes]	Production Time	Public Release	Annual Data Vol. Archived at NSSDC	Annual Data Vol. Stored at GRO SSC	Annual Data Vol. Stored at PI Site
High-Level Processed Data - Type a:											
7 Binned response matrices											
- Exposure matrix	FITS						1 day	1 yr			
- Sensitivity matrix	FITS						1 day	1 yr			
- Point spread function matrix	FITS						1 week	1 yr			
- Geometric response matrix	FITS						1 week	1 yr			
- Spectral responce matrix	FITS						1 month	1 yr			
- Burst spectral response matrix	FITS						1 month	1 yr			
8 Standard FOV image (max. entropy)	FITS	Observ'n	26	0.3	Mbytes	0.0078	1 week	1 yr	0.0078		
9 Binned background information											
- Background matrix	FITS						TBD	TBD			
- Background spectra (telescope)	FITS						TBD	TBD			
- Background spectra (burst detector)	FITS						TBD	TBD			
High-Level Processed Data - Type b:											
10 Specific source region results											
- Source parameters	special						1 month	TBD			
- Source significance map)	FITS						1 month	TBD			
11 Diffuse emission results											
- Diffuse component map	FITS						1 month	TBD			
- Source component parameters	special						1 month	TBD			
- Cosmic diffuse emission results	special						TBD	TBD			
12 Pulsar analysis results	special						1 week	TBD			
13 Solar neutron analysis results	TBD						TBD	TBD			
14 Gamma ray burst results	special						TBD	TBD			
15 Polarized source results	TBD						TBD	TBD			
16 Source Catalogs	TBD						TBD	TBD			
17 Documentation	ASCII						Available with data products				
EGRET						0.3534	+TBD		0.3534	TBD	TBD
Low-Level Processed Data											
1 Event matrices (~10 energy bins)	FITS	Observ'n	26	1	Mbytes	0.026	2 months	1 yr	0.026		
2 Inst exp matrices (~10 energy bins)	FITS	Observ'n	26	1	Mbytes	0.026	2 months	1 yr	0.026		
3 Intensity matrices (~10 energy bins)	FITS	Observ'n	26	1	Mbytes	0.026	2 months	1 yr	0.026		
4 Intensity error information	TBD	Observ'n	26				2 months	1 yr			
5 Data for user-selected regions	FITS+TBD	Observ'n	26	0.4	Mbytes	0.0104	2 months	1 yr	0.0104		
6 Data for g-ray bursts or solar events	FITS	Burst	500	10	kbytes	0.005	2 months	1 yr	0.005		
7 Time-ordered event list	TBD	Observ'n	26	10	Mbytes	0.26	1 yr	1 yr	0.26		

Gamma Ray Observatory (GRO)
Data Set Summary Table

	Data Format	Logical Granules	Data Granules per Year	Data Vol per Granule	Unit	Ann Data Volume [Gbytes]	Production Time	Public Release	Annual Data Vol. Archived at NSSDC	Annual Data Vol. Stored at GRO SSC	Annual Data Vol. Stored at PI Site
High-Level Processed Data											
8 Energy spectra of diffuse emission	FITS						1 yr	1 yr			
9 Low energy g-ray spectra	FITS						6 months	1 yr			
10 Malfunction/Unusual Events	ASCII						2 months	1 yr			
11 Housekeeping & instrument perf DB	ASCII						2 months	1 yr			
12 Instrument Calibration Info.	FITS						Ready at L	1 yr			
Catalogs							Initial Release				
13 EGRET Source catalog											
- Time histories & Phase plots	ASCII/FITS						2 yrs	1 yr			
14 Gamma ray burst catalog	ASCII						2 yrs	As soon as available			
15 Solar event catalog	ASCII						2 yrs	As soon as available			
16 Data archive summary	ASCII						2 yrs	As soon as available			
17 Documentation	ASCII						Available with data products				
BATSE						2.23543	+TBD		2.23543	TBD	TBD
Low-Level Processed Data							(after burst)				
1 Trig'd burst/flare (sel time/energy res)	FITS/Internal	Burst	500	110	kbytes	0.055	2 weeks	1 yr	0.055		
2 Background processed data set	FITS/Internal	Observ'n	26	14	Mbytes	0.364	2 weeks	1 yr	0.364		
3 Pulsar low-level data set	FITS/Internal	Observ'n	26	52	Mbytes	1.352	2 weeks	1 yr	1.352		
4 Occultation source analysis data set	FITS/Internal	Observ'n	26	3.6	Mbytes	0.0936	2 weeks	1 yr	0.0936		
5 Detector response matrix DB	FITS/Internal	Observ'n	26	10	Mbytes	0.26	TBD	End of PI	0.26		
High-Level Processed Data											
6 Trig'd burst/flare net spectral (sel res)	FITS/Internal	Burst	500	20	kbytes	0.01	2 weeks	1 yr	0.01		
7 Burst/flare time history data set	FITS/Internal	Burst	500	150	kbytes	0.075	2 weeks	1 yr	0.075		
- 64 ms resolution, summed detectors											
- other time/energy resolution											
8 Burst/flare analysis results data set	FITS/Internal	Burst	500	2	kbytes	0.001	2 weeks	1 yr	0.001		
- fit results for standard models											
9 Occultation source net spectral	FITS/Internal	Observ'n	26	15	kbytes	0.00039	2 weeks	1 yr	0.00039		
10 Occultation source analysis results	FITS/Internal	Observ'n	26	11	kbytes	0.00029	2 weeks	1 yr	0.000286		
11 Pulsar folded-on-board analysis	FITS/Internal	Observ'n	26	350	kbytes	0.0091	2 weeks	1 yr	0.0091		
12 Pulsar folded-on-ground analysis	FITS/Internal	Observ'n	26	9	kbytes	0.00023	2 mos (req)	1 yr	0.000234		
13 Pulsar spectral analysis results	FITS/Internal	Observ'n	26	70	kbytes	0.00182	2 weeks	1 yr	0.00182		
14 Parametrized background data set	FITS/Internal	Observ'n	26	500	kbytes	0.013	2 mos (req)	1 yr	0.013		
Catalogs											
15 Burst catalog	FITS/Internal						2 wk u/d	End of Phase 1 (updates at 6mo)			
16 Occultation source catalog	FITS/Internal						2 wk u/d	End of Phase 1 (updates at 6mo)			
17 Pulsed source catalog	FITS/Internal						2 wk u/d	End of Phase 1 (updates at 6mo)			
18 Documentation	ASCII						Available with data products				

Jet Propulsion Laboratory
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(818) 354-4321

JPL

February 22, 1993

Dr. James Harris
NASA Headquarters
Code SM
Washington D.C. 20546

Subject: Review of the Guidelines for Development of a Project Data Management Plan (PDMP) dated December 1992

Dear Jim:

General Comments

In general, the PDMP guidelines put forth in this document dictate a format and structure that are too detailed to be useful for project data management.

The PDMP should be a high level document that addresses the project's plans for managing its data from the point it arrives on the ground to its entry into an archive system. It should address the roles, responsibilities and policies that guide the planning and implementation of the project's data management capabilities.

In order to make the PDMP guidelines more useful to projects at JPL we must take into consideration the fact that JPL missions produce other archive planning documents and the PDMP must play into an already established hierarchy of documents.

JPL Lessons

At JPL, the PDMP is the highest level data specification document produced early in the project. It documents the project's commitment to archive; it explains the global plan and identifies roles and responsibilities. The PDMP is rarely updated.

The next document produced is the Science Data Management Plan (SDMP). The SDMP is a plan to ensure that the science oriented systems and mechanisms are in place to facilitate acquisition, reduction, and analysis of mission data. The SDMP is rarely updated.

The Archive Policy and Data Transfer Plan (APDTP) is usually produced last and it contains very detailed lists of data products and their associated archive schedule. The APDTP also describes an end-to-end plan by which the scientific data acquired during the mission are managed, recorded, stored and distributed to the experiment investigators and archived for future use. The APDTP is updated frequently.

The ultimate goal of the data take outplanning activity should be to streamline the work performed by the projects while ensuring useable archive products for science users. This streamlining includes the production of documents. The SDMP and APDTP should take requirements from the PDMP and document detailed planning information. The three documents should not contain redundant information.

Both the Magellan Project and the Mars Observer Project have produced PDMPs. The Galileo Project produced an SDMP which also doubles as their PDMP. In all cases, the PDMPs discuss the mission and the end-to-end data flow including the processing that occurs at various points in the data path. The information contained in the PDMP is kept at a high level but the document still addresses the commitment of the project to properly manage their data products from receipt to archive. The lower level documents such as the SDMP and the APDTP identify very detailed archive plans for the missions.

Please review samples of SDMPs and APDTPs before you finalize the PDMP guidelines. If you conclude that JPL is the only institution with other archive documents in its hierarchy that may conflict with proposed PDMP guidelines, then it might be possible to allow waivers for certain sections of the document if a project can identify where the information can or will be found.

Sincerely,

Sue

Susan K. McMahon
PDS Project Manager

Sue for Y. Fletcher

Yolanda J. Fletcher
PDS Mission Products Manager

Attachment

cc: J. Bergstralh
S. Gulkis
L. Preheim
A. Walton
G. Walker
T. Renfrow
J. King, NSSDC

MEMORANDUM OF UNDERSTANDING

between

NATIONAL SPACE SCIENCE DATA CENTER

and the

PLANETARY DATA SYSTEM

DATED : January 13, 1994

Approved by:

Joseph H. King
Director, National Space Science Data Center

for Susan McMahon
Project Manager, Planetary Data System
Jet Propulsion Laboratory

Jay Bergstralh
Program Manager, Planetary Data System
Solar System Exploration Division
Office of Space Science

Joseph H. Bredekamp
STI/Chief, Information Systems Branch
Office of Space Science

I. PROLOGUE

Effective data management is necessary to maximize the science output from NASA missions. Such data management provides scientists the ability to locate and access needed data, and to obtain information and software required to make the data useful. It has become a precept that data should be managed as close to the data producing science community as possible. To this end, NASA has established a number of Discipline Data Centers (DDC's) to augment the National Space Science Data Center (NSSDC) to facilitate data access and utilization in those respective disciplines. One of these is the Planetary Data System (PDS).

NSSDC is responsible for top-level data management functions that span all OSS programs and scientific disciplines and for selected discipline-specific responsibilities to be defined by mutual agreement between the NSSDC and the relevant OSS program division.

As a DDC within the NASA archive environment, the PDS has primary responsibility for the collection of lunar and planetary data (hereafter referred to merely as planetary data), the definition of its content, its validation and catalog management.

This Memorandum of Understanding identifies the roles of NSSDC and the PDS in preserving and facilitating access to data acquired by NASA planetary missions.

II. INTRODUCTION

A. PURPOSE

The purpose of this document is to describe the roles of the PDS and NSSDC in acquiring, archiving, and distributing planetary data. This document sets the general constraints on the interfaces between the two organizations. Additional mission specific details of the interfaces will be developed and specified in future documents which will govern the details of the interface between NSSDC and the PDS.

B. SCOPE

The scope of this document covers areas of operation where there is joint responsibility between the PDS and NSSDC or where, despite possibilities of ambiguity, there is a sole responsibility of one or the other. Other documents exist which describe the full range of operations of each organization.

Attachment

Review of the Guidelines for Development of a Project Data Management Plan (PDMP) dated December 1992

Section 1.2 - PDMP Development, Maintenance and Management Responsibility
The emphasis should be on advanced planning of the management of data acquired by NASA. Typically, PDMPs do not contain low-level product information, therefore they have not been revised frequently. Note that low level product information is normally not known early in a project.

Section 1.4 - Relevant Documents
Establish the relationship of the PDMP to other established Project data management documents, such as the SDMP and the APDTP.

Section 2.4 - Mission Summary
Revise the mission summary parameters. Some of the parameters probably are not needed, at least from an archive data management perspective. Parameters such as spacecraft mass, propulsion type and attitude control have no relationship to a project's data management planning.

Revise the mission data acquisition parameters also. The information required is very detailed and not generally applicable to data management planning. If this information is really necessary for this document, perhaps a brief description field may work better.

Section 3.1 - Instrument Capabilities and Requirements
It will be very difficult to get all of this information in tabular form and as stated previously, some of this information may not be required for data management purposes.

A short description of the science objectives for each instrument and a short list of the most important parameters measured should suffice.

Many of the instrument summary parameters resemble parameters collected by an archive system for cataloguing purposes. This information is not required for a data management planning document. In fact, PDS is trying to reduce the quantity and complex structure of instrument descriptions provided by flight projects, so that the project impact is greatly reduced. There are simpler ways to obtain what an archive system needs than described in this section.

Section 4.1.1.1 - Space to Ground Communications and
Section 4.1.1.2 - Telemetry Processing
While the PDMP should address data rates which is an important aspect of data management planning, the information required in Tables 4 and 5 appears to be in a complicated format. There has to be a simpler way to collect and depict data rates for the various instruments and data types. For example it is unclear how to provide these parameters (Table 4) for various modes and with multiple communication systems. Should the block be repeated for multiple modes/systems? Table 5, based on instrument as well as year may also be highly variable. Should the table repeat to make it possible to get reasonable data?

Section 4.2.3 - Science Data Set Generation
Add an example of a completed Table 6 to the appendix.

Section 4.3.1.x - Project Data Repositories, Discipline Archive, and NSSDC
Add examples of completed Tables 7,8 and 9 to the appendix.

Section 5.2 - Associated Archive Products
Add Engineering, Navigation, Geometry and Calibration Products to the archive products list.

Sections Missing from the PDMP Guideline

1. There is no section that discusses project requirements for data quality including validation and release of products to the archive system.

2. Policies concerning security of the data sets and products should be added.

3. Policies concerning Archive Media for delivery of products to the archive system should be addressed.

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

FEB 6 1992

Reply to Attn of: SM

TO: Goddard Space Flight Center
Attn: 100/Director

FROM: S/Associate Administrator for Space Science and Applications

SUBJECT: Functional Responsibility of the National Space Science Data Center

Enclosed is a mission statement for the National Space Science Data Center (NSSDC) which has been developed for me by the Office of Space Science and Applications (OSSA) Information Systems Management Board, and coordinated with senior managers at Goddard. In brief, the NSSDC is responsible for top-level data management functions that span all OSSA programs and scientific disciplines and for selected discipline-specific responsibilities to be defined by mutual agreement between the NSSDC and the relevant OSSA program division.

This mission statement for the NSSDC reflects the changes in the science data environment since the NSSDC was originally chartered. It clarifies relative roles of the individual OSSA science divisions as they assume full responsibility for determining the approach to manage their data and assure that it is appropriately archived.

We look to Goddard to implement this important mission for OSSA. I appreciate your care and attention to assure that the cross-cutting function for OSSA science disciplines is appropriately emphasized, along with the emerging discipline-specific data system responsibilities at Goddard.

L. A. Fisk

Enclosure

cc:
S/Mr. Alexander
SB/Mr. Chambers
SE/Dr. Butler
SL/Dr. Quaide
SM/Mr. Bredekamp
SN/Mr. Schmitz
SP/Mr. Santiago
SS/Dr. Willett
SZ/Dr. Riegler

NATIONAL SPACE SCIENCE DATA CENTER
MISSION STATEMENT

1. Maintain and operate the NASA Master Directory (which is to be inclusive of all NASA Space and Earth science data regardless of the discipline data system where they reside).

   This includes upgrading master directory capabilities.

2. Maintain and coordinate broad data standards which are appropriate to most or all disciplines and recommend, maintain and monitor implementation of minimum NASA data standards with which all discipline systems must comply.

   This includes examination of discipline data system compliance with minimum standards. It does not include format standards, etc. which are unique to or primarily within the purview of a single discipline data system. The formal establishment of minimum data standards is the responsibility of OSSA.

3. Establish, maintain and operate selected discipline independent information services as assigned by OSSA.

4. Provide technical support to OSSA in the oversight of Project Data Management Plans, data preservation, and discipline data systems as requested.

5. Make available to data systems developers and operators expert advice and counsel, particularly in areas involved in meeting overall NASA requirements on data systems.

   This is the "how to" function available to all OSSA data systems as a support upon request. This also includes the correlative requirement to maintain expertise in data management and related technologies.

6. Serve as a data center node in OSSA discipline data systems and as a distribution center for data products as requested by discipline divisions.

7. Fulfill appropriate responsibilities as a component of World Data Center - A for the international exchange of NSSDC data holdings.

C. AUDIENCE

The following groups are the intended audience for the document:

1. Staffs of the PDS and NSSDC.

2. Those who are preparing planetary science data such as Principal Investigators, planetary missions, data restorers.

3. Those who want to access planetary science data, including NASA planetary scientists and other domestic and foreign scientists.

4. NASA Headquarters personnel who manage and provide the operating funds for NSSDC and the PDS.

5. Managers of institutions participating in NSSDC or PDS activities.

6. Members of other data centers.

7. PDS and NSSDC advisory groups.

D. SUMMARY

The following are the key components of this MOU:

1. The PDS will serve as the point of entry for planetary data into the NASA archive environment.

2. The NSSDC shall maintain and coordinate broad data standards for data management and archiving which are appropriate to most or all disciplines and recommend, maintain and monitor implementation of minimum NASA data standards.

3. The PDS shall be responsible for establishing and maintaining data standards, data structures, and data formats which are appropriate for use by the Planetary Science community.

4. The PDS serves as the primary interface with the planetary data producers, obtaining the data and checking them for correctness of format and content. The data products are then passed on to NSSDC for "deep-archiving" along with appropriate catalog and ancillary information.

5. The NSSDC shall maintain and operate the NASA Master Directory (which is to be inclusive of all NASA Space and Earth science data regardless of the discipline data system where they reside.) The PDS shall support the

population of the Master Directory. In addition, the PDS shall maintain a multi-layered catalog residing at the Central Node and Discipline Nodes of the PDS.

6. The NSSDC shall maintain a deep archive of all planetary data designated for indefinite archiving in HQ/SL-approved Project Data Management Plans (PDMPs) (or equivalent documents), and shall assure the continued existence/readability of such data until/unless HQ/SL declares such data to be disposable.

7. The PDS is intended to serve Code SL-sponsored planetary scientists and has distribution responsibility primarily for digital data products.

8. NSSDC serves the non-SL community and, for special needs (e.g., analog products, large volume distributions, distributions from NSSDC's pre-PDS holdings, etc.), also the SL-funded community.

F. MOU REVIEW PROCEDURES

This MOU will be reviewed periodically by both NSSDC and the PDS to determine each organization's compliance with the MOU as it exists at the time. Any statements in the MOU in conflict with the current policy and procedures of either NSSDC or the PDS will be identified. The reasons for these discrepancies will be reviewed and either the MOU or the operational policies and procedures of NSSDC or the PDS will be changed to reflect a resolution of this discrepancy. These changes may be necessary if either organization is unable to comply with the MOU or the statements in the MOU no longer reflect current NSSDC and PDS policies and procedures.

Any conflicts or discrepancies related to the roles of the NSSDC and PDS shall be resolved by the Director of the NSSDC and the Project Manager for the PDS. In the event that resolution is not possible at this level, the matter will be elevated to NASA Headquarters where the appropriate program sponsors can resolve the issue.

III. ORGANIZATIONAL SCOPE

A. NSSDC

The NSSDC is sponsored by the Technology and Information Systems Office within NASA's Office of Space Science (Code STI) to have primary responsibility for the multi-disciplinary Master Directory and underlying information systems at NSSDC, for evolving and coordinating widely relevant data management and archiving (DMA) standards, and for providing a DMA infrastructure for use by

NASA science divisions in concert with their Discipline Data Centers (DDCs). In addition to normal management reviews, the work and priorities of NSSDC will be reviewed by an NSSDC User's Group to be constituted by both end-user scientists and by DDC officials.

B. PDS

The PDS is sponsored by NASA's Solar System Exploration Division (Code SL) to ensure the long-term usability of data, to stimulate research, to facilitate data access, and to support correlative analysis.

The PDS will serve as the primary interface to flight projects for product and catalog definition, standards usage, product generation and product validation. The PDS will establish a Management Council comprised of planetary scientists from various disciplines who will serve as a decision-making body on archive policies and procedures that affect the PDS.

IV. PROJECT INTERFACE

The PDS will serve as the point of entry for planetary data into the NASA archive environment. The PDS will maintain a Mission Interface which is responsible for negotiating individual Project Data Management Plans and Archive Plans with the projects which at least satisfy the OSS Policy on Science Data Management. In most cases, the PDS will have signature authority over the Project Data Management Plans and Archive Plans. In cases where the PDMP specifies certain products will be archived at NSSDC, then both NSSDC and PDS will sign the document.

All active mission data products that enter the NASA archive environment through the PDS Mission Interface will be validated and passed on to NSSDC for long term archive. These data products shall be specified in pre-launch PDMPs and Archive Plans signed by NASA Headquarters (Code SL) and may include raw science data, ancillary data, organized higher level data products agreed upon by the Project's Science Steering Group, and individual reduced data sets deemed important by individual investigators as well as all relevant documentation.

The PDS will also be the archive entry point for all data restored from past planetary missions.

PDS and NSSDC will agree on and document the terms covering the transmission of archive products from PDS to NSSDC such as media type, volume and frequency of delivery.

V. CATALOG

The PDS will maintain a catalog of their planetary data holdings. This catalog will be multi-layered with the high level catalog residing at the Central Node and the lower level, more detailed, catalogs residing at the Discipline Nodes. This multi-layered PDS catalog will be accessible by NSSDC.

NSSDC will maintain and make available to the general community appropriate information relevant to planetary data in its own information systems. NSSDC will maintain a multidisciplinary NASA Master Directory which will include limited information about PDS holdings. Appropriate descriptive information from the high level PDS catalog will be sent to NSSDC's Master Directory via the Directory Interchange Format (DIF). NSSDC will provide instructions to PDS in the appropriate use of the DIF Format and will review PDS entries in the Master Directory. NSSDC will also maintain electronic links into the PDS catalogs from the Master Directory. For each new data set sent to NSSDC, PDS will also send a completed data set description template to be used by NSSDC in populating the NSSDC Master Catalog at the data set level.

The NSSDC shall coordinate the Master Directory design evolution to meet mutual budget and system scope constraints.

All changes to be made to the Master Directory that will require the PDS to develop and/or modify their operational system shall first be coordinated with the PDS.

VI. DATA

Recognizing PDS budget constraints, the PDS shall strive to coordinate and share archive tasks with NSSDC and flight projects to do the best possible job with the available resources. Therefore, the management of planetary data will be a cooperative effort involving the PDS, NSSDC and flight projects. Each organization will have responsibilities concerning the preparation, storage, and distribution of the data.

A. DATA PREPARATION

1. **Mission Data:** As described in Section IV, the PDS is responsible for maintaining the Mission Interface. All NASA mission data will enter the NASA archive environment through the PDS under the Project Data Management Plans and Archive Plans negotiated with each of the projects. The PDS will verify the correct format, completeness, and continuity of the data and will monitor the validity and content of the incoming data. The PDS will also verify the correct format, completeness, and continuity of the catalog data. Part of the data preparation process includes populating

the PDS catalog with the new information. It will be the responsibility of the PDS to monitor project compliance to the negotiated Project Data Management Plans and report cases of non-compliance to NASA Code SL management as requested.

2. **Restored Data:** The restoration of old planetary data sets will be coordinated and overseen by the PDS. The normal procedure for data restoration will be initiated by a Discipline Node or proposal to the PDS for the establishment of a Data Node which will exist for a short period (a year or two) for the sole purpose of reformatting and documenting the data set. The restoration process will be sponsored by the appropriate Discipline Node and the resulting data set will be validated by a peer review process. As with mission data sets, the restored data sets will result in an update of the PDS catalog. The data flow will be into the PDS under the appropriate Discipline Node, even though the pre-restoration location of the data set may be NSSDC. In cases where NSSDC has the opportunity to restore planetary data sets, it is important that the PDS be involved in the selection of which data sets are to be restored, consistent with the priorities set by the PDS.

B. DATA STORAGE

Most planetary data will be stored in more than one location. The location of the deep archive for the long-term preservation of planetary data will be NSSDC. The NSSDC shall maintain a deep archive of all planetary data designated for indefinite archiving in HQ/SL-approved Project Data Management Plans (PDMPs) (or equivalent documents), and shall assure the continued existence/readability of such data until/unless HQ/SL declares such data to be disposable. When practical, affordable and necessary, NSSDC will create a duplication set from the PDS-provided archive set; this duplication set will be used in creating data copies for requesters, thereby minimizing use of the archive set.

The concept for the PDS Discipline Nodes includes the provision for the maintenance of a working set of all data considered to be relevant to that particular discipline at the Discipline Node. The working data sets will be used to support ongoing research carried out by and through the Discipline Nodes. The research effort will, from time to time, result in new, derived data sets which will be cataloged and submitted to NSSDC for archiving. Information on data sets which are at Data Nodes and are in the process of being restored will be available through the PDS. The data sets themselves need not be stored elsewhere in the PDS or NSSDC while they are in preparation.

A complete set of non-machine-readable planetary data will be archived, maintained, and distributed by NSSDC. The PDS will catalog these holdings and will arrange for the validation, submission, and documentation of these non-digital products, but it will not store or distribute them.

C. DATA DISTRIBUTION

The distribution of planetary data will be a function shared by NSSDC and the PDS. The only exception to this rule will be the distribution of pre-PDS data archived at NSSDC. NSSDC shall be primarily responsible for storing and distributing these products. NSSDC will be responsible for the distribution of partial or complete data sets from requests which are considered 'standard' in the sense that the request may be fulfilled by the straight-forward duplication of one or more tapes or disks. Distribution of all non-machine-readable planetary data products (such as photo products and videos) will be the sole responsibility of NSSDC.

The PDS will have distribution responsibility for filling requests for small amounts of digital data (i.e. a single or partial tape or disk volume), or for requests which require manipulation of the data or the assistance of scientific expertise within the PDS in the preparation of the distribution. The distribution of all data being stored at Data Nodes will be the responsibility of the PDS.

These distribution guidelines hold regardless of the source of the request of the data, whether from a Code SL-supported scientist (initiated from within the PDS) or from another individual (The non-Code SL-supported scientist will initiate his request in NSSDC). Both the PDS and NSSDC will keep each other informed of the status of all requests and provide periodic statistical summaries of all planetary data requests.

Neither NSSDC or the PDS is capable of easily fulfilling requests which involve large amounts of data or large quantities of expert support for the manipulation of data. The NSSDC has well-established charging methods which will be implemented for large requests of planetary data. This holds even if the request is initiated by a scientist supported by NASA Code SL. The PDS does not currently have a charging mechanism for requests which involve large resource expenditures to fulfill. Therefore, it is anticipated that an exchange of services between NSSDC and the PDS can be arranged to satisfy occasional resource-intensive requests.

Both the PDS and NSSDC will fulfill requests using NSSDC standard media as appropriate, including magnetic tape, optical disks, or electronic distribution under standard protocol.

As the PDS releases new products for archive on CD-ROM, they shall provide NSSDC with an initial set of 50 CD-ROMs to seed their archive collection.

VII. USER SUPPORT SERVICES

The PDS is chartered to service primarily the planetary scientists supported by NASA Code SL, although when resources permit the PDS will serve non-Code SL scientists and other planetary users in the U.S. and foreign community. All users can access planetary data through the NSSDC.

Both NSSDC and the PDS will supply users access to catalogs of the planetary data and will support the browse and query of these catalogs.

Planetary data analysis support is the responsibility of the PDS. As such the PDS Discipline Nodes will have data, hardware and software tools, and data management capability to support the analysis of planetary data. The Discipline Nodes will provide the technical and scientific expertise required to use the PDS and to answer questions concerning the data.

VIII. TECHNOLOGY DEVELOPMENT

It is in the interest of both the PDS and NSSDC to continue to develop data management, storage, presentation, computation, and communication technologies as well as standards to better serve the scientific community. Lead roles should be negotiated by NSSDC and PDS (or other DDC's) for particular types of developments for which a DDC is especially suited; and these should be put to use in the overall NASA Distributed Data System as appropriate.

MEMORANDUM OF UNDERSTANDING

BETWEEN THE

PLANETARY DATA SYSTEM

AND

THE REGIONAL PLANETARY IMAGE FACILITIES

September 1993

Approval:

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Jay Bergstrahl, PDS Program Manager

Robert Strom, RPIF Director's Committee Chairman

Ray Walker, PDS Project Scientist

Raymond Arvidson, PDS Geosciences Node Director, Washington University RPIF Director

Laurence Soderblom, PDS Imaging Node Director, USGS RPIF Director

MEMORANDUM OF UNDERSTANDING BETWEEN THE PLANETARY DATA SYSTEM AND THE REGIONAL PLANETARY IMAGE FACILITIES

INTRODUCTION

The intent of this memorandum of understanding is to outline the roles and responsibilities of the Planetary Data System (PDS) and the Regional Planetary Image Facilities (RPIFs) and to establish a formal interface agreement between the two organizations.

BACKGROUND DISCUSSION

As the NASA Planetary Geology and Geophysics (PGG) program grew in the 1970s it became apparent that the Program could not afford to duplicate the extensive and growing collection of planetary image data at each Principal Investigator site. This was particularly the case since the dominant form of analysis was by use of hardcopy forms of the image data sets. The solution was to establish a set of RPIFs, each located at an institution with a long-term, core group of planetary scientists who would use the collections. Further, the sites were chosen to ensure that investigators not located at institutions with RPIFs would not have far to travel to use one of the RPIFs. The PGG program provided funds to generate new mission data sets and facilities like JPL and USGS distributed them to each of the RPIFs. Catalogs were designed and implemented by the Washington University RPIF and then made available to the other RPIFs.

The charter of the RPIFs is focused on providing access to image collections and associated archives (maps, mission documents, etc.), providing expert help on understanding the collections and details of how to order subsets from the National Space Science Data Center and providing public outreach to the local community by having an annual open house. Over the past two decades the outreach component has grown to include short courses and other activities. The RPIFs have also grown in capability to handle digital catalogs and digital forms of the data sets. However, the original charter of providing access to the data sets and expert help have remained unchanged.

The operational PDS has been in existence for several years. The objectives of the PDS have a rather different focus as compared to the objectives of the RPIFs. The charter of the PDS can be summarized in four points. First, the PDS has the responsibility of archiving data sets from past, current, and future missions. Archiving includes putting the data in PDS formats, generating and including quantitative (calibration files) and qualitative (event-related text) documentation, providing peer reviews of the archives, and distributing (e.g., Viking Orbiter VIS EDR CD-ROMs) the archives primarily to the Code SL planetary community, including the RPIFs and NSSDC. This overall activity has been termed data publication since the approach has many parallels to publication of manuscripts in peer-reviewed journals. Second, PDS works with missions to define and validate products (e.g., Magellan MIDR CD-ROMs) and with the research community to plan archives that are fully PDS-compatible prior to distribution to the planetary community. That way the archives do not need to be retrofitted. Third, the PDS is the home and developer of standards for planetary archives. Further, the PDS provides information (e.g., digital catalogs) and expert advise on the data sets (e.g., Magellan User Support Office at Washington University).

To implement its tasks, the PDS is divided into a Central Node at the Jet Propulsion Laboratory (JPL), the Image Node at the USGS-Flagstaff and JPL, the NAIF Node (navigation), and a suite of discipline nodes (Geosciences, Plasma Interactions, Atmospheres, Small Bodies, Rings). The two nodes of primary interest in this memorandum are the Image Node, which maintains archives of raw image data (and the capability to process the data) and the Geosciences Node. The Geosciences Node is responsible for derived image data sets for moons and the inner planets, together with other data sets that are relevant for understanding the geophysical and geological evolution of Mercury, Venus, Earth's Moon, Mars, and Phobos and Deimos.

For reference, the RPIFs are managed by the NASA Planetary Geology and Geophysics Discipline Scientist. The PDS is managed by the Jet Propulsion Laboratory through the PDS Project Manager. The Project Manager in turn reports to the PDS Program Manager at NASA Headquarters.

INTERFACE AGREEMENT

In general, with the exception of providing expert advice, the roles and responsibilities of the RPIFs and PDS are distinct. The RPIF focus is on providing on-site user access to data sets, particularly hardcopy oriented products and catalogs. The PDS focus is on disseminating digital data archives primarily to the Code SL planetary community (no international or non-SL dissemination is supported due to budget limitations). In fact, one view of the relationship between the PDS and the RPIFs is that the RPIFs are a prime customer of the products generated by the PDS. The RPIFs are, in a sense, retail outlets where the PDS-generated products can be viewed, analyzed, and ordered. Of course, the community could also browse at the factory store (i.e., Node sites) and order by mail (e.g., email, phone, letter, etc.).

What is required to continue the valuable services offered by the PDS and RPIFs is a formal interface agreement between the two organizations. This formal interface agreement between the PDS and RPIFs also recognizes their relationship with the NSSDC (which is documented in a separate memorandum of understanding between the PDS and the NSSDC). As part of the interface, particularly, the needs and advice of the RPIF Directors and Data Managers must be periodically folded into the general PDS planning efforts.

Thus,

- The PDS Geoscience Node will use the RPIF Directors Committee as an informal science advisory board and incorporate their recommendations and suggestions as appropriate and convey these recommendations to the PDS Management Council.

- The PDS will act as the primary interface with planetary missions in product and catalog definition, standards usage, product generation (digital and non-digital) and product and catalog validation.

- The PDS will negotiate mission catalogs for transferring to post-mission repositories.

- The PDS will provide funds for CD-ROM copies for PDS distribution.

- The PGG will provide funds for CD-ROM copies for RPIF distribution.

- The PGG will provide funds for generating mission photoproduct copies for RPIF distribution.

- The PDS and the RPIFs will continue to rely on the National Space Science Data Center (NSSDC) for digital and analog product distribution to the non-NASA funded community.

MEMORANDUM OF UNDERSTANDING
between the
OFFICE of FLIGHT PROJECTS
and the
OFFICE of SPACE SCIENCE AND INSTRUMENTS
for
SPACE DATA SYSTEMS

DATED: March 15, 1988

Approved by:

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Space Flight Operations Center

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Planetary Data System

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Science Information Systems Office

Approved by:

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Approved by:

Charles Elachi
Office of Space Science and Instruments

I. PROLOGUE

The overall science data system for planetary exploration includes elements of flight projects, the Space Flight Operations Center (SFOC) and the Planetary Data System (PDS). The intent of this Memorandum of Understanding (MOU) is to identify the responsibilities and interfaces of the flight projects, SFOC and the PDS related to science data systems. The goals of this coordinated science data system are:

- to minimize the cost of development and operations and to maximize the scientific benefits from planetary missions,
- to provide a common environment which supports distributed mission operations and data analysis,
- to enable correlative data analysis across instruments and missions, and
- to produce a validated science archive beneficial to the planetary science community.

II. INTRODUCTION

A. PURPOSE

The agreements made within this MOU are to maximize the commonality and standardization of user and data interfaces within the science data system and to establish collaboration between flight projects, SFOC and the PDS in data systems development and implementation.

B. SCOPE

The scope of this document covers areas related to fundamental responsibilities of the participating organizations, the architecture of the data, user interfaces developed and provided by each facility, and the design and development of operational systems.

C. AUDIENCE

The following groups are the intended audience for the document:

1. Staffs of the Office of Flight Projects (FPO), Office of Space Science and Instruments (OSSI), the Space Flight Operations Center and the Planetary Data System.
2. Flight project management, science representatives (e. g. Project Scientist, Science Manager), and engineering representatives.
3. Members of the planetary science community who are participating in flight projects.
4. NASA headquarters personnel who manage and provide the operating funds for FPO, SFOC and the PDS.
5. Members of review boards chartered to guide or direct the activities of SFOC and the PDS.

D. SUMMARY

The following are key components of this MOU:

1. The flight projects have the overall responsibility for producing a validated, well-documented set of archival science data products and for delivering them to the PDS.
2. The formal interface agreement between flight projects and SFOC are identified as the FPSO Support Agreement (FSA), and between projects and the PDS as the Project Data Management Plan (PDMP).
3. The requirements for commonality in the development and implementation of data interchange standards, user interface standards and network communications support are identified.
4. A joint SFOC/PDS working group to coordinate data system and technology development is established.

E. REFERENCES

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[3] *Solar-Terrestrial Data Access, Distribution, and Archiving*, Joint Data Panel of the Committee on Solar and Space Physics, Commission on Physical Sciences, Mathematics, and Resources, National Research Council, National Academy Press, Washington, DC, 1984.

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[9] PDS System Design Team, *Planetary Data System Functional Requirements Document*, JPL D-3454, October 21, 1986.

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[11] Policy Concerning Data Obtained from Space Science Flight Investigations, *NASA Management Instruction 8030.3A*, May 2, 1978.

[12] Green, J. L., et al., *Guidelines for the Development of the Project Data Management Plan*, in preparation, 1986.

[13] Thieman, J. R., and J. H. King, NASA/NSSDC Central Online Data Directory (CODD), in *Proceedings of the Tenth International CODATA Conference*, in press, 1986.

[14] Martin, T. Z. et al., *Standards for the Preparation and Interchange of Data Sets*, JPL D-4683, January 18, 1988.

F. MOU REVIEW PROCEDURES

This MOU will be reviewed yearly by FPO, SFOC, OSSI, and the PDS to determine each organization's compliance with the MOU as it exists at that time. Any statements in the MOU in conflict with the current policy and procedures of FPO, SFOC, OSSI or the PDS will be identified. The reasons for these discrepancies will be reviewed and either the MOU or the operational policies and procedures of the organizations will be changed to reflect a resolution of this discrepancy. These changes may be necessary if either organization is unable to comply with the MOU or the statements in the MOU no longer reflect current FPO, SFOC or the PDS policies and procedures.

III. ENVIRONMENTS AND RESPONSIBILITIES

Important similarities as well as differences exist between the flight projects, SFOC and the PDS. All environments are distributed and support remote access by science investigators. The flight projects and SFOC support mission critical functions as well as proprietary data, placing strong requirements on system security, reliability and responsiveness. The PDS is a public data system having an open architecture, and significantly lower requirements for reliability, security and response time.

Specifically, a flight project:

1. has a finite lifetime, a specific set of scientific objectives and programmatic visibility at the NASA Administrator level,

2. interfaces with a subset of the entire planetary science community, selected from a community wide Announcement of Opportunity response,

3. is responsible for its flight/ground data system with options to contract support from SFOC and provides computational resources, workstations and a project database to science investigators to support mission operations and data analysis,

4. supports real-time, near-real time and non-real time operations and proprietary data, and

5. has the overall responsibility for producing a validated, well-documented set of archival science data products and for delivering them to the PDS.

The Space Flight Operations Center:

1. is a permanent facility established to provide a broad base of services for all flight projects,
2. provides restricted access to resources by SFOC and project engineering staffs and project science investigators,
3. develops and maintains a set of multi-mission capabilities including Mission Operations Database (MODB), the Multi-mission Image Processing Subsystem (MIPS), and the Navigation Ancillary Information Facility (NAIF), science and engineering workstations, computational facilities and a Science Operations Database (SODB),
4. supports real-time, near-real time and non-real time operations and proprietary data,
5. provides contracted data processing services to flight projects and may provide archival data delivery of project data records to the PDS as directed by the project, and
6. fulfills institutional or NASA requirements for data record maintenance and disposition of products not specified in the Project Data Management Plan.

The Planetary Data System:

1. is a permanent facility established to support the planetary science community and is funded from data analysis programs,
2. supports data retrieval and distribution for the entire planetary science community,
3. develops and maintains a set of mission independent capabilities for catalog access and browse, and provides discipline specific tools for planetary science analysis,
4. does not provide special services to support mission operations,
5. provides access to data after the project proprietary/validation time period, and
6. acts as an agent for the National Space Science Data Center (NSSDC) to archive required flight project data as specified in the Project Data Management Plan.

IV. FORMAL INTERFACES

The controlling document defining the interfaces and responsibilities between the flight projects and SFOC is the Flight Projects Support Office Support Agreement (FSA). The controlling document defining the interfaces between the flight project and the PDS is the Project Data Management Plan (PDMP).

The FSA defines the flight project contracted level of support from SFOC. This support includes any of the baseline set of multi-mission capabilities as well as extensions to the baseline capabilities. Also included would be data volume, throughput, holding time periods, content, interchange standards, and other requirements.

The PDMP, required by NASA Management Instruction 8030.3a, is the controlling document for specifying the formal interface between the flight projects, SFOC and the PDS. The PDMP includes the responsibilities and timelines for data production, data standards, quality assurance and data delivery. The existing MOU between the PDS and NSSDC specifies the PDS as the point of entry of flight project data for national archive.

As an aid to flight projects the PDS provides a PDMP Guideline which affirms the use of data interchange standards and standard higher level data products to promote the correlation and interchange of data across all instruments and flight missions. The PDS, acting as an agent for the NSSDC, ensures that all necessary documentation, calibrations and software are archived with the science data to ensure usability.

V. DATA INTERCHANGE STANDARDS

The flight projects, SFOC and the PDS will adopt and implement a common set of data interchange standards to promote system, catalog and data interoperability. These data interchange standards include data formats, nomenclature, catalog structure, reference systems, interchange languages, and software.

The JPL Standards Procedure is recognized as the formal process to be used in adopting, registering and implementing data interchange standards. Flight projects, SFOC and the PDS will adhere to these standards or follow standard procedures to obtain waivers. The JPL Control Authority Office will negotiate standards and waiver agreements applicable to each flight project and these standards will be documented in the PDMP.

The current JPL Standards Procedure for adopting, registering and implementing data interchange standards involves the JPL Standards Working Group, working within JPL, NASA and the Consultative Committee on Space Data Systems (CCSDS), making recommendations to the JPL Standards Approval Board. Those standards approved by the board are concurred by the JPL Deputy Laboratory Director and registered with the JPL Control Authority Office. The JPL Control Authority Office then maintains these standards for implementation and enforcement throughout Flight Projects, SFOC and the PDS.

VI. USER INTERFACE

A uniform user interface to data system services shall be developed and supported. Users shall not be required to learn several different command languages or interface protocols when dealing with flight project, SFOC and the PDS data systems. All parties should use the same methodology for developing the user interface and provide a basic menu driven interface as an option. Elements of the user interface which should be common to all data systems include session control, screen menus, windows, system commands and prompts, data query and display, as well as data display formats.

VII. COMMUNICATIONS

The flight projects, SFOC and the PDS must support electronic networking capabilities which are in general use by the planetary science community. At the present time, the DECNET and TCP/IP protocols are widely used, and shall be supported during the anticipated migration of network vendors to the ISO/OSI standard. The networking services to be supported include mail, remote computer logon and file transfer. Protocols can be supported either by direct use or by providing transparent gateways between protocols.

The selection of these network protocols is based upon their widespread use by the planetary science community. Most major planetary institutions rely on the Space Physics Analysis Network (DECNET) for electronic communications. The use of TCP/IP will increase as the NASA Science Network and the SFOC workstations are implemented. The evolving ISO/OSI protocol will become the internationally adopted standard when developed and validated. Therefore, networking development within flight projects, SFOC and the PDS must allow for the transition to ISO/OSI when commercially available.

VIII. SYSTEM AND TECHNOLOGY DEVELOPMENT

An SFOC/PDS Joint Working Group is established as a forum for technical and management exchange to eliminate redundant development activities, to expand complementary developments and to provide a mechanism for managed collaboration. This group will report to the Flight Projects Support Office and Science Information Systems Office managers.

MEMORANDUM OF UNDERSTANDING

between the

VOYAGER PROJECT

and the

PLANETARY DATA SYSTEM

DATED: October 10, 1989

Approved by:

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Voyager Project

Approved by:

Terry Z. Martin
Science Manager
Planetary Data System

Approved by:

Norman R. Haynes
Project Manager
Voyager Project

Approved by:

J. Thomas Renfrow
Project Manager
Planetary Data System

Purpose

This Memorandum of Understanding identifies the process by which the Planetary Data System and the Voyager Project will cooperate to archive Voyager data from the Neptune encounter and to insure that important project data sets are transferred to the Planetary Data System prior to disbanding any project elements.

Background

1. Voyager and PDS have collaborated in the successful production of a series of CD-ROM disks containing a substantial archive of Jupiter, Saturn and Uranus imaging data. In addition, several non-imaging scientists have submitted Uranus data sets for a non- imaging CD-ROM.

2. The Voyager Project will continue during the Interstellar Mission, but some of the mission and instrument support functions will phase out during this period. Important Project data sets and documents need to be transferred to an archive facility.

3. The National Space Science Data Center (NSSDC) is currently designated as the archive site for Voyager science data. PDS has been designated as the point of contact for planetary missions with respect to archiving by a Memorandum of Understanding with NSSDC. The procedures developed by PDS for the submission and validation of project data are more stringent than those followed by NSSDC and could require extra effort by the Voyager scientists to fulfill.

Agreements

Topic: Receipt of data from the Voyager Principal Investigators.

PDS will: Sponsor a Neptune data workshop for Voyager scientists and engineers to identify important archive data sets and to explain the PDS requirements for data set documentation and formatting. PDS will also verify data documentation, labelling and formatting of sample data sets submitted by Voyager personnel.

Voyager will: Offer to each of its instrument teams the option of sending their data directly to NSSDC or to the PDS. If it is the PDS then the teams will follow the standards identified in the Standards for the Preparation and Interchange of Data Sets (SPIDS), Version 1.1, JPL Document D-4683.

Topic: Develop an Archive and Transfer Plan for Project data sets and documents, to include Master Data Records, Mission Sequence of Events, Project Bibliography, navigation data sets and project documentation which is not available through JPL's Vellum Files.

PDS will: Work with Voyager to develop a plan that is compatible with both PDS' and Voyager's plans for data handling. Identify excess PDS resources required to do the work.

Voyager will: Work with PDS to develop a plan that is compatible with both PDS' and Voyager's plans for data handling. Identify excess Voyager resources required to do the work.

Topic: Production of Neptune CD-ROMs.

PDS will: Provide technical assistance in planning for the production of Voyager Imaging and non-imaging CD-ROMs. This will include contracting for pre-mastering and mastering services and production of replicas of the Voyager CD-ROMs for general distribution to the science community.

Voyager will: Prepare images and other science data sets in PDS format. Deliver the data files to PDS on magnetic tape. Provide funds for mastering and replication.

Planetary Data System

CD–ROM

Mastering and Distribution

Policy and Procedures

JPL

Jet Propulsion Laboratory
California Institute of Technology

JPL D-8712

22 July 1991

A PDS CD–ROM Mastering and Distribution Policy and Procedures

A PDS CD–ROM Mastering and Distribution Policy and Procedures

1.0 PDS CD–ROM Distribution Policy

The PDS publishes planetary data on CD–ROMs. Distribution of data on CD–ROM is performed in a distributed manner. The PDS Central Node and Discipline Nodes distribute to predefined lists of Code SL–affiliated recipients. NSSDC distributes to other entities.

Limited quantities of CD–ROMs are purchased by PDS for each distribution site. Additional duplications of disks are to be made by NSSDC.

1.1 Code SL and NASA Distributions:

All final PDS CD–ROMs will be distributed by the PDS Central Node, the appropriate PDS Discipline Nodes, and the National Space Science Data Center.

The PDS Central Node will distribute CD–ROMs to a predefined list of JPL and NASA headquarters personnel. (see Appendix A)

At no charge, PDS will provide 50 copies of each CD–ROM to the National Space Science Data Center for distribution. It is the responsibility of NSSDC to fund additional supplies of disks.

Each PDS Discipline node will be provided with copies of new CD–ROM titles.

Discipline nodes that are responsible for curation of particular CD–ROMs will stock additional copies on a product–by–product basis. These CD–ROMs will be distributed to planetary scientists, VIPs, and product–specific distribution lists, developed by the nodes, in consultation with the PDS manager and NASA Headquarters.

The PDS manager may approve distribution of disks on a case–by–case basis to JPL or other NASA–affiliated individuals. PDS personnel may request single copies of PDS disks. Any JPL employee or organization, not on the standard distribution lists, may order disks from the CN disk inventory by supplying a valid JPL charge number. A charge per disk will be levied with the resulting funds being journaled to the operations budget and used to replenish the reserve, when necessary.

The total standard distribution (see Appendix A) is as follows:

Quantity	*Distribution*
12	NASA Headquarters
50	NSSDC
48	JPL Central Node
16	Discipline Nodes
150	Responsible Discipline Node(s)
12	Outside
37	Central Node Reserve
325	Total

1.2 Distribution to Non-NASA Entities:

A standard method for providing public access to PDS CD–ROM disks may be developed.

The PDS manager may approve distribution of disks, on a case–by–case basis, to individuals not affiliated with NASA.

1.3 Foreign Distribution:

All foreign distributions are subject to the U.S. Federal statutes at the time of distribution. NASA Headquarters (code SL) and JPL legal council should be consulted before exporting data on CD-ROM.

Special arrangements must be made for particular groups and countries.

The U.S. and Soviet Joint Working Group, of which Arden Albee of CalTech, Ray Ardvison of Washington University, and Tom Duxbury of JPL are members, has a NASA–approved vehicle in place for transfer of certain classes of data to the Soviet science community.

1.4 Mission Distribution:

For mission generated CD–ROMs, each flight project is responsible for distribution to mission personnel, including science teams. PDS does not fund the creation, duplication, nor distribution of project products to project teams. Flight projects are responsible for data preparation, premastering, and mastering of all project products. PDS provides expert assistance in the production process.

2.0 PDS CD–ROM Mastering of Restoration Data

2.1 Costs Associated with Mastering and Duplicating CD–ROMs:

The costs associated with data preparation, premastering, and mastering vendors must be carefully planned with mission teams. Discipline Nodes or other data preparers will fund the data preparation. The PDS Central Node will provide funds for premastering, mastering, and duplication of the quantity of products as described in Section 1.1 of this plan. Additional quantities may be ordered from the vendor, if funded by the data preparer.

The PDS Management will make final determinations as to the funding source of PDS–published CD–ROM preparation and duplication.

The costs of data preparation including: labeling, transferring, template preparation, validation, and review are difficult to quantify. These costs can be tracked by JPL SRM instruments.

The costs of premastering can be tracked by the JPL SRM system. Premastering includes labor, computer resources, media, and art/design activities. Premastering media costs are approximately $200 per CD-ROM. The media costs are for WORM disks and 8mm tapes.

The costs of vendor mastering, printing, duplication, and shipping are tracked against JPL purchase orders. Approximate costs include:

Vendor Mastering	$1,080.00 per mastered title
Vendor Duplication	$1.50 per duplicated copy
Vendor Setup	$190.00 per reduplication order

3.0 PDS CD–ROM Procedures

This section outlines procedures for planning, premastering, mastering, and distributing PDS–published CD–ROMs. PDS fiscal involvement is described within this document.

3.1 Getting On The Schedule:

At the time it becomes apparent that a CD–ROM will be produced, a request form, (see Appendix B), should be submitted to the CD–ROM Production Coordinator. The form includes schedule, financial, technical, and distribution information.

"The time and resources required to prepare data for transfer to CD-ROM should be considered before scheduling the production of a CD. Any support required from the CN for label preparation, template preparation, or data validation should be coordinated with the appropriate PDS management."

Most CDs are planned before the fiscal year that they are to be produced. The CD–ROM

Production Coordinator is responsible for including a CD–ROM production schedule and financial estimate into the Fiscal Year Planning package that is submitted to PDS management.

Unexpected requirements and deviations from production plans will require revising the CD–ROM master schedule and budget. Changes to CD–ROM schedules should be presented at the earliest Project Management Review (PMR) for impact assessment.

3.2 Ordering CD–ROM Mastering:

All PDS CD–ROM mastering orders must be coordinated by the CD–ROM Production Coordinator. It is expected that mission entities and NSSDC may be involved in ordering titles at the same time as PDS.

Premaster tapes and artwork or hardcopy inserts should be shipped to the mastering vendor by the CD–ROM Production Coordinator.

The CD Cognizant should consult appropriate mission personnel, Discipline Nodes, and NSSDC before placing an order. If any entities wish to augment their allocation, (see Appendix A), they may supply funding for the additional copies. It is a CD–ROM Production Coordinator duty to inform DNs and NSSDC of imminent mastering and duplication action.

3.3 Restocking and Ordering CD–ROM Duplication:

In general, PDS will not initiate restocking activity. PDS nodes will distribute CD–ROM stock until a minimal level is reached. At that point, remaining copies will be made available to requesters on a loan basis from PDS. NSSDC will provide disks through its normal distribution procedures.

All PDS–initiated CD–ROM restocking and duplication orders must be handled by the CD–ROM Production Coordinator. It is expected that NSSDC may be involved in reordering titles at the same time as PDS.

Discipline Nodes and NSSDC should be consulted before the CD–ROM Production Coordinator places an order. It is a CD–ROM Production Coordinator duty to inform DNs and NSSDC of imminent duplication action.

Reciprocity should be practiced by NSSDC. If NSSDC initiates a restocking order, PDS should be notified so that PDS may order , if need and budget permit.

3.4 Receiving CD–ROMs At JPL:

All CD–ROM shipments from vendors to JPL should be addressed to the CD–ROM Production Coordinator. The CD–ROM Production Coordinator will deliver all copies to the PDS Operator for distribution to pre–defined lists, NASA HQ, NSSDC, DNs, and CN stocking.

The CD–ROM Production Coordinator is responsible for handling discrepancies and damaged shipments.

3.5 Distributing CD–ROMs to Distribution Lists:

The CD–ROM Production Coordinator will deliver all copies to the PDS Operator for distribution to pre–defined lists, NASA HQ, NSSDC, DNs, and CN stocking.

3.6 Tracking CD–ROM Distribution:

The PDS Operator and appropriate Discipline Nodes are responsible for updating and maintaining CD–ROM distribution tracking databases. These distributed databases will provide PDS with the ability to distribute updated versions of CD–ROMs, hardcopy updates, and periodic announcements to the PDS CD–ROM community.

3.7 Obsolete CD–ROMs and Updated Versions

PDS will, on a best efforts basis, notify the science community when CD–ROM discs become obsolete. As resources permit, PDS may replace obsolete discs with new versions.

3.8 Filling Code SL Requests:

Code SL–funded personnel may order PDS data using the Central Node catalog, contacting Discipline Nodes, or the PDS Operator. Most orders should be filled through Discipline Nodes. Priority requests from code SL–funded personnel may be filled directly from PDS stock.

3.9 Filling Non-Code SL NASA Requests:

Non–Code SL–funded NASA personnel may order PDS data using the Central Node catalog or NSSDC. The orders should be filled through NSSDC.

3.10 Filling Non-NASA Domestic Requests:

Non–NASA personnel may order PDS data using NSSDC. The orders should be filled through NSSDC.

3.11 Filling Requests for Export to Foreign Entities:

Requests for data to be exported to foreign requesters should be handled through NSSDC. NSSDC is able to handle export requests. In special circumstances, to expedite the process the PDS Central Node may provide NSSDC with copies of media to be distributed to the foreign requesters.

APPENDIX A

PDS Central Node Standard CD–ROM distribution list:
The following distribution list shall be used for all final CD–ROMs generated by PDS. Annually, this list shall be reviewed by PDS Management.

NASA HQ Distribution	Quantity — 12	
	Wes Huntress	(Code SL)
	Bill Quaide (5)	(Code SL)
	Greg Hunolt	(Code SE)
	David Okerson	(Code SL)
	Jim Willett	(Code SS)
	Joe Bredekamp	(Code SM)
	Jim Harris	(Code SM)
	Betsy Beyer	(Code SL)

NSSDC Distribution — Quantity — 50

PDS will provide NSSDC with 50 copies of each CD–ROM title to seed distribution. NSSDC charges requesters a fee to generate revenue to purchase additional copies as demand warrants.

NSSDC may purchase additional copies of any disk series by direct negotiation with the mastering facility. Current JPL masters are held by DADC (all Voyager disks, Magellan disks, all FY91 disks) and NIMBUS (Pre-Magellan and Viking IRTM).

PDS will provide NSSDC prior notice of release of each new CD–ROM title and each re–duplication of CD–ROM titles. NSSDC may choose to order and fund additional copies.

PDS Nodes — Quantity — 16

Small Bodies Node
Rings Node
Geosciences Node
Imaging Node (JPL)
Imaging Node (Flagstaff)
Atmospheres Node
Planetary Plasma Interactions
Navigation Ancillary Information Facility

APPENDIX A

JPL Distribution	Quantity — 48	
	Sue McMahon	PDS Project Manager
	Gary Walker	PDS Baseline Manager
	Yolanda Fletcher	PDS Mission Interface Manager
	Dave Childs	PDS System Engineer
	Tom Renfrow	Science Data Systems Section Manager
	Mike Martin (5)	PDS Technology
	Jason Hyon (2)	CD-ROM Production
		PDS Operations
		PDS Data Engineering
		PDS System Engineering
		PDS Software Development
	Art Zygielbaum (5)	Science Information Systems Office
	Jim Weiss	Geology and Planetology Section
	Pat Liggett	FIST Lab
	Ralph Kahn	JPL Datalab
	William Kausman	SPACE project
	Tom Handley	FPO Technology Planning
	Bud Jacobsen	Science Visualization
	Steve Coles	JPL
	Elizabeth Smith	NASA Ocean Data System
	Ernie Paylor	Pilot Land Data System
	Tom Kotlarek	Alaska SAR Facility
	Peter Kahn	Mars Observer Project
	Ted Clarke	Galileo Project
	Tom Duxbury	CRAF/Cassini
	Rich Miller	IPAC
	Ray Wall	Image Processing Lab
	Bill Green	Image Processing Lab
	Sue LaVoie (5)	Multimission Image Processing Lab
		Public Education Office
	Frank O'Donnell	Public Information Office
		Public Affairs Office
	John Hewitt	JPL Photolab
	Mike Hooks (2)	JPL Archives

APPENDIX A

External Distribution	Quantity — 12	
	Randy Davis	U of Colorado
	Bob Mehlman	UCLA, ODL Developer
	Jerry McFaul	Federal CD–ROM Special Interest Group SIGCAT, Education Subcommittee
	Joel Mosher	ODL Developer
	Dana Swift	ODL Developer
	(Reciprocal Distributions)	
	Dave Traudt	USGS
	Madeline Zirbes	National Earthquake Information Center
	Donna Scholz	EROS Data Center
		National Snow and Ice Data Center
		National Geophysical Data Center
		Einstein Observatory

APPENDIX B

CD–ROM Schedule Request Form

Date ____________________

CD–ROM Title ____

Cognizant Engineer ____________________________________

Volume Description ____

____

____

____

____

PREMASTERING

Expected Start Date ______________

Expected Completion Date ______________

Computer Resources Required __________________________

Workforce Required __________________________________

Funding Source _____________________________________

MASTERING

Expected Date to Vendor _____________________

Expected Mastering Date _____________________

Expected Date Discs to be Delivered to JPL _____________________

Funding Source _____________________________________

Quantity ____

From: YOLANDA FLETCHER (5/31/95)
To: Peggy Cribbs, Steve Hughes, Ronald Joyner, KAREN LAW, Ruth Monarrez, Jean Mortellaro, Gail Woodward
CC:
BCC:
Priority: Normal Date sent: 5/31/95 9:35 AM

OFFICE MEMO

Subject: Data Distribution Policy

Time: 9:28 AM

Date: 5/31/95

Attached you will find a copy of the Data Distribution Policy.
Please forward comments to me by the end of the week.
Thanks,
Yolanda

PDS DATA DISTRIBUTION POLICY

Introduction

It is important to understand the roles and logistical and financial responsibilities for distribution of planetary data products. The intent of this brief policy statement is to provide guidelines that address these issues. Entities involved include the National Space Science Data Center, the Planetary Data System, the Regional Planetary Image Facilities, planetary missions, and data analysis research and analysis programs.

Roles and Responsibilities

A. The Planetary Data System serves as the primary interface to flight projects for product and catalog definition, standards usage, product generation and validation. All active mission data products enter the NASA archive environment through the PDS. The PDS is also the archive entry point for all restored data from past missions and products produced by data analysis and research programs, resources permitting.

B. The National Space Science Data Center (NSSDC) is the deep archive for planetary data sets and maintains an archive of all planetary data designated for indefinite archiving and shall assure the continued existence/readability of such data until/unless HQ/SL declares such data to be disposable.

C. The charter of the Regional Planetary Image Facilities (RPIFs) is focused on providing access to image collections and associated archives (maps, mission documents, etc.), providing expert help on understanding the collections and details of how to order subsets from the NSSDC and providing public outreach to the local community.

- more -

From: YOLANDA FLETCHER (5/31/95)
To: Peggy Cribbs, Steve Hughes, Ronald Joyner, KAREN LAW, Ruth Monarrez, Jean Mortellaro, Gail Woodward
CC:
BCC:
Priority: Normal Date sent: 5/31/95 9:35 AM

D. Planetary Missions are responsible for producing Planetary Data System-compliant archives from mission observations. The Project Archive Policy and Data Transfer Plan identifies which mission products shall be archived with the PDS as well as a schedule for archive activities. After the mission personnel have validated and released the archives, the Planetary Data System becomes responsible for archiving and distributing data to the Code SL community and the National Space Science Data Center is responsible for deep archiving and distributing to the broader community.
E. Research and Data Analysis Programs (R&DA programs) often produce products of wide interest that require review, replication, and distribution. The Planetary Data System and the R&DA program shall jointly produce a Program Data Management Plan that identifies which data products are suitable for archive and distribution through the PDS as well as a schedule for archive activities. Data archive generation and review are the responsibility of the program producing the data. The PDS is responsible for archiving and distributing the data products as defined in the PDMP to the Code SL community. The National Space Science Data Center is responsible for deep archiving and distributing to its community.
Guidelines for Archive Volume Generation

A. Planetary Missions are responsible for producing Planetary Data System- compliant archives from mission observations. Missions shall fund the generation and validation of archive products. For archives on CD-ROM, the missions are responsible for the premastering, mastering, and replication of the number of volumes needed for validation, peer review and science team use. The relevant Planetary Data System Discipline Node(s) shall provide archive structures and standards and be involved in the peer review of the archive products.

B. Research and Data Analysis Programs are responsible for producing products specific to their funded areas of research and analysis. If a product has been targeted for archive in the Planetary Data System, then the R&DA program is responsible for producing PDS - compliant archives and shall be responsible for funding the generation and validation of the archive product. For archives on CD-ROM, the R&DA program is responsible for the premastering, mastering, and replication of the number of volumes needed for validation and peer review. The relevant Planetary Data System Discipline Node(s) shall provide archive structures and standards and be involved in the peer review of the archive products.

C. The Planetary Data System is responsible for funding the generation, validation, premastering and mastering of all restoration products. Both the planetary missions and the R&DA programs shall provide inputs to the PDS regarding restoration

- more -

priorities.
Guidelines for Archive Volume Distribution
CD-ROMs
A. Upon the release of approved archive volumes (CD-ROM Masters) from the Planetary Missions or Research and Data Analysis Programs to the PDS, the PDS shall fund the distribution of archive products to the NSSDC, RPIFs and Code SL funded scientists. The Planetary Data System and the NASA Code SL Program Managers shall, on a yearly basis, generate a global list of all Code SL funded scientists. The PDS Node leading each archive effort shall generate a distribution list from this global list based on product type and distribution budget limitations. The final distribution list for each archive product shall be approved by the PDS Management Council and the NASA Code SL Program Managers.

In addition, the PDS shall

- Provide 1 copy of each archive product to the NSSDC for deep archive
- Provide 2 copies of each archive product to each RPIF

B. The National Space Science Data Center (NSSDC) is the deep archive for planetary data sets and the primary entity for distribution to people not funded by NASA Code SL under a research and data analysis program. The NSSDC shall manage the distribution of products to the educational community, the interested public, and scientists not funded under the above programs.

CD-WOs
A. Planetary Missions, R&DA Programs or PDS Nodes that generate CD-WO archive products shall ensure that at least 2 copies of the product are generated for archive. One copy will remain with the archiving PDS Node and the other copy will be sent to NSSDC for deep archive.

B. The method for distribution or availability of archive data on CD-WO shall be left to the discretion of the archiving PDS Node. Options for data access include, but are not limited to the following:

- On-Line Jukebox Access
- Generation of CD-WO copies as requested
- CD-WO Loan Program

- more -

From: YOLANDA FLETCHER (5/31/95)
To: Peggy Cribbs, Steve Hughes, Ronald Joyner, KAREN LAW, Ruth Monarrez, Jean Mortellaro, Gail Woodward
CC:
BCC:
Priority: Normal Date sent: 5/31/95 9:35 AM

Access to On-Line Archives

A. On-line data sets shall be accessible via ftp services and should be left open to the public as long as network traffic is not a problem. Researchers funded by NASA Code SL should be given priority access to on-line data sets if network traffic becomes a problem.

Other Media Types

A. Guidelines for the distribution of archive products on other media shall be handled on a case-by-case basis.

From: SUE MCMAHON (5/23/95)
To: TERRI ANDERSON, Ann bernath, Peggy Cribbs, ELAINE DOBINSON, YOLANDA FLETCHER, Steve Hughes, Ron Joyner, KA
CC:
BCC:
Priority: Normal

Date sent: 5/23/95 4:54 PM

OFFICE MEMO

Subject: Clementine distrib policy

Time: 4:57 PM

Date: 5/23/95

FYI - this draft policy was just sent to HQ (and node mgrs) for comments. Let me or Yolanda know if you have major probs with it. thx, Sue

Jay Bergstralh
Code SL
NASA Headquarters
Washington, DC 20546-0001

SUBJECT: PROPOSED PDS DISTRIBUTION POLICY FOR CLEMENTINE DATA

Dear Jay:

In response to the recent PDS Management Council discussion and action items on PDS data distribution for Clementine, we have drafted a policy for your comment and approval. Many of the questions which prompted this review came from J. Plescia. I propose we reach an agreement internally on the plan, and then coordinate with him through you as our program manager.

Two items should be noted. First, there has been a thought-out PDS distribution plan in place for Clementine for some time; however, it was not communicated well at the recent Council meeting, and we document it here. In that original planning, a letter was distributed by PDS to the existing Imaging Node list of science users, requesting rationale for receipt of the Clementine data. While many of the names suggested for deletion by J. Plescia are on this request list, we feel an obligation to these users who are expecting the deliveries promised earlier by PDS.

Second, since many of the issues raised by J. Plescia may indeed apply to other Code SL Research and Analysis Programs, we are drafting a broader PDS Data Distribution Policy which we will send separately for your review. In the future, we want to have an efficient mechanism to ensure that each individual on our distribution list is approved by Code SL, including the R+A program managers. Yolanda Fletcher is

- more -

coordinating inputs across all nodes so there is one clear, consistent PDS policy, rather than separate agreements made between individual nodes and program managers.

Please let me know if you have questions or suggestions for this policy.

Sincerely,

Sue McMahon
PDS Project Manager

attach.

cc:
PDS Node Managers
Y. Fletcher
G. Walker

5/22/95 skm

PDS DISTRIBUTION POLICY FOR CLEMENTINE DATA
D R A F T

CLEMENTINE DISTRIBUTION LISTS: The process for the distribution of the Clementine products was designed in FY94 after severe budget constraints limited the PDS ability to service the community. Because of these budget constraints and the anticipated large set of new titles, PDS did not plan to distribute individual sets of the Clementine archive to a large community. In an effort to ensure that this data would be accessible to the Planetary community, PDS planned to give each Clementine Science Team member a complete set, place the archive at each RPIF, maintain a remote-access on-line database of Clementine data products at the PDS Imaging Node,

- more -

and make all CD-ROMs orderable through NSSDC for a small fee. Scientists that did not have adequate access to the CD-ROMs through any of the above methods were asked to justify their requests for Clementine data via a form. The forms were mailed in June 1994 by Yolanda Fletcher, PDS Mission Products Manager, to the existing distribution list maintained by the PDS Imaging Node/USGS.

In response to the letter, PDS received requests for data from about 50 scientists and mission engineers. After reviewing their rationale for needing the data, these individuals were placed on the distribution list. While some of these individuals may not be currently funded Code SL scientists, PDS feels a commitment to distribute the products which we promised to these individuals last year in our letters.

PHYSICAL DISTRIBUTION OF CLEMENTINE PRODUCTS: The distribution list is coordinated and controlled centrally at the PDS Imaging Node/USGS. The physical distribution of PDS products is coordinated by the Central Node because it manages the CD-ROM mastering contract, and all coordination with the vendor is centralized. The most cost effective distribution method for the Clementine products is to have the vendor ship 130 copies to the Imaging Node, who will perform the primary distribution. Approximately 95 copies are to be shipped by the vendor to JPL, from which copies will be sent to the JPL RPIF, which will do distribution to the other RPIFs. The remaining JPL CD-ROMs will be sent through interoffice mail by the Central Node to those scientists on the final distribution list that reside at JPL. Any remaining CD-ROMs will be kept in an inventory at the Imaging Node/USGS.

COPIES TO RPIF SITES: Originally PDS planned to distribute 3 copies of each CD-ROM title to each Regional Planetary Image Facility. Recently, J. Plescia/RPIF Program Manager requested that each RPIF receive only 2 copies, which will be implemented by PDS. Also, PDS proposes that the RPIF distribution list remain separate from the PDS individual scientist list because the RPIF-specific distribution is done by the JPL RPIF, and the amount of overlap in this area does not warrant the tedious task of manually reviewing the scientist list for each new distribution in search of RPIF managers.

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109-8099
(818) 354-4321

JPL

25 September 1996

Dear Colleague:

At the last PDS Management Council, I was given the action item to develop a copyright clearinghouse for the Planetary Data System. This action is complete.

The clearinghouse is now in operation. This clearinghouse is an access database that I will maintain. When copyright permission is granted, provide me a package with copies of all copyright permission request letters, copyright permission letters, and any other correspondence related to a request. Please do not send the package in pieces. I will enter the information into the database. If you need information, please call me at (818) 306-6263 or send electronic mail to gwalker@archive.jpl.nasa.gov. At this point, I can not promise, but we may find it possible to place the database on the network for all PDS nodes and subnodes to read.

The Database:
The database includes information regarding the request, the permission granted, the copyrighted item, and the PDS product we plan to use the item for. Database fields, types and descriptions are listed below.

DATABASE FIELD	DATA TYPE	DESCRIPTION OF FIELD
PERMISSION_CD	YES/NO	permission granted to put on CD
PERMISSION_REPRINT	YES/NO	permission granted to put on reprints of CD
PERMISSION_ONLINE	YES/NO	permission granted to put on CD on line
PERMISSION_DURATION	DATE	permission granted to use until DATE, *(we do not plan to use, but if a data rights owner asks for this, it is covered in the database)*
PERMISSION_SCOPE_NOTES	MEMO	notes detailing any special scope constraints
PERMISSION_COPYRIGHT_STATEMENT	MEMO	actual required copyright or permission statements
PERMISSION_DATE	DATE	date permission granted
PERMISSION_LETTER	OLE OBJECT	scanned copy of the permission letter
PERMISSION_LETTER_FILE_TYPE	TEXT	type of permission letter (e-mail, hardcopy, FAX, ...)
REQUEST_NODE	TEXT	node or subnode that requested permission
REQUEST_DATE	DATE	date permission requested
REQUEST_LETTER	OLE OBJECT	scanned copy of the request and other correspondence
REQUEST_LETTER_FILE_TYPE	TEXT	type of request letter (e-mail, hardcopy, FAX, ...)
ITEM_DESCRIPTION	MEMO	description of requested item
ITEM_TYPE	TEXT	type of item (journal article, image, movie, sound, ...)
ITEM_FORMAT	TEXT	file type (hardcopy, GIF, AU, MOV, JPEG, ...)
ITEM_OWNER	TEXT	name of permission-granting entity
ITEM_AUTHOR	MEMO	name or list of names of authors
ITEM_MISSION	TEXT	mission associated with requested item
ITEM_INSTRUMENT	TEXT	instrument associated with requested item
PRODUCT_DATASET	TEXT	data set name or ID of target PDS product
PRODUCT_VOLUME	TEXT	volume of target PDS product

The Request Letter:
Each PDS entity that requests copyright permission must ask for appropriate permissions. We are concerned with permission to put the items on CDs and to put the CDs on the

network. It is important that the item owners are a ware of what the PDS is, how it will use the items, how they are distributed, that we reorder or reprint CDs.

I have written a sample letter template. I ask all PDS nodes and subnodes to use this sample letter template to request items. You should feel free to make adjustments to the text, but keep the substance of the letter. Items in square brackets [ ] are notes for you and should be omitted when you prepare a request.

Sincerely,

Gary N. Walker

attachment: Sample Request Letter Template

encl: Word® RTF file on diskette

Dear ---------------------------:

Regarding the inclusion of ——(title)—— on a (set of) CD-ROM(s).

The Planetary Data System is in the final stages of producing a (set of) CD-ROM(s) containing data from ----*(mission)*----. Content plans include ASCII text versions of papers published in ----*(publication/journal)*----.

The Planetary Data System has been charged with the task of providing the highest quality data and documentation from planetary missions to scientists for all time. The science community has determined that in order for the data to be useful to future generations of scientists, the associated documentation must fully describe the instruments, data processing, and other aspects of the data sets. Before they are "published" on CD-ROM, the Planetary Data System peer reviews data sets and documentation in much the same way journals review papers. Once data have been accepted into the Planetary Data System NASA archive, they are made available to scientists at no cost until the initial duplication order (usually about 300) is exhausted. After this time, there is a nominal reproduction cost to users. CD-ROM distribution is handled initially by the Planetary Data System and by the National Space Science Data Center (NSSDC) and then solely by the NSSDC. The NSSDC charges a nominal fee to cover costs of reproduction, shipping, and handling.

The Planetary Data System is formally requesting permission to reproduce ----*(requested item(s))*---- from ----*(publication/journal)*---- on the ----*(PDS product name)*---- product. PDS further requests permission to place ----*(requested item(s))*---- online with the PDS archived volumes.

Additional information is detailed below. Thank you for your time and attention to this matter.

Description of the Planetary Data System:

[Legal status, structure, ownership, management, history, clientele, teaming relationships, collaborations.]

The Planetary Data System (PDS) is a NASA-funded project. The NASA Planetary Data System (PDS) archives and distributes digital data from past and present NASA planetary missions, astronomical observations, and laboratory measurements. The PDS is sponsored by NASA's Office of Space Science to ensure the long-term usability of data, to stimulate research, and to support data analysis.

Immediate management responsibility of the PDS resides at the Jet Propulsion Laboratory (JPL) in Pasadena, CA. Teaming relationships exist within the PDS among, JPL, NASA's Ames Research Center, the United States Geologic Survey, Washington University, Stanford University, New Mexico State University, and the University of Maryland. Other collaborations exist among research institutes, government agencies, and educational institutions under contract or memoranda of understanding with the PDS.

Users of the archived data are primarily the NASA-funded science community and secondarily the international science community.

Proposed Project Plan:

[Intended use, nature of inclusive package, computer platforms supported, size and market for distribution, distribution media]

The PDS project of interest is the ----*(PDS product name)*----. A (set of) CD-ROM(s) containing observations from various instruments, is being generated to provide the planetary science community with a complete set of the observations. The purpose is not so much to distribute and disseminate as much as to gather all the data into one place and archive them before they become lost.

The use of the ----*(requested item(s))*---- will be as a source of documentation to accompany the set of data taken by ----*(mission and instrument)*---- during and around the time of the ----*(encounter or event)*----. Future plans call for all PDS CDs to be accessible through the World Wide Web as full volumes and complete volume sets.

The CD-ROM(s) will be distributed to a list of NASA scientists. Additional copies will be held for future science interests. PDS may replicate additional copies to be distributed on a not-for-profit basis.

Detailed Technical Plan:

[format, details, size]

Our plan is to include a ----postscript/PDF/RTF/ASCII/----*(file format type)*---- file of ----*(requested item(s))*---- Version---- in the documentation section of the CD-ROM(s) that contain ----*(event/mission/target)*---- observations. Your work will be thoroughly cited in a credits/bibliographic entry. We will use the copyright and permission statements that you provide. Due to the size of the file, we may publish it on only the first CD containing ----*(event/mission/target)*---- data. This file will accompany a set of standard PDS documents describing the instrument, the instrument host, the mission and the data set.

The CD-ROM(s) may be posted on World-Wide Web sites as complete volumes. The Planetary Data System has no plans to excerpt or place value judgments upon your contribution.

Please provide any suggestions or comments that you feel may be necessary

Sincerely,

J. Q. Requester

From: Gary Walker (4/17/96)
To: SUE MCMAHON, Mike A'Hearn, Ray Arvidson, Reta Beebe, Eric Eliason, Ed Grayzeck, lloyd huber,
CC: YOLANDA FLETCHER, Chuck Acton, Ken Bollinger, John S Hughes, Susan K Lavoie, Mark Showalt
BCC:
Priority: Normal **Date sent: 4/17/96 9:15 AM**

Mail*Link® SMTP

Dear Colleague:

At the Management Council meeting, I was asked to send you information regarding data classification procedures.

In general, it is necessary to get your data holdings classified through the Department of Commerce to avoid the possibility of being outside the bounds of U.S. import/export, security, and other statutes. The Departments of State and Defense have regulations that will be covered by the Department of Commerce classification.

Hot buttons include: spectral instruments, instrument designs, and Earth-observing information.

Rings and JPL PDS sites are already covered. I think I heard Mike A'Hearn say that SBN/UMD was also compliant.

Your international affairs office or legal department should be able to guide you through the very simple process.
You must submit an Export Classification request to the Department of Commerce.

Below are the procedures to obtain an Export Classification request through the Department of
Commerce.

1. The exporter must attempt to identify which Export Control Commodity Number (ECCN) covers the commodity proposed for export. The general characteristics of the commodity will usually guide the exporter to the appropriate Commodity Group. Once the appropriate Commodity Group is identified, the particular characteristics and function of the equipment should be matched to the specific ECCN.

2. The index to the Commodity Control List may also help to match a general description to a specific ECCN entry. All items subject to Commerce licensing jurisdiction are included on the Commodity Control List (CCL), either in a specific commodity listing or in an "other, n.e.s." entry at the end of each Commodity Group.

Information Required on a Classification Request

1. The requester must submit a recommended classification for the commodity(ies) and explain the reasons for this classification.

   This explanation must contain an analysis of the classified commodity(ies) in terms of the technical control parameters specified in the appropriate ECCN. If the requester cannot determine the appropriate classification, then the requester must explain the reasons for failing to recommend an appropriate classification. This explanation should include an identification of ambiguities or deficiencies in the regulations that preclude making a classification.

- more -

From: Gary Walker (4/17/96)
To: SUE MCMAHON, Mike A'Hearn, Ray Arvidson, Reta Beebe, Eric Eliason, Ed Grayzeck, lloyd hube
CC: YOLANDA FLETCHER, Chuck Acton, Ken Bollinger, John S Hughes, Susan K Lavoie, Mark Showa
BCC:
Priority: Normal **Date sent:** 4/17/96 9:15 AM

2. The requester must attach descriptive literature, brochures, technical papers or specification that provide sufficient technical detail to enable Export Administration personnel to verify or correct the commodity classification.

3. No more than five commodities will be considered in a single request. Exceptions may be made on a case-by-case basis for several related products if the relationship between these products is substantiated and documented.

4. The request must be mailed to one of the following addresses:

   U.S. Department of Commerce
   P.O. Box 273
   Washington, D.C. 20044
   Attn: Commerce Class.
   Technical Support Staff

   U.S. Department of Commerce
   Room 2631
   14th & Penn. Avenue, N.W.
   Washington, D.C. 20230
   Attn: Commerce Class.
   Technical Support Staff

   Requests must be clearly marked at the top of the first page and lower left-hand corner of the envelope: "Commodity Classification Request"

   Requests may also be faxed to (202) 219-9179 or (202) 219-9182

Gary

REVISED DRAFT
PDS Policy on International Activities

Michael F. A'Hearn

June 3, 1996

The PDS MC recognizes the importance of foreign collaborations for several reasons, including first and foremost the improved science that will result but also and more immediately the possibility of directly enhancing the products we can deliver to SL users and in increasing the use of SL mission products. To this end, the PDS has been working with European, Russian, and Japanese facilities and missions to adopt PDS standards and approaches. These activities have been fruitful, both for international science and for U.S. planetary scientists.

For example, there is a European Magellan Data Node at Graz Technical University, a prototype Russian PDS at IKI in Moscow, and a Data Node at DLR in Berlin for the HRSC/WAOSS camera system to be flown on Mars 96. These activities are associated with the PDS Geosciences Node. Further, the Small Bodies Node has been working with ESA to archive data from the Giotto Extended Mission and has agreed in principle with ESA that the data from the International Rosetta Mission will be archived to PDS standards using primarily ESA personnel, some of whom are resident at the Small Bodies Node. This Node also has a subnode in Budapest for European distribution of data and for assistance with restoring data from the VeGa missions. The Planetary and Plasma Interactions Node is participating in the Ulysses mission (a joint ESA- NASA) mission in an arrangement under which the interplanetary data are archived through PPI and the heliospheric data are archived through ESA. The International Mars Working Group (IMEWG) adopted PDS standards at its September 1995 meeting in Capri. The PDS is represented on the U.S./Russian Joint Working Group on Solar System Exploration and plans are underway to archive many of the datasets expected from the Mars 96 mission as PDS- compliant archives. Finally, as U.S. participation in internationally- sponsored missions increases, the management of datasets held jointly by the U.S. and international partners will become an issue.

The broad objective for interactions between PDS and international partners is to make data and information from all relevant missions available to the international planetary science community. It is expected that each country, space agency, or other national institution, as appropriate, will maintain primary responsibility for archiving its own data, providing information on its holdings, and distributing its own archives.

Specific PDS-related guidelines for meeting the overall objective of international availability of archives are:

1. The PDS should work with the international community to establish standards and archives.

2. The PDS should provide expert advice for data system activities (e.g., generation of archives, construction of PDS-compatible catalogs, etc.), working cooperatively with the foreign partners. This includes foreign subnodes and interfaces to foreign missions.

3. PDS can play a role in archive production or distribution when it is judged appropriate, either to enhance the availability of data to the U.S. community or to enhance future collaboration between PDS and international archives. Such roles might include:

   (a) Distribution of non-US archival material to US planetary scientists.

   (b) Limited distribution of PDS archival material to non-US planetary scientists.

   (c) Validation of and assistance in the preparation of archives.

4. When significant resources are involved in an international collaboration, say more than 5% of a node's budget or effort, participation should be presented to the Management Council for endorsement.

PLANETARY DATA SYSTEM
GUIDELINES FOR EDUCATION AND OUTREACH ACTIVITIES
JULY 1996

The PDS focuses on generation and distribution of planetary archives to the scientific community for use in research. The PDS also provides expert advice on the archives and works with missions to ensure the production of PDS-compatible data sets and documentation. In many cases software tools for use of PDS archives are also developed and distributed. The PDS also develops and maintains standards for archives and related activities, e.g., web pages for access to data and documentation. In some cases the products generated by the PDS can be used directly by the educated public and teachers. In other cases, the data need to be simplified in format or content and software tools need to be included for use by layman and educators. Finally, the PDS has, on occasion, developed products specifically targeted to the educational or public communities, e.g., the PDS Educational CD-ROM.

What guidelines should PDS use in serving the educational and public communities? Given the importance of education and outreach in today's environment, the PDS must take an active role, one that builds on the ongoing activities associated with the main PDS functions. The following statements are meant to be guidelines for PDS activities in education and outreach:

1. Ensure that archives that can be used by educators and the public include tools to access and display the data, or reference to easily accessible and affordable public-domain or commercial software. Ensure that PDS web pages are accessible to the public or some designated pages are accessible to the public.

2. Focus on generation of 1 or 2 products or capabilities per year that will be of wide interest to the educational and/or public communities. Examples might be a best of the Soviet Planetary Program CD-ROM, sets of CD-ROMs and software to access the MDIMs and other Mars map products on commonly available platforms, and fields and particles data on DVD.

3. Coordinate efforts with missions and other NASA-related entities that seek to have aggressive education and outreach programs. PDS maintains data and expertise about data and software to access and display software. Ensure that this expertise is utilized and that PDS is given credit for its efforts and products.

4. Transfer relevant technology and data to commerical vendors who are capable of generating value-added products for sale to the public and/or to educators and selling the products at costs affordable by these customers.

Planetary Data System Guidelines For World Wide Web Homepages

Version 1.2
17 January 1995

This update incorporates changes including:

1) logo dimensions downsized,
2) U.S. Department of Commerce classification information,
3) NASA page footer instructions, and
4) changes to the PDS organization.

Planetary Data System Guidelines
World Wide Web Homepages
Version 1.2

Purpose: This document includes guidelines for WWW homepages that ensure 1) maintainability, 2) correctness of information, 3) efficiency for users, and 4) conformance with NASA instructions and legal statutes. PDS nodes and subnodes are encouraged to follow the guidelines to facilitate review.

Concept: Each PDS WWW homepage should include common elements presented in a similar manner. The elements should be accessed efficiently. Maintenance will be facilitated by common naming conventions with holders of information responsible for the update of the information. User navigation among nodes should be facilitated by commonality of look and feel.

Page Layout: Each homepage should be headed by a 150 x 150 pixel PDS logo and the local node/subnode's logo. The PDS logo is to be inserted by a link to:

http://stardust.jpl.nasa.gov/PDSLOGO.GIF

Figure 1

or by downloading and maintaining a local copy of PDSLOGO.GIF from stardust.

Optimally, logos should be 150 x 150 pixel 22.5KB files; the maximum size should be limited to 40KB files. The node/subnode logos should be named similarly and should only be referenced by the local homepage. No node/subnode should include a link to another node/subnode's logo.

Each node should work through its International Affairs Office or legal services organization to obtain U.S. Department of Commerce classification of data. Based upon the JPL precedent, it is expected that the GTDA classification will be issued. Upon receipt of GTDA classification, the node's home page should include the following GTDA identification language:

All data has been classified as GTDA by the US Department of Commerce.

The GTDA in the above statement should be a link to or should be appended by the following:

All data classified General Technical Data Available (GTDA) by the U.S. Department of Commerce, Bureau of Export Administration, may be exported outside the United States as public open literature.

Each homepage should include a title in the header section. The title should be enclosed in <TITLE> and <H1> tags, the <H1> tag located directly under the logo region *[see figure 2]*.

Each node homepage should include:

1) a description of the node, including links to subnodes*[see figure 2]*,
2) a description of the node's services, including links to catalogs and services *[see figure 2]* ,
3) descriptions and links to local documents,
4) optional items of local interest, and
5) a common locator to other PDS nodes and PDS general services.

Item 5 above will be maintained at the PDS Central Node. This common section will be available as:

http://stardust.jpl.nasa.gov/PDSCOMMON

and should be linked to a button labeled PDS Services or the node may choose to be placed on a distribution list to automatically receive the HTML file for inclusion into a homepage. When future versions of HTML are released, an <INCLUDE> tag will be the preferred method of handling the common section.

This common section *[see figure 3]* will include:

1) a node road map of links,
2) a link to the PDS Central Node Data Set Catalog, and
3) searchable meta-data from the PDS Central Node Data Set Catalog, the Planetary Science Data Dictionary , the PDS Data Preparation Workbook, the PDS Standards Reference, sample PDS High-Level Catalog Templates , and PDS Data Object Label Examples.

Footer Information: Each PDS homepage must include a NASA-required footer with contact information and a line stating the date of last update. NASA requires the following:

Web Curator: name, Institution **Responsible NASA Official:** name, Discipline Node Manager, Institution **Last Updated:** 12/14/94

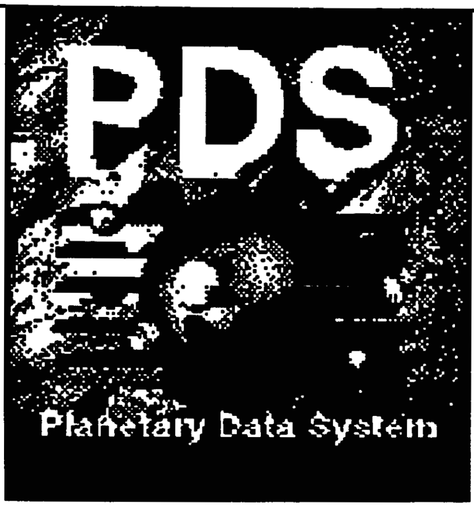
Links: Nodes/subnodes should limit their link hierarchy to a maximum of 3 levels. No node should include links to subnodes of another discipline. The common section should include the only links to other disciplines. No passwords should appear on a PDS homepage for telnet connections.

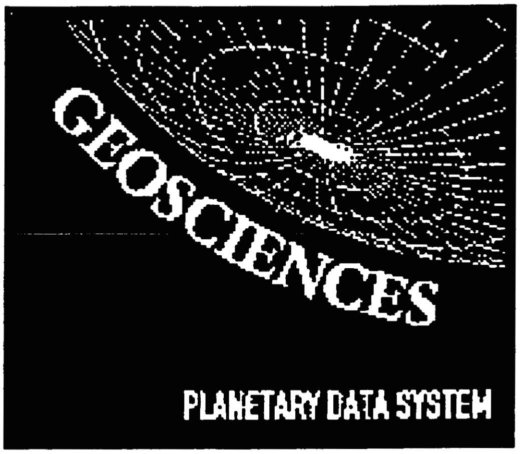
Document Formats: All homepages should be prepared using standard features of HTML. HTML-Plus will be investigated for future use. Documents referenced by PDS homepages should be WAIS, HTML, or plain text resources. If non-HTML is included, e.g. forms, a caveat notifying the users should be included. To assist preparation, the Central Node has utilities for converting common word processor formats to HTML. A printable form of the document should be included, e.g. a postscript file.

Audio Formats: Audio should be included if it is useful and efficient. Music should be avoided! Audio files tend to require heavier use of the network, and slow the user. Music has copyright infringement ramifications. All audio icons should be labeled with file size and type information.

The recommended audio format is Sun Ulaw 8kHz files with .au extensions. UlawPlay 1.1 for the Macintosh and ShowAudio for the Sun will play these audio files. Care should be taken when including sound as these files can get large; a 30 second sound file requires 265 KB.

Animation Formats: MPEG is the recommended format for animations or digital video. Public domain viewers exist for MPEG. PDS has no production capabilities at this time. Thumbnails or links for animations should be labeled with file sizes and types.





Welcome to the PDS Geosciences Node

The Geosciences Node of the Planetary Data System (PDS) archives and distributes digital data related to the study of the surfaces and interiors of planetary bodies. The Geosciences Node is based in the Department of Earth and Planetary Sciences at Washington University in St. Louis, Missouri. The Node includes these subnodes:

- Microwave (MIT)
- Spectroscopy (Brown University)
- Infrared Imaging (Arizona State University)
- Geophysics (Washington University)

Services

Figure 2

Image Formats: Images should be included if they are useful and efficient. Images tend to require heavier use of the network, and slow the user. All thumbnails should be labeled with browse and full resolution file sizes and types.

It is recommended that all images be represented by a 100 x 100 pixel 10KB thumbnail. A 640 x 480 pixel browse image should be the result of clicking upon the thumbnail link. Full resolution compressed JPEG (10 to 1 compression) for larger images with a native format image should be available for transfer. JPEGViewer will handle these images with acceptable efficiency. *The DDL has Image Alchemy available for converting images to efficient GIF and JPEG formats.*

PDS Organizations
- Contact Information
- The Central Node
- Planetary Bodies Node (Geoscience)
- Plasma Interactions Node
- Small Bodies Node
- Imaging Node
- Rings Node
- Navigation and Ancillary Information Facility Node (NAIF)

Services
- Introduction
- PDS Data Set Catalog
- Magellan Standard Products Catalog (login as "mgnuser")
- Image Retrieval and Processing System (IRPS) (login as "pds_remote")
- Imaging Node On-Line Catalog
- Planetary Plasma Interactions Access to Data

- Welcome to the Planets (Educational Resource)
- Shoemaker-Levy 9 Bulletin Board
- PDS Software Inventory

Submitting Data to the PDS
- Introduction
- Full-Text Search of Documentation
- The PDS Data Preparation Workbook
- The PDS Standards Reference
- The Planetary Science Data Dictionary (ASCII text file for downloading)

Figure 3

Review: All homepages should be reviewed by the preparing node/subnode. The review should be based upon content, efficiency, and adherence to the guidelines. The node/subnode is the best judge of whether the content is appropriate and meaningful. Central Node should review efficiency and adherence to guidelines. A guideline checklist is provided as an aid.

Configuration Management: Configuration management (CM) must allow for the dynamic nature of the WWW. The level of CM should allow for registration of documents referred to by links. New homepages and updates to existing homepages should be registered with PDS CM; they will be automatically entered into the PDS *What's New* section.

Preparers of new homepages should send notification of review completion and URLs of node/subnode specific documents to the PDS Operator who is the keeper of PDS CM.

Modified documents do not have to be re registered with CM. Additional documents placed on-line at later dates should also be reported to the PDS Operator PDS_OPERATOR@JPLPDS.JPL.NASA.GOV.

Periodic review will be used to ensure consistency. A semi-annual review of all PDS homepages will be conducted in January and again in July.

Metrics: A common metrics collection guideline will be established for annual report data.

SECTION CHARACTERISTICS

PDS Logo? ❑ YES ❑ NO
Node/Subnode Logo? ❑ YES ❑ NO
    physical size ____
    file type ________
    file size ____
Node description? ❑ YES ❑ NO
    subnode links? ❑ YES ❑ NO
Node services? ❑ YES ❑ NO
    links to catalogs? ❑ YES ❑ NO
        username and password listed? ❑ YES ❑ NO
Local Document Links? ❑ YES ❑ NO
Local Interest
    Graphics ❑ YES ❑ NO
        physical size ____
        file type ________
        file size ____
    Sound ❑ YES ❑ NO
        physical size ____
        file type ________
        file size ____
Common Locator ❑ YES ❑ NO
Footer ❑ YES ❑ NO
    WWW Contact ❑ YES ❑ NO
    Update Note ❑ YES ❑ NO

GENERAL CHARACTERISTICS

Link Hierarchy – Maximum Depth = ______

Number of Documents linked = _______

Number of Documents with Printable Form = _______

Efficient Graphics? ❑ YES ❑ NO

Efficient Sound? ❑ YES ❑ NO

Tested Platforms:
❑ Macintosh ❑ PC ❑ UNIX

Comments

PLANETARY DATA SYSTEM
GUIDELINES
for
PROJECT DATA MANAGEMENT PLANS

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JPL Document D-5111
04 January 1988

JPL D-5111

PDMP GUIDELINES TABLE OF CONTENTS

SCOPE

During the prelaunch phase of a Planetary Flight Project, a Project Data Management Plan (PDMP) is produced. Part of each PDMP addresses the data interface between the Flight Project and the Planetary Data System (PDS). The scope of this document includes guidelines to the Flight Projects for writing those sections within their PDMP dealing with the PDS interface. Also, this document describes the mechanisms and procedures employed by the PDS to work with the Flight Projects and supports the generation of the PDMP. Additionally, this document gives an overview of the NASA/JPL Data Interchange Standards to be imbedded within the Flight Project data being transferred to the PDS as a guide in preparing these data.

The intended audience for this document includes Project Science Managers, Project Scientists, Deputy Project Scientists, Mission Operation System Managers, Mission Analysis/Engineering Managers, End-to-End Project Engineers, Space Flight Operations Center Representatives, Principal Investigators, Team Leaders, Team Members, Interdisciplinary Scientists and Co-Investigators. This audience includes all members of a Project who have responsibilities over the flight and ground data systems which produce the science and supporting data as well as the scientists who develop the instrument models, calibrations, geophysical models and data processing algorithms for producing raw and reduced data sets.

I. INTRODUCTION

NASA Management Instruction 8030.3a (Appendix 1.) requires that each NASA Flight Project develop a Project Data Management Plan (PDMP) to insure that all science and supporting data are archived and readily accessible in a useable form to the general science community after the project's proprietary/validation period has expired. The Project data are transferred to a national archive such as the National Space Science Data Center (NSSDC), or for Planetary Missions, the Planetary Data System (PDS) acting as NSSDC's agent.

As a guide to the overall NASA mission community, the NSSDC has produced a high level PDMP Guideline (Appendix 2.). The NSSDC document has been used as a model for this document which has been specifically tailored to the Planetary Flight Projects. This PDS document corresponds in spirit to its NSSDC counterpart while addressing the specific and unique aspects of Planetary Flight Missions and their data sets. The authority of the PDS to act as an agent for the NSSDC and support the development of PDMPs is included in the Memo of Understanding between the NSSDC and the PDS (Appendix 3.).

The Project data to be transferred to the PDS is quite broad and includes the science data and all supporting data necessary for data interpretation. The data sets of Experimenter Data Records (EDRs) and Navigation Ancillary Information Facility (NAIF) SPICE files are basic; but calibration algorithms, files and software, instrument and experiment objectives and descriptions, data directories and catalogs, processing histories, etc. are also as important. Additionally, Project peculiar data processing hardware and software used to construct the archive data products must be saved after the end of a mission if they are not part of the multimission Space Flight Operations Center (SFOC).

The guidelines presented in this document encourage interoperability within a flight project and between flight projects, the PDS and the NSSDC through the implementation of data system standards. These standards cover catalog structure and nomenclature, data storage and distribution media, network services and protocol, data interchange labels, formats and languages, cartographic coordinate systems, software, user interfaces, etc. Interoperability as well as reduced overall NASA costs are achieved through the implementation of these standards which are a major part of any multimission function.

The architecture of the PDS, a distributed system, supports remote science user access to its Central and Distributed Discipline Nodes. These guidelines additionally support this type of distributed architecture for Flight Project Ground Data Systems. The connectivity and interoperability obtained through the adoption of data standards will be needed for distributed and remote planning, sequencing and operations as well as correlative science investigations.

The PDS will not only support the development of the PDSP, it will also support the implementation of the PDMP. The Flight Project management and investigators, being a part of the general science community which the PDS serves, may obtain the same services supplied to the general science users. While handling proprietary data (data still being validated by a Flight Project) or supporting mission operations is outside of these services, the PDS supports data query and distribution of nonproprietary data as well as provides consultative expertise on data storage media, networking, data interchange standards, directories and catalogs. This document also elaborates upon these PDS services which are available to the Project and its investigators.

II. DATA AND PDMP RESPONSIBILITIES

II.1 Project Responsibility and Organization

The PDS recognizes the Flight Project as being responsible for all data products it produces directly or that are contractually produced by its science investigators and by the SFOC. Therefore, the PDS looks to the Flight Project to determine the responsibilities within its organization to develop the PDMP and implement the PDS data interface. The Flight Project may choose to act as an agent for SFOC and the science investigators and implement the data interface totally within its Ground Data System or may delegate parts of the PDS data interface responsibilities to SFOC and its investigators. This is consistent with the Memorandum of Understanding between the Flight Project Office (FPO) and the PDS (Attachment 4.). The levels of responsibility of all parties involved are to be documented in the PDMP.

The responsibility of producing the PDMP typically rests with the Project Science Manager or designate (referred to as the PSM). The PSM would have the support of both science and engineering organizations within the Project as well as the PDS to produce the PDMP. As part of this science support, an Interdisciplinary Scientist for Data Management and Archive or equivalent (referred to as IDS/DMA) is to be selected by the Announcement of Opportunity (AO) process or appointed by the Project. The IDS/DMA is a member of the Project Science Group (PSG) which is led by the Project Scientist (and Deputy). The PSG also includes the Principal Investigators (PIs), the NASA Facility Instrument

Team Leaders (TLs) and the Interdisciplinary Scientists (IDSs). This group represents the scientific integrity of the instruments and data products produced from instrument data.

The PSM, in coordinating the development of the PDMP across all Project elements, should look to the IDS/DMA for the science data products specific information. The IDS/DMA, as the scientific focus within the Project, would develop the rationale, description, and requirements for all science and supporting data products to be produced and archived by the Project for its own operations and science analyses. It is expected that the IDS/DMA is knowledgable of the data interchange, catalog, networking and media standards as well as the formal standards, policies and procedures within NASA and JPL. The Project data products are required by NASA and JPL Policy to meet these interchange standards.

II.2 PDS Support of PDMP Development

The PDS will support the development of the PDMP by working with the IDS/DMA to insure that all PDS required data are identified for archive and will meet NASA/JPL data standards. The PDS Mission Interface Team (MIFT) shall be included in the initial drafting of the PDMP. The Project IDS/DMA should supply the MIFT with a list of all data products and documentation, including descriptions, being produced and archived by the Project. The MIFT will obtain PDS Science Discipline Node and Management review of the data products for completeness and also adherence to data standards. This PDS reviewed list shall then be included in the DRAFT PDMP for Project review.

Upon successful review within the Flight Project, the Formal version of the PDMP would be produced and approved by Flight Project Management and the PDS Project Manager. The PDS, a PDMP signatory, will support the Project in presenting the PDMP to the NSSDC for their approval. The PDS Project Manager would also augment the PDS long range plans to accommodate the expected data products described in the PDMP.

The PDS would provide technical assistance to science investigators in supporting the data interface with the PDS if requested by the Project. This support would be specifically in the areas of implementing data processing software to meet the Data Interchange Standards required by NASA and JPL and also in bringing the investigator's home institution's computer facilities online with NASA provided networks.

III. PROJECT DATA TO BE TRANSFERRED TO THE PDS

To meet the mandate of NMI 8030.3a, specific data products must be produced and archived by a Flight Project for its own use and then copied or transferred to the PDS after any applicable proprietary/validation time period. These products are grouped into two catagories: science data products and the associated supporting data products needed to interpret the science data products.

III.1 Science Data Products

MDRs, EDRs, and RDRs

A Flight Project shall maintain one complete set of engineering and science data, referred to as the Master Data Record (MDR) or Experiment Data Record (EDR), prior to any manipulation of the basic data values and one set of all reduced digital products, referred to as the Reduced Data Records (RDRs).

MDR/EDR science information is recorded in digital data numbers (DNs) which are proportional to the scientific phenomena being observed. MDR/EDRs should include all spacecraft engineering data and all science information produced by the flight instruments that were transmitted to Earth. Effects of multiplexing, packetization, tape recorder playback, channel/error correcting coding, data compression, or other telemetry transmission and capture processes external to the instrument should be removed; but no unique science information should be lost.

MDR/EDR's should be structured and indexed for simple catalog retrieval by time, instrument, major observation sequences and mission phase. The MDR is considered a superset of the instrument specific EDR's. If an MDR product is chosen as the deliverable to PDS, then supporting software capable of generating all instrument EDR data records via simple command inputs must also be provided.

RDRs have instrument signatures removed by converting the telemetered instrument DN observations to geophysical units. These corrections may involve temporal or environmental dependence, as well as algorithmic dependence. Higher level RDRs include the removal of instrument viewing geometry by registering and map projecting the data to standard reference frames, coordinate axes or physical model parameters. The algorithms, models, software, files and procedures for producing the RDR's should be documented and archived along with the RDRs.

Special Products from other Missions

Projects may also require special products (e.g., maps or mosaics) produced from previous mission data. The generation of these products should be integrated with ongoing PDS data restoration work to avoid duplication of effort and to assure that the products conform to format and interchange standards negotiated between the Project and PDS. The number of copies, media and distribution mechanism should also be coordinated with the PDS to insure that the widest NASA science community benefits from production of the special products within available Project and PDS resources.

III.2 Supporting Data Products

Project Bibliography

A Project Bibliography should be kept which references: all formal project documentation; all internal and external papers and reports describing mission analyses, the ground data system, the spacecraft, instruments, and science analysis results; and all conference papers, journal articles and NASA publications produced by the Project.

Press Release/PIO Products

Both the PDS and NSSDC should be on the Project's distribution list to receive Press Release/Public Information Office (PIO) products. The NSSDC should receive a duplicate negative of any image product as well as a hardcopy print. The timing of these deliveries to PDS/NSSDC should be the same as their release to the public.

Instrument Objectives, Description and History

The complexity of instruments used in planetary exploration requires that comprehensive documentation of instrument operation and data reduction be provided by the investigation team to capture the knowledge needed for data interpretation. The documentation should be in the form of written text (ASCII), with tables and figures supplied as needed to clarify the subject. Electronically readable documentation is strongly preferred, as much of this information will eventually be archived in that form for online access and distribution.

The following material should be included in each instrument document:

• Experiment Overview - a few paragraphs covering the instrument observational and scientific objectives. Also, relationships with other instruments and data sets should be included.

• Personnel Section - include the names and addresses of experiment team members and the support staff which assisted in developing and running the experiment. Also include a description of the procedure and protocol for noninvestigation scientists to obtain experiment data sets or consulting support on experiment related issues.

• Instrument History - include an overview of the original instrument concept, any earlier development, prototype and flight versions, the theory behind its energy generation and detection, the operating modes, and limits or qualifications of its performance and data interpretation. References to detailed, open literature articles are encouraged.

• Radiometric and Geometric Models - include the mathematical models which relate the detected energy to the physical phenomena being observed as well as the location of the observed energy to a coordinate system external to the instrument if applicable (e.g., inertial, magnetic, planetary body-fixed). The radiometric model is needed to convert the telemetered instrument DN into geophysical units and the geometric model is needed to register and map project the geophysical data into standard reference frames to support correlative studies. Include the coordinate system and measurements which describe instrument alignment relative to platform or spacecraft-fixed reference axes. Also, describe any internal articulation capabilities and associated timing. Use of figures and drawings is encouraged.

• Calibration - describe both ground and flight observations needed to determine the parameter values of the radiometric and geometric instrument models and the mathematical equations relating the observations to the model parameters. Calibration results which give model parameter values, the accuracy of the values, qualifications and limitations associated with the calibration process and the results, and problems encountered should be included.

• Timing - describe all internal instrument timings and delays and the relationship between instrument observation event and the spacecraft clock. Include descriptions of timing convertion and transformation algorithms.

• Software - document the algorithms and associated software used for instrument calibration and for producing the higher level RDRs (e.g., data products having geophysical units and/or map projected to standard reference frames). Transportable code is recommended with significant inline user help and documentation. Text files should also be provided which includes operating procedures and defines all I/O files and parameters. Software should meet all relevant standards described in the JPL Software Management Plan (JPL Document D-4000).

• User Abstracts - maintain a record to document when science investigators make significant improvements to existing products, create useful new products, make significant new discoveries about the data sets, or obtain signficant new science results with the data sets.

Catalogs

Catalog data should be produced and archived for all MDR, EDR and RDR data records and products. It is expected that the MDR and EDR catalogs will be generated, maintained and delivered to the Project by SFOC for all standard processing which is multi-mission in nature. The Project itself would produce these for unique products (e.g., SAR imaging using the Advanced Digital SAR Processor). Also, the science investigators may be responsible for some RDR products. Interoperability between Project, SFOC and PDS catalogs is essential.

Ancillary Files

All geometric and radiometric information needed for the interpretation of instrument data should be produced, documented and archived. These data allow the recovery of the full scientific value of the returned data and facilitate the correlation of data taken at different times, by different instruments and by other spacecraft or observing platforms. This ancillary information should be continuously online from launch and span the entire mission lifetime as either predict data or actual data when available. The software to read, process and adapt this data to science investigators needs should also be online and accessible by the investigators.

Data Processing History

A digital log should be kept on each data product to trace its heritage for source, algorithms used, model parameters, etc.

IV. PDMP IDENTIFICATION OF DATA FOR PDS INTERFACE

The PDMP is required to contain a listing of the above data products to be transferred to the PDS. Each product should be identified by:

- Project name
- spacecraft name and identification
- investigation/experiment name
- data product identifier
- short description of the product
- organization or institution responsible for producing the product
- individual/organization point of contact for data product
- data volume of the product
- media containing the product

- data standards associated with the product
- proprietary/validation time period
- validation procedure
- time period covered by data product
- location of data within Project
- point of delivery (Node location) to PDS, and
- delivery date.

The delivery dates would include negotiations between the Project, Investigators, SFOC and the PDS. Since the data products may reside within SFOC or at a remote institution rather than within the Project Ground Data System and may be delivered to a PDS Discipline Node rather than the PDS Central Node, these data interface points of contact should be clearly identified.

The volume of information is large and may change during the lifetime of the Project (with joint Project/PDS approval), so this information may be referenced in the main body of the PDMP and included as an appendix to the PDMP.

V. DATA STANDARDS TO BE IMPLEMENTED

NASA, the NSSDC, and JPL have formal requirements for Data Standards that are placed on all science data produced within a Flight Project. These Data Standards cover Formats, Nomenclature, Labels, Catalogs, Media, Network Protocol, Software and Reference Systems. It is JPL Policy that these standards be implemented throughout a Flight Project, including data products generated by SFOC and at the science investigator's institutions for the Project. Any deviation from these Data Standards requires a waiver granted by the JPL Deputy Director.

The intent of these data standards is to promote interoperability between Planetary Flight Projects, the SFOC, the PDS, the general planetary science community as well as other NASA and international science projects. Reduced mission costs and greater scientific results are achieved by standardizing data interfaces across projects enabling an effective multimission environment.

Data Standards are typically recommended for JPL approval by the JPL Standards Approval Board, approved by the JPL Deputy Director and then registered and enforced by the JPL Control Authority Office. The source of these standards brought before the Standards Approval Board may be SFOC, the PDS, the international Consultative Committee for Space Data Systems (CCSDS), the NSSDC, the Federal Council on Communications, Storage, Standards, and Technology (FCCSSAT), etc.. Once registered with the Control Authority Office, these standards fall under JPL Standard Practices Policy JPL d413.2.

The PDS will support the development of the PDMP by working with the IDS/DMA to insure that all data identified for archive meet NASA/JPL data standards. These data standards will be referenced in: the PDMP; the investigator's contracts for producing EDR, reduced/derived and supporting science data products; all Software Interface Specification Documents; Science Requirement Documents; Mission Operation Systems Requirements Documents; End to End Information System (EEIS) Requirements Documents; and Software Management Plans.

The following gives a general overview of the content and intent of the data standards. The deatiled PDS standards are described in the PDS Standards for the Preparation and Interchange of Data Sets (Attachment 5.). Each Project is responsible for obtaining a complete set of these standards from the JPL Control Authority Office prior to designing its Ground Data System.

V.1 Catalog

Catalog standards address the architecture of cataloging systems used to produce and maintain data catalogs, recommendations for a consistent nomenclature to be employed in naming components of catalogs, and minimum requirements for parameters to be included in catalogs to promote the use of catalog data by others and the integration of mission catalogs in the PDS catalog architecture.

The SFOC and PDS organizations have jointly developed a set of nomenclature standards which define the rules for constructing data object names. The purpose of establishing a standard syntax for data naming is to facilitate user access to a system's data. It is particularly important to use common nomenclature in database management systems, where searches are made for a variety of disciplines, instruments and spacecraft missions. For a given data object, it is intended that any system user will be able to construct the same unique data object name by following these rules.

V.2 Media

Media standards address the physical media on which Project data will be stored and the utilization of that media for data being delivered to the PDS. The Flight Project has the responsibility of delivering data to the PDS on media suitable for long-term, highly reliable archive.

Several factors to consider in selecting media include:

• Longevity - Media should be selected which will minimize both the degradation of the data and cost of storage over the life of the product. Only the highest quality products should be used for magnetic storage or archival records. Color separates should be produced for final versions of color film products.

• Interoperability - Media and storage devices should not be proprietary to a single vendor. Multiple sources of media and access hardware should be available for all storage systems used to record archival data. Media selected for Project use should conform to NASA or ANSI specifications for physical and recording characteristics.

• Efficiency - Media used for storage of archival products should be utilized efficiently. This includes full recording of individual media volumes, selection of recording formats to minimize wasted space on the media, and the use of simple data compression techniques to reduce the volume of infrequently accessed data.

• Distributability - Media should be selected which meet both internal Project distribution requirements and the long-term requirements for distribution to the wider science community after the Project. The use of replicable media, such as CD-ROM for products which are expected to be widely used, is recommended.

V.3 Network

The NASA Office of Space Science and Applications has adopted the TCP/IP Network Protocol as a standard and will support National and International Science Internets using this protocol. However, all network implementation using this protocol are to allow the natural transition from TCP/IP to the evolving ISO/OSI Network Protocol when available. It is also recommended that DECNET be supported until the ISO/OSI protocol is available since DECNET is so prevalent within the Planetary Science Community.

V.4 Data Interchange

All planetary project data sets delivered to the PDS are to be implemented as NASA Standard Formatted Data Units (SFDU). The SFDU provides a flexible architecture for both the physical and logical recording of digital data records, and for the registration and maintenance of data descriptive information. Compliance with the SFDU will help avoid confusion or loss of data when written or printed documentation is mislaid or misapplied, simplify the electronic transfer of data files so that data identity is packaged with the data itself for automatic interpretation, and simplify the cataloging of data through automation.

Within the SFDU architecture, the PDS has developed a data interchange language which provides self-contained format and data description parameters. It is recommended that RDR's produced by Project teams utilize the PDS data labelling system, or one of several other approved SFDU data descriptive methodologies such as the Flexible Image Transport System (FITS), the ISO General Data Interchange Language (GDIL) or the Video Image Communication and Retrieval (VICAR).

V.5 Software

Project software should be developed using the JPL SOURCE Standards (JPL Document 601.42) which rely on ANSI standard high-level languages such as FORTRAN 77 and C. Software development and maintenance should follow accepted software engineering procedures for design, documentation, coding and maintenance. It is anticipated that all formal project software will comply with JPL software development requirements, but suitable methodologies must also be employed in the development of data reduction software by instrument teams.

A major requirement for the post-project use of software is transportability. This can be achieved by modular program architectures with partitioning of machine or language dependent extensions into exhaustivley documentated segments.

Coding Standards

Adopting good coding standards and practices also promotes transportability. These practices include liberal use of inline comments and documentation and help text imbedded in the code. Extensions to ANSI standard languages are discouraged; however, if used, should be clearly isolated and documented in the code to ease transportability to an environment that does not support the extensions. The adoption of these standards and practices in the development of new code will enhance the future usage of that material and smooth its incorporation into the PDS.

V.6 Reference System

A major factor promoting correlative analyses, the sharing and comparison of data sets taken at different times and by different instruments, is the transformation of the original EDR data to common reference systems and geophysical units. The principal reference systems used in planetary sciences are: body-fixed, surface coordinates; atmospheric coordinates; gravity field harmonics; solar wind coordinates; and magnetic coordinates. The PDS recommends the following guidelines for adopting reference system standards.

Body – Fixed, Surface Coordinates

- Use the Earth Mean Equator and Equinox of J2000 as the basic inertial reference system to define body-fixed coordinate orientation;
- Use the IAU standards for defining the North Pole and Prime Meridian of the body-fixed coordinate system;
- Use the IAU standard Cartographic latitude and longitude ~~(positive East)~~ to produce digital map products - Digital Terrain Models (DTMs) and Digital Image Models (DIMs);
- Use the sinusoidal, map projection to produce, store and transport digital terrain, map and registered products.
- Use a spatial resolution for the DTMs and DIMs of $1/2^n$ deg where n is chosen to satisfy Project needs and to promote correlative studiess between other Project data sets.

The planetary body parameters used to produce any Reduced Data Record should be documented and archived with the data product.

Atmospheric Coordinates

To be supplied or otherwise dropped.

Gravity Field Harmonics

To be supplied or otherwise dropped.

Solar Wind Coordinates

To be supplied or otherwise dropped.

Magnetic Coordinates

To be supplied - the GSFC Model 066? - or otherwise dropped.

V.7 Ancillary Data

The specific implementation of the SPICE Kernel Files and Toolkit as defined and produced by the multimission SFOC Navigation Ancillary Information System (NAIF) are recommended for Project implementation. The NAIF/SPICE approach provides to the Project and its individual science investigatorsthe basic Kernel files and associated software to compute any instrument viewing geometry parameter. The software and files can be combined for mission and sequence planning as well as data analysis. The files and software are transportable to a host of computers having a variety of operating systems. This transportability is achieved by adopting Fortran 77 and ASCII character representation as a standard.

The SPICE Kernel files include:

• S Kernel - the Spacecraft trajectory in J2000 coordinates relative to the sun and all planetary bodies of interest. Though J2000 is the standard inertial reference system, output in B1950 may be obtained at user request;

• P Kernel - the ephemerides of Planets, satellites, comets, asteroids, body-relative features, and also planetary parameters such as radii, rotation and magnetic pole directions, spin rates, speed of light, etc.;

• I Kernel - includes Instrument model and parameter values describing the geometric/astrometric and radiometric properties such as focal length, mounting alignments, resolution, spectral domain, internal timing, etc. to interpret the instrument produced data;

• C Kernel - the Coordinate orientation of the science instruments, scan platform and spacecraft in inertial space (J2000); and

• E Kernel - the sequence of Events of spacecraft, instrument, flight data system, telemetry link and ground data system states and performance including anomolies and science notebook entries by mission and science teams.

The NAIF/SPICE system also includes a portable software toolkit to read the SPICE Kernels and algorithms to compute generic and instrument specific viewing geometry parameters.

V.8 Project Control Authority Group

Within a Flight Project, a variety of conventions, definitions and parameter values are adopted for broad project use. It is recommended that the IDS/DMA establish a Project Control Authority Group within the PSG to be responsible for those areas affecting data products. These would include coordinate systems, reference frames, reference surfaces, reduced/derived data resolution, astronomical parameter values, planetary body parameter values, NAIF/SPICE Kernel Files or SEDR equivalent, geophysical data units, etc. The Project Control Authority Group should approve the adoption of these conventions and definitions as well as approve the implementation of initial and updated parameter values used throughout the Project lifetime. The PDS would continue this control function at the end of the Project.

VI. DATA DISTRIBUTION

Many Project data records will be of great interest outside the Project and will need to be distributed to the larger planetary science community after the proprietary/validation period has lapsed. Such products include CD-ROM versions of RDRs as well as photoproducts, maps and mosaics. It is important that the PDS and the NSSDC be involved with the Project in planning the production and distribution of these products. Combining the distribution requirements of both Project and PDS/NSSDC at the time of the initial product generation can reduce the cost to all parties by taking advantage of data distribution expertise of the PDS and NSSDC staffs, reducing administrative costs associated with contracts and procurements, and take advantage of economies of scale in product production.

VII. SPECIAL DATA FACILITIES

Standard data handling and processing systems common to many Projects are provided by the Space Flight Operations Center as part of its multimission responsibility. These baseline capabilities do not disappear after any Project is completed but are supported independent of a specific Project. However, some data handling and processing systems are developed for Project-unique requirements and would not be maintained after the end of that Project. The PDMP needs to address the transfer, from the Project to the PDS, of all hardware, software, data files, operating instructions, environmental requirements, and maintenance contracts for these special data handling and processing facilities which would still be needed after the end of the Project for data processing and reconstruction.

VIII. DATA QQC

Flight Project Quality, Quantity and Continuity (QQC) requirements are to meet the PDS data ingest standards. Random data product sampling, by the Project, should be planned in order to validate that the standards are being met and to identify unforseen problem areas. Records are to be kept identifying those data sets not passing validation as well as the corrections made to eliminate the problem.

QQC problems can be minimized if sample deliverables or phased deliveries are made to PDS during the course of the Project. Preliminary deliveries of RDRs are also advised. This will allow an independent evaluation of data processing and verification of data formats and documentation. This sampling mechanism should be incorporated in the Project data delivery schedule. Products not passing the agreed validation standards may be returned to the Project for regeneration.

The project archive will include numerous versions of products. The PDMP should address the mechanism by which the project maintains these various versions and determines which are obsolete and should not be delivered as part of the project archive.

IX. PROPRIETARY/VALIDATION DATA POLICY

The PDS will not place data into its active archival holdings until after the proprietary period has expired and after the data has been validated. Project validated data may be delivered to the PDS prior to the end of the proprietary period for either its' or the PDS's convenience; however, the PDS will not place this data online within the proprietary time period.

The PDS does not have a guideline for the length of the proprietary/validation time period. The IDS/DMA, working within the PSG, should determine these time periods for each science data product. These time periods, typically expressed in terms of months rather than weeks or years, should be documented in the PDMP.

X. PDS DATA DELIVERY REPORTING

The PDS is required to report quarterly to the NASA Solar System Exploration Division on all data delivery activities. These data delivery activities include data restoration of past mission data as well as obtaining scheduled data sets from active Projects. The PDS will identify the responsible organization or individuals and report on the quality, completeness and timeliness of the delivered data. For a Flight Project, the PDMP identifies both the responsible organization or individuals and the schedule for delivery of all science and supporting data sets to the PDS which will be the basis for the PDS reporting on the Project data interfaces.

XI. PDS SERVICES AND SUPPORT

The PDS provides data search, query, summary display and distribution of its holdings to the NASA Code EL supported Planetary Science Community. Flight Project members are a part of this supported community and will receive the same services provided throughout the community.

It is important to remember that major operational differences exit between the environment provided by the PDS as compared with the Flight Project environment. The PDS does not support proprietary data or functions crucial to mission operations. This allows significant operational cost savings to the PDS by allowing less stringent security and reliability constraints.

Special usage requirements of a Flight Project or its instrument teams must be identified in the PDMP. These include heavy access to prior mission datasets, use of PDS communications network facilities or the PDS computational or display capabilities. Since the PDS design is modular, it should be possible to increase capacity during critical project periods if the nature and extent of project use of PDS is identified well in advance. However, the PDS will not be able to respond to unforecasted uses of the facility which utilize significant resources.

Also, as mentioned previously, the PDS will support the implementation of data interchange standards and networking capabilities at remote science institutions.

XII. APPENDICIES

The following Appendicies are attached for completeness:

1. NASA MANAGEMENT INSTRUCTION 8030.3A, November 1978.
2. NSSDC Guidelines for Project Data Management Plans, July 1987.
3. Memo of Understanding between the NSSDC and the PDS, December 1986.
4. Memo of Understanding between the FPO and the PDS, January 1988.
5. PDS Standards for the Preparation and Interchange of Data Sets (SPIDS), January 1988.

From: RMONARREZ@JPLPDS.JPL.NASA.GOV (10/9/95)
To: YOLANDA FLETCHER
CC:
BCC:
Priority: Normal
Date sent: 10/9/95 3:03 PM

Mail*Link® SMTP

TO: Data Engineer
FROM: Ruth Monarrez
SUBJ: Data Engineer Process
DATA: 9-OCT-1995 (last modified)

Below is a checklist providing the steps of archiving/ingesting data into the PDS.

1. ________ Prepare/Distribute Data Set Submission Package

2. ________ Perform Catalog Feasibility Study

3. ________ Set Peer Review Date

4. ________ Select Peer Review Committee

5. ________ Receive Draft Templates

6. ________ Set Peer Review Database

7. ________ Set Database Build Date

8. ________ Template Checklist and/or Earthbase Template Checklist, Template/File Correspondence and Template Processing Checklist.

9. ________ Template Processing Checklist

9.a ________ Template Formatting

10. ________ Run Label Verifier

11. ________ Run Loader

12. ________ Correct any errors ($search filename.rpt "error"/window=10)

13. ________ Repeat from step 11 until clean report is generated

14. ________ Testload SQL (begin transaction, rollback transaction)

15. ________ Real Load SQL (/*begin transaction*/, /*rollback transaction*/)

16. ________ Query Database

17. ________ Run Referential Integrity (RI) utility

18. ________ Apply Standard Values Data file to Peer Review Database

19. ________ Re-run RI utility

20. ________ User-Interface / WEB Interface Testing

21. ________ Identify liens

- more -

From: RMONARREZ@JPLPDS.JPL.NASA.GOV (10/9/95)
To: YOLANDA FLETCHER
CC:
BCC:
Priority: Normal **Date sent:** 10/9/95 3:03 PM

---

22. ________ User View Test Set Package
23. ________ Peer Review
24. ________ Correct liens
25. ________ Have DBA re-fresh Database
26. ________ Repeat from step 11 - 20
27. ________ Compile RI Report Memo
28. ________ RSIRS Form
29. ________ Archive File Naming Guildelines
30. ________ DIF Form
31. ________ Turnover Memo

From: RMONARREZ@JPLPDS.JPL.NASA.GOV (10/9/95)
To: YOLANDA FLETCHER
CC:
BCC:
Priority: Normal
Date sent: 10/9/95 3:03 PM

Mail*Link® SMTP

TO: Data Engineer
FROM: Ruth Monarrez / Ron Joyner
SUBJ: Data Engineer Process - Described
DATE: 3-6-95
10-9-95 (last modified)

Below are descriptions and information of the steps involved in archiving/ingesting data into the PDS.

DATA SET SUBMISSION PACKAGE

The purpose of the data set submission package is to provide a data supplier with the necessary information and documentation to archive data. This includes the latest copy of any applicable documents, i.e., Standards Reference and the Data Dictionary. A set of the most up to date templates the data supplier is required to complete. Also, if the data set id's are known, they should be listed.

A sample of a Data Set Submission Package can be found in:

*** to be provided later ***

Template Checklist, Template/File Correspondence

These forms are filled out as a means of keeping track of the required set of templates and their filename correspondence.

Required Templates:
- MISSION
- INSTRUMENT HOST
- INSTRUMENT
- DATA SET or DATA SET COLLECTION
- DATA SET MAP PROJECTION*
- REFERENCE
- PERSONNEL
- INVENTORY
- TARGET*

* - if applicable

TEMPLATE PROCESSING CHECKLIST

This form is filled out as a means to make sure all the necessary utilities are applied to the templates.

TEMPLATE FORMATTING

The templates received from the data supplier should be in pretty good shape. However, if headings are missing or if the line length

- more -

exceeds 70 character, additional formatting may need to be done to the templates. There exists a few formatting utilities that you can apply to your templates. They currently reside in:

```
   $disk$usera:[rjoyner.c_progs.misc]
and
   $disk$usera:[rjoyner.c_progs.lformat]format70.exe
```

Some very useful utilities are described below and in more detail in FORMAT-PROGRAMS.DESC found in the DATA_ENGR directory.

```
    ADDBLANKS.EXE
      Function:  Reads each line in an input file, pads each line
                 with blanks to 78 chars, and then adds the <CR><LF>
                 line terminators for 80 chars/line.

      Usage:     $ProgramName InputFilename OutputFilename


    BACKV.EXE
      Function:  Either inserts or removes \v's into/from the description
                 fields of an input file. Used for disabling the word-wrap
                 feature of the Loader.

      Usage:     $ProgramName InputFilename OutputFilename ADD (or) REMOVE


    EXCTABS.EXE
      Function:  Reads each line in an input file, and replaces
                 TAB characters with blanks.

      Usage:     $ProgramName InputFilename OutputFilename TabSize
                  (The tabsize for most platforms is 8)

    FORMAT70.EXE
      Function:  Reads and formats the descriptions within a TEMPLATE file
                 to 72 characters (exclusive of <CR><LF>).  This particular
                 utility requires a blank space at the beginning of each
                 new line to properly work.

      Usage:     $ProgramName InputFilename OutputFilename


    LINE.EXE
      Function:  Reads a file and displays the line number, the number
                 of characters in each line, and the number of cumulative
                 bytes read.

      Usage:     $ProgramName InputFilename OutputFilename


    REFS.EXE
      Function:  Performs a cross-reference of two input files for:
                    (1) missing references
                    (2) references that are not cited

      Usage:     $ProgramName RefsFileName CitationFileName OutputFilename.
```

- more -

```
REMBLANKS.EXE
  Function:  Reads each line in an input file, and removes any
             extra blanks and line terminators at the end of
             the line.

  Usage:     $ProgramName InputFilename OutputFilename
```

RUN LABEL VERIFIER

The Label Verifier is one utility applied to the templates and to data labels to aid in the validation process. A summary of the Label Verifier can be found in the 'Label Verifier User's Guide', Version 1.2, Nov. 9, 1992, Command Reference section.

Before running the Label Verifier, one needs to define the following in their login.com file on JPLPDS:

```
$! The following defines the location of the Label Verifier
$!    which is under configuration control.
$!
$lv_tool :== "$cmdisk:[config.toolbox.master.tool_main]lvtool.exe"
$assign cmdisk:[config.toolbox.master.tool_main] dd_dir
```

To run the Label Verifier, submit the following command:

```
$lv_tool -a -v -d dd_dir:pdsdd.idx -r <report_filename>.rpt-
$ -f <input_filename.ext>
```

where:
- -a turn on aliasing
- -v verbose reporting (to turn off use: -nv)
- -d calls a data dictionary index
- -r identifies the report filename to be written
- -f identifies the input filename, the file to be validated

SUN/Unix users

To run the Label Verifier on SATARGATE submit the following command:

```
$lv_tool -a -v -d dd_dir:pdsdd.idx -r <report_filename>.rpt-
$ -f <input_filename.ext>
```

where:
- -a turn on aliasing
- -v verbose reporting (to turn off use: -nv)
- -d calls a data dictionary index
- -r identifies the report filename to be written
- -f identifies the input filename, the file to be validated

** RUN LOADER

This utility runs on JPLPDS only.

The loader utility is run to verify that the templates are properly filled-in. It does syntax and standard value checks and verifies table hierarchy. This utility generates the ISQL insert and delete statements into separate files with the extensions of *.SQL and *.DEL. A report file is also generated with the extension of *.RPT. The report file is used to spot any errors that may exist in the template. The templates should have the filename extension of *.CAT. A description of the loader utility can be found in:

cmdisk:[config.maintain.dbautil.doc]RUN_LDR.TXT

Below is an example of a loader command file:
filename: Loader.com

```
$! The Loader.com file runs the loader utility to generate
$!    *.sql, *.del and *.rpt.
$!
$set def aux$disk:[rmonarrez.ppi.cdtest.templates]
$loader :=="$cmdisk:[config.maintain.dbautil.exe]catldr_v2r2.exe"
$loader -s -l -d testdb -t "scdataset"
$loader -s -l -d testdb -t "scinstrument"
$loader -s -l -d testdb -t "parameter"
```

The fourth line sets the default to the directory where the templates reside. This needs to be edited to correspond to your directory.
The fifth defines the loader. The loader can also be defined in one's login.com file instead of within the command file.
The sixth through last lines supply the data base and template filename.
The options are:

-s to produce SQL file (default = N)
-d to assign database dbname (e.g., PDSCAT1R11)
-t to assign the template file name w/o .CAT extension
-l option is used if the templates you are loading are the longname version as opposed to the shortname version.

The above example loads three distinct template files against a data base named 'testdb'.

Once the command file has been created you can run the loader interactively or in batch mode. Batch mode is preferred since it allows one to have up to three jobs processing simultaneously and not tie up one's terminal.

To actually run the loader submit the following command:

$@<filename_of_loader_com_file>

Ex. $@loader

Or, to run in batch mode, create a command file and submit it. An example is this command file called 'submit_loader.com'

```
$! THIS *.COM FILE RUNS THE LOADER, i.e., SUBMITS THE JOB AND CREATES
$!     A *.LOG FILE CALLED LOADER.LOG
$!
$submit/notify/log_file=develop:[rmonarrez.templates]loader.log-
/keep/noprinter/que=jplpds_batch develop:[rmonarrez.templates]loader.com
```

- more -

Then just type: $@submit_loader

Correct any errors ($search <filename>.rpt "error"/window=10)

The report file generated from the Loader utility allows for error checking. One can easily search for the errors by typing:

$search <filename>.rpt "error"/window=10

A sample report file can be found in:

develop:[detarc.data_engr]sample_rpt_file.txt

** TESTLOAD SQL (begin transaction, rollback transaction)

To test the insert statements against the test data base,

1. Make sure the 'begin transaction' at the beginning of the *.SQL file has a corresponding 'rollback transaction' at the end of the file.

2. Make sure BEGIN TRANSACTION and ROLLBACK TRANSACTION have no quotation marks around them, and that nothing else appears on the same line.

   The ROLLBACK.EXE will automatically comment the rollback statements in the *.SQL file.

   $COMMENT <input_filename>.sql

3. Testload the file input *.sql file using the APPLY_SQL.COM file:

   The file APPLY_SQL.COM can be found in:

   develop:[detarc.data_engr]

   Copy this command file into your current working directory. Edit the file to make specific to your database. In the line,

```
$ isql/username="magellan"/password=""/ECHO/input='param1'/output='fspec'.out
```

   change "magellan" to the username given to you by the Data Base Administrator.

   To run the command type:
   $@APPLY_SQL <input_filename>.sql

   A report file is generated (with the extension *.out) containing the number of rows which have been affected in a particular table.

** REAL LOAD SQL (/* begin transaction */, /* rollback transaction */)

To run the real load, comment out the 'begin transaction' and the 'rollback transaction' statements. This commits the data to the data base. To delete the data just committed, apply the corresponding delete file, *.DEL, in the same manner. They should look like:

- more -

```
/* BEGIN TRANSACTION */
        ...
/* ROLLBACK TRANSACTION */
```

The ROLLBACK.EXE will automatically uncomment the rollback statements in the *.SQL file so that the changes are committed to the database.

```
$UNCOMMENT <input_filename>.sql
```

The command files exist in:

```
develop:[detarc.data_engr]comment.com
develop:[detarc.data_engr]uncomment.com
```

At this point you re-run the APPLY_SQL.COM file as described above.

QUERY DATABASE

Once the data has been committed to the peer review or test data base, use ISQL commands to query the tables you have just populated by using values corresponding to your data.

Below are a list of the tables that are affected as a result of applying the SQL statement. These are the table names you use in the 'select' statement, i.e.,

```
1> select * from discd
2> go
```

```
tblname
------------
discd
dscolld
dscolldoc
dscollds
dscollinfo
dscollusgd
dsconf
dsd
dsdoc
dshost
dsinfo
dstarg
hostd
hostdoc
hostinfo
instd
instdoc
instinfo
msnd
msndoc
msnhost
msninfo
msnobjsmy
noded
```

- more -

nodeinfo
perselecmail
persinfo
persmailaddr
refd
targetd
targetdoc
targetinfo

This list can be re-generated by submitting the command:

```
$isql
1> select * from ddtbl where tbltype="H"
2> go
1> exit
$
```

** USER-INTERFACE TESTING

An account must be set up with the System Manager/Administrator in coordination with the Data Base Administrator to allow a user to access a peer review data base through the User Interface. This requires a username and a password. The purpose of this is to assure that the data has been properly loaded into the test or peer review data base and that the long descriptions are correctly formatted.

-------- This procedure has changed to use a WEB Browser ---------

Use a Web Browser of your choice, Netscape, Mosaic, etc., to search through the PDS Catalog to verify the data you have just ingested is correct. If you see a discrepancy you should first check the actual tables in the database using ISQL. The list of tables are listed above, QUERY DATABASE.

RUN REFERENTIAL INTEGRITY (RI) UTILITY

After all the data has been applied to the test or peer review data base and the User Interface tested, the Referential Integrity utility is applied.
This utility has three parts. The first part performs a Standard Value check. The second part performs the Referential Integrity check. The last part is the generation of a standard values load file. A description of the RI utility can be found in:

cmdisk:[config.maintain.dbautil.doc]RUN_DDRI.TXT

Define in your login.com file:

```
$ddri :=="$cmdisk:[config.maintain.dbautil.exe]ddri_v2r1.exe"
```

Below is a sample command file to run the RI:

```
filename: RUN_DDRI.COM
$! A command file to run the Referential Integrity: RUN_DDRI.COM
$!
$set def disk$user1:[rmonarrez.vgr]
```

- more -

```
$DDRI -s -r -d vgr -t DDRI
$exit
```

APPLY STANDARD VALUES DATA FILE TO PEER REVIEW DATABASE

The standard values load file generated as a result of the RI utility is used as input to the standard values tables. Review the list of standard values and verify the values are indeed from your data, remove any duplicates, and delete any records with the value of UNK. The UNK is not an acceptable value, but the value N/A is acceptable. A sample of a standard values load file and command files to load it can be found in:

```
develop:[detarc.data_engr]stdval_load_file.dat
develop:[detarc.data_engr]stdval_load.com
```

An executable exists in the above directory which will run against your stdval.dat file and remove any duplicates. The name of the executable is:

```
REMOVE_DUPES.EXE
```

For ease, define in your login.com file:

```
$ remove_dupes :=="develop:[detarc.data_engr]remove_dupes.exe"
```

The parameters are:

```
$ ProgramName InputFileName
```

ex. $ remove_dupes stdval.dat

IDENTIFY LIENS

Create a report of the templates and identify any liens against the templates. The report should be sent to the Peer Review Committee at least two weeks prior to the Peer Review along with the User Interface Test Set Package. This report is generated with a word processor to allow one to check for spelling errors, for numbering lines and pages and generating a table of contents.

A sample of the report can be found with Ruth Monarrez.

** USER INTERFACE TEST SET PACKAGE

This package is for the Peer Review Committee. It is broken up into two parts a 'cover letter' and 'helpful hints' memo. The cover letter provides login information, i.e., specifics on accessing the system, communication parameters, login username and password.

The Helpful Hints memo provides the Peer Review Committee with basic commands and names of User View screens to be accessed. This exercise should be done at least two weeks prior to the Peer Review. This memo also supplies the necessary information to view the data, i.e., data_set_id, instrument_id and instrument_name, software_name, data_set_ and instrument_ parameter_name, etc.

- more -

A copy of the Planetary Data System Data Set Catalog User's Guide should also be provided. This can be obtained from the PDS Operator.

An example of this memo can be found in:

develop:[detarc.data_engr]uif_test_package.mmo

CORRECT LIENS

It is up to the Peer Review to decide how to handle the liens.

ARCHIVE FILE NAMING GUIDELINES

When the data has passed the Peer Review and all of the above steps have successfully been carried out, the files will be renamed according to the Archive File Naming Guidelines. This can be found in:

develop:[detarc]archive_filenaming_guidelines.doc

COMPILE RI REPORT MEMO

An RI Report Memo is generated for each build. It documents any new anamolies that may occur as a result of your data. A copy of this memo is sent to the DBA, the PDS Operator and the PDS System Engineer. A sample of an RI Report Memo can be found in:

develop:[detarc.data_engr]vgr_19930304_ri.mmo

A utility exists which checks each line of the your RI output against the previous build's RI report. A report file is created with flags marking each line as:

(b) - existing in both reports (previous and your RI report)
(+) - not in previous report; added
(-) - was in previous report but has been corrected

Use this report file as a guide in generating the RI Report Memo. You want to be sure to report especially the lines with (+), these are new errors that were introduced as a result of your data or those values that were not reported in the previous build.
To use this utility, define in your login.com file the following:

```
$ ri_check :=="$develop:[detarc.data_engr]ri_check.exe"
```

You will be referencing the most current RI report. You may want to do a $dir/date to $cmdisk:[config.maintain.dbarc.ri] to make sure you know which RI report is the latest.

Below is a description of the input parameters for the ri_check utility.

```
$<ProgramName> <Build-InputFileName> <Test-InputFileName> <List-parameters>
```

- more -

From: RMONARREZ@JPLPDS.JPL.NASA.GOV (10/9/95)
To: YOLANDA FLETCHER
CC:
BCC:
Priority: Normal Date sent: 10/9/95 3:03 PM

```
ProgramName:           The name you have defined in your login.com file,
                       ex. ri_check.
Build-InputFileName:   The filename of the most recent build which you
                       will compare against, ex. dsdd_ri.rpt
Test-InputFileName:    The filename of your RI report which was generated
                       as a result of the RI utility,
                       ex. vgr_19930303_ri.rpt.
List-parameters:       For the first execution the parameter is: build.
                       This builds a file of keys which is used in the
                       second execution of this program.
                       For the second execution, the parameter is: -+b

Ex. $ri_check dsdd_ri.rpt vgr_19930303_ri.rpt build
    $ri_check dsdd_ri.rpt vgr_19930303_ri.rpt -+b

The output filename the first time is: nri-keys.inp
The output filename the second for this example is: vgr_19930303_ri.lst
```

RSIRS FORM

This is an electronic form sent to NSSDC describing a data set for archive. A copy of this form can be found in:

develop:[detarc.data_engr]rsirs.frm

DIF FORM

*** to be described later ***

TURNOVER MEMO

This memo is supplied to the Data Base Administrator when the data is ready for a build. It provides the location and names of files to be included in a build along with any special instructions. A sample of this memo can be found in:

develop:[detarc.data_engr]turnover.mmo

PDS ATMOSPHERES NODE
TRANSITION PLAN

Ronald Joyner / JPL
Reta Beebe / NMSU

1 MARCH 96

PDS ATMOSPHERES NODE
TRANSITION PLAN

- BACKGROUND
  - FY95 Challenge
  - FY95 Plan
  - New Atmospheres Node Selection

- TRANSITION SUMMARY
  - R. Beebe Leadership
  - Hardware Procurements / Installation
  - Transition UColorado Tasks to NMSU
  - Transition Datasets / Homepage to NMSU
  - Transition Training

- TRANSITION SCHEDULE SUMMARY

- DETAILED DATASET DESCRIPTIONS

PDS ATMOSPHERES NODE TRANSITION PLAN

BACKGROUND

- FY95 Challenge - To support the Atmospheres community without an atmospheres node.
  - Early 95: No Atmospheres Node proposal was selected during the recent NRA for new PDS nodes.
  - Late 95: New NRA to be issued by HQ for Atmospheres Node proposals. Central Node (CN) and UColorado (previous Atmospheres Node lead) to support atmospheres community during interim.

PDS ATMOSPHERES NODE
TRANSITION PLAN

BACKGROUND

- FY95 Plan: Continued support to Atmospheres community
  - PDS/CN to act as "temporary" curator of Atmospheres data and provide continued support to atmospheres community until new Atmospheres Node is selected.
  - UColorado will maintain PANDA at minimum level; no new data or capabilities added.
  - Central Node leads transition activities.
  - Central Node is temporary source of Atmospheres data for users.
  - Central Node will inform users of transition plan, when approved.
  - Atmospheres Science Advisor(s) will provide advice on Atmospheres community needs.

PDS ATMOSPHERES NODE
TRANSITION PLAN

BACKGROUND

- FY96: New Atmospheres Node Selected

  - Reta Beebe / New Mexico State University is Atmospheres Node lead
    - Node team provides scientific and curating expertise.
    - NMSU leads subnodes and data nodes in overall data evaluation, documentation, and quality control.

  - Subnodes selected by Atmospheres Expertise
    - Venus: Anthony Del Genio, Larry Travis / Goddard Institute of Space Studies
    - Mars: Bob Haberle, Jim Murphy / NASA Ames Research Center
    - Outer Planets: Reta Beebe, Mark Marley / NMSU
    - Infrared Data Node: John Pearl / GSFC
    - Radio Science Data Node: Richard Simpson / Stanford University
    - Ultraviolet Data Node: to be added in FY97

PDS ATMOSPHERES NODE
TRANSITION PLAN

TRANSITION SUMMARY

- R. Beebe / NMSU

(1) Assumed leadership of Atmospheres Node in Nov95.
(2) Represented atmospheres community at Dec95 PDS Management Council.
(3) Established transition priorities with Central Node.

- Hardware Procurement / Installation

(1) Due to government budget problems, NMSU and its subnodes were not funded or put on contract until later than originally scheduled. This delay has affected their ability to procure hardware and proceed with personnel requisitions, all of which have to be in place before the node can go on-line.

- Transition UColorado Tasks to NMSU

(1) NMSU is preparing a letter to go out to the atmospheres community notifying them of the transition, the key personnel, the sub-nodes, the key issues, and the focal areas that are to be addressed by NMSU in the coming months.
(2) NMSU has identified (and plans on using) alternate methods for those tasks for which PANDA (a system developed by Ucolorado for storing, retrieving, and peer-reviewing archive data) had previously been used. NMSU has identified the set of users who have logged-in to PANDA in the last 90 days. These users will be asked to respond to a "survey" of how they use PANDA. The results of the survey will be used to ascertain that no functionality is lost in the transition from PANDA.

PDS ATMOSPHERES NODE
TRANSITION PLAN

TRANSITION SUMMARY

- ### Transition Datasets / Homepage to NMSU

(1) CN, acting as the interim curator of the atmospheres data, will begin "sending" those archived products that are currently completed to NMSU.

(2) CN will coordinate with UColorado to "send" the set of incomplete-products to NMSU. The completion of these products will be a learning experience for NMSU and its sub-nodes.

(3) NMSU currently has a "copy" of the atmospheres homepage, has made minor revisions to the homepage, and expects to post the "final" homepage as soon as the atmospheres data has been transitioned to NMSU.

- ### Transition Training

(1) CN will train NMSU personnel in the following areas:
- Archiving data from active missions and restorations
- PDS Standards
- PDS Catalog templates and product labels
- Data ingestion techniques
- PDS tools

PDS ATMOSPHERES NODE
TRANSITION PLAN

TRANSITION SCHEDULE SUMMARY

• NMSU team selected	(completed)	10/95
• Rbeebe assumes leadership	(completed)	11/95
• Atmospheres data transfered to NMSU		03/96
• NMSU site on-line		05/96
• PANDA users provided alternate functionality		FY97

APPROVAL:____________________
S. McMahon

ACHIEVEMENT:
R. Joyner

ATMOSPHERES TRANSITION

3 LEVEL

Status Schedule

STATUS AS OF: February 25, 1996

#	Activity Name	1995 Oct	1995 Nov	1995 Dec	1996 Jan	1996 Feb	1996 Mar	1996 Apr	1996 May	1996 Jun	1996 Jul	1996 Aug	1996 Sept	1996 Oct	1996 Nov	1996 Dec
1	New Atmos Node Tasks															
2	Identify Node Advisors			▼												
3	Identify Subnodes															
4	Identify User Priorities					▼						▽ Reassess				
5	Meetings		MC ▼			Kickoff ▼	▽ Transfer Data									
6	Node Hardware/Systems			▼ Plan			Procure ▽	▽ Install	▽ On-line							
7	Define "what's needed/required" from CN						Draft ▽									
8	Contracts/Funding						On Contract ▽	▽ Funded								
9	Review "old" Atmos data									▽ Start						
10	Node Schedule/Budget					▼ Draft		▽ Update	▽ Final							
11	Node Training							Missions ▽	▽ PDS Standards/Metrics							
12	PANDA Evolution						▽ Hit list				▽ Plan					
13																
14	LASP Tasks															
15	In-process datasets															
16	Viking Lander Datasets (28 & 29)						▽ PR									
17	PVO OUVS Datasets (30 & 31)						▽ PR		▽ Fix Liens	▽ P2						
18	Magellan RSODR Fixes (26 & 27)							Fix Liens ▽		▽ P2						
19	Mars GCM Fixes (20 - 25)							Fix Liens ▽		▽ P2						
20																
21	Close-out Tasks									▽ Plan			H/W Transfer ▽	▽ Close-out		
22																
23	Old Atmos Subnode Tasks															
24	UCLA/Walker															
25	GSFC/Sandel															
26	Stanford/Simpson					▼ Rocc										
27																
28	CN Tasks															
29	Transfer Data					▼ Start				▽ End						
30	Transfer Homepage					▼ Draft				▽ On-line						
31																
32	Unfunded Datasets									▽ Prioritize			▽ Plan			
33																
34																

NOTES:

P2 = Phase II Archive
RC = Re-certify
PR = Peer Review

WWW = Atmos Homepage Relocated

JPL

Planetary Data Systems

APPROVAL:____________________
S. McMahon

ACHIEVEMENT:____________________
R. Joyner

ATMOSPHERES TRANSITION

3 LEVEL

Status Schedule

STATUS AS OF: February 25,1996

#	Activity Name	1995 Oct	Nov	Dec	1996 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
35	Panda - Archived Datasets/LASP Carryover Funds															RC ▽
36	Viking Mars Atmospheric Water Detector	(1)														
37	Viking and Mariner 9 Mars Cloud Catalog	(2)														
38	Viking Infrared Thermal Mapper (IRTM)	(3)														
39	Mars Digital Albedo Map	(4)														
40	Mars Thermal Inertia Map	(5)														
41	Mars Topographic Map	(6)														
42	VL Meteorology Point-BY-Point Pressure	(7)														
43	VL Meteorology Summary Pressure Data	(8)														
44	VL Meterology Binned Pres/Temp/Wind	(9- 10)														
45	VL Imaging Atmospheric Optical Depth	(11)														
46	VGR 1 & 2 IRIS RDR Spectral Data, Jupiter	(12 -13)														
47	VGR 1 & 2 IRIS RDR Spectral Data, Saturn	(14- 15)														
48	VGR 2 IRIS RDR Spectral Data, Uranus	(16- 17)														
49	VGR 2 IRIS RDR Spectral Data, Neptune	(18- 19)														
50																
51	In-Process Datasets/LASP Carryover Funds															
52	Mars General Circulation Model (GCM)	(20- 25)				▽										
53	MGN Radio Occulation Derived (RSODR)	(26- 27)				▽										RC ▽
54	VL Meteorology Footpad Temperatures	(28)				▽										
55	VL Meteorology Sol Averages	(29)				▽										
56	Pioneer Venus Orbiter OUVS Images	(30- 31)				▽										
57	VGR 1&2 IRIS Derived Atmos Parameters, Jup	(32)				▽										
58	VGR 1&2 IRIS Derived Atmos Parameters, Sat	(33)				▽										
59	VGR 1&2 UVS Derived Atmos Parameters, Jup	(34)				▽										
60	VGR 1&2 UVS Derived Atmos Paramerers, Sat	(35)				▽										
61																
62	Funding (FY95)															
63	Pioneer Venus OCPP Images/UCLA	(36- 37)				▽										
64	MAR-9 IRIS RDR Spectral/GSFC	(38- 39)				▽										
65	MGN Raw Radio Occulation (ROCC)/Stanford/RS	(44)				▼	PR				▽					
66	GLL EUV Raw (EDR)/Walker	(46)				▽										
67	GLL EUV (RDR)/Walker	(47)				▽										
68	GLL UVS (RDR)/Walker	(48)				▽										
69																

NOTES:

P2 = Phase II Archive

RC = Re-certify

PR = Peer Review

WWW = Atmos Homepage Relocated

APPROVAL:____________________
S. McMahon

ACHIEVEMENT: [signature]
R. Joyner

ATMOSPHERES TRANSITION

(3 LEVEL)

Status Schedule

STATUS AS OF: February 25,1996

#	Activity Name	1995			1996											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
70	New Funding(FY96)															
71	SL-9 Palomar Infrared Data Set/GSFC	(49)					▽									
72	VGR 1&2 UVS (S,U,N)/Arizona	(52)					▽									
73	Solar Occulation Data/Arizona	(53)					▽									
74	GLL Atmos Archiving Preparation/NMS	(57)														
75	SL - 9 Specific Datasets/NMS	(58)												▽		
76														▽		
77																
78	Datasets: Not Funded															
79	VGR UVS RDR Spectral, Jupiter/Arizona	(40-41)														
80	VGR 1 Jupiter's Great Red Spot/LASP	(42)														
81	Methane Spectral Database/LASP	(43)														
82	VL "Fast Meteorology" Raw Data/LASP	(45)														
83	VGR UVS/Arizona	(50)														
84	VGR UVS - Saturn Ring Occutation Data/Az	(51)														
85	Outer Helioscope Maps/Arizona	(54)														
86	Other Specialized Data Sets/Arizona	(55)														
87																
88																
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102																
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104																

NOTES:
P2 = Phase II Archive
RC = Re-certify
PR = Peer Review

WWW = Atmos Homepage Relocated

PDS ATMOSPHERES NODE
TRANSITION PLAN

DETAILED DATASET DESCRIPTIONS

17 January 1996

Detailed Dataset Descriptions

(A) PDS Status

(1) All "Phase II copy finished" datasets can be transferred to RBeebe as soon as she is ready.

(2) All "Phase II copy finished" datasets "Requires re-certification by RBeebe".

(3) Transition of the Atmospheres Home page (PDS/CN is currently the curator) can be transferred to RBeebe as soon as she is ready.

(4) SLee has agreed to deliver the remaining CD-WOs. His time table remains questionable.

Note: The "Phase II copy finished" datasets and the "Requires re-certification by RBeebe" datasets are identified in the Addendum section below.

(B) Questions to RBeebe

(1) What is your position on "leading" the peer-review of those datasets that are "Under Peer Review". You can designate a team. I can assist your team. Or, SLee can continue to "lead" the peer-review(s).

For the "NEW FUNDING" and "ADDITIONAL" datasets, your team should be leading those peer-reviews, and directing the archive effort. SLee was not funded for participation. Also, a new schedule should be generated for these datasets, as the completion date for all of them has slipped. The funds for completing these datasets have been delivered. And, its not clear that there has been any significant work towards completing them. What appropriate actions should be taken, if any:

(a) Nag
(b) Reschedule
(c) Re-assign the funds to other higher priority tasks

(2) What is your position on who should finish the remaining "Waiting for Phase II copy from SLee" datasets. SLee currently has 4 unfinished datasets. Two require peer-review, and two require simple editing/ clean-up. Any suggestions on who might be qualified to "finish" these:

(a) MGN Radio Occultation Derived (RSODR) - simple editing/cleanup
(b) Mars General Circulation Model (GCM) - import into PANDA, labeling
(c) Pioneer/Venus Orbiter OUVS Images - peer review
(d) Viking Lander Meteorology Footpad/SOL - peer review

(3) What is your recommendation on the continued use or demise, replacement, or evolution of PANDA.

(4) What are your plans for a detailed catalog.

(5) PDS/CN funded SLee for the Atmospheres transition ($20K). You have also identified funds ($30K) for the same task. Is there a better use for those funds.

(6) Have you developed any ideas for informing the Atmospheres users of the "transition" from PDS/CN to NMS (both data and homepage).

(7) The work that you have identifed for NMS and subnodes for this fiscal year needs to be added to the current PDS/CN schedule. I will fax a copy of the "preliminary" schedule.

Note: The datasets defined by quoted phrases are identified in the Addendum section below.

(C) Addendum

The following represents a listing of the Archive Volumes that:

- Are currently cataloged in PDS
- In process by SLee (data sets that SLee was funded to complete)
- In process by subnodes (funded prior to 1995)
- In process by subnodes (new funding - 1995)

Note: The legends for the values designated within the four columns (1,2,3,4) and the values for the CD-WO column are listed after the tables.

PDS DATA SET CATALOG

	1	2	3	4	CD-WO
MR9/VO1/VO2 MARS IMAGING SCIENCE SUBSYSTEM/VIS 5 CLOUD V1.0		P	R	R	B
VG1/VG2 JUPITER IRIS 3 RDR V1.0		P	R	R	E
VG1/VG2 SATURN IRIS 3 RDR V1.0		P	R	R	E
VG2 NEPTUNE IRIS 3 RDR V1.0		P	R	R	E
VG2 URANUS IRIS 3 RDR V1.0		P	R	R	E
VL1/VL2 MARS LCS DERIVED ATMOSPHERIC OPTICAL DEPTH V1.0		P	R	R	A
VL1/VL2 MARS METEOROLOGY DATA CALIBRATED DATA PRESSURE V1.0		P	R	R	A
VL1/VL2 MARS METEOROLOGY RESAMPLED DAILY AVG PRESSURE V1.0		P	R	R	A
VL1/VL2 MARS METEOROLOGY RESAMPLED DATA BINNED-P-T-V V1.0		P	R	R	A
VL1 MARS METEOROLOGY DATA RESAMPLED DATA BINNED-P-T-V V1.0		P	R	R	A
VO1/VO2 MARS ATMOSPHERIC WATER DETECTOR 4 V1.0		P	R	R	D
VO1/VO2 MARS IRTM BINNED DATA AND DERIVED CLOUDS V1.0		P	R	R	C

PLANETARY ATMOSPHERES - SLee

	1	2	3	4	
Ancillary CD (Mars map data)		P	W	R	F
VGR 1&2 IRIS Derived Atmos Parameters (J,S)		P	I	R	I
MGN Radio Occultation Derived (RSODR)		W	I	R	J
VGR 1&2 UVS Derived Atmos Parameters (J,S)		P	I	R	G
Mars General Circulation Model (GCM)		W	I	R	H
Pioneer/Venus Orbiter OUVS Images	U	W	I	R	K
Viking Lander Meteorology Footpad/SOL	R	W	I	R	L

NEW FUNDING

	1	2	3	4	Estimated Complete Date
Pioneer/Venus OCPP Images (UCLA/RWalker)					12/95
MAR-9 IRIS RDR Spectral (GSFC/BConrath)					12/95
VGR UVS RDR Spectral (J) (LASP/SLee)					Not Funded
Methane Spectral Database (LASP/SLee)					Not Funded
MGN Raw Radio Occultation (ROCC) (Stanford/RSimpson)					12/95
VL "Fast Meteorology" Raw Data (LASP/SLee)					Not Funded
GLL EUV Raw EDR (UCLA/RWalker)					12/95
GLL EUV RDR (UCLA/RWalker)					12/95
GLL UVS RDR (UCLA/RWalker)					12/95

ADDITIONAL DATASETS - NEW FUNDING

	1	2	3	4	
SL-9 Palomar Infrared Data (GSFC/BConrath)					12/95
VGR UVS (Arizona/BSandel)					Not Funded
VGR UVS Saturn Ring Occ (Arizona/BSandel)					Not Funded
VGR 1&2 UVS (S,U,N) (Arizona/BSandel)					12/95
Solar Occultation Data (Arizona/BSandel)					12/95
Outer Helioscope Maps (Arizona/BSandel)					Not Funded
Outer Specialized Data (Arizona/BSandel)					Not Funded
GLL Atmos Archiving Preparation (NMS/RBeebe)					12/95
SL-9 Specific Datasets (NMS/RBeebe)					12/95

Column Legend:

1 - Peer Review
  - R = Requires Peer Review
  - U = Under Peer Review

2 - Phase II Copy
  - W = Waiting for Phase II copy from SLee
  - P = Phase II copy finished

3 - Ingested in PDS catalog
  - I = Needs to be ingested
  - R = Needs to be re-ingested (older version exists)
  - W = Will not be ingested

4 - Re-Certification
  - R = Requires re-certification by RBeebe

CD-WO Legend:

A - USA_NASA_PDS_VL_1001

Viking Lander Meteorology Binned Pressure, Temp, Wind Corr
- VL1 MARS METEOROLOGY DATA RESAMPLED DATA BINNED P-T-V V1.0
- VL1/VL2 MARS LCS DERIVED ATMOSPHERIC OPTICAL DEPTH V1.0
- VL1/VL2 MARS METEOROLOGY DATA CALIBRATED DATA PRESSURE V1.0
- VL1/VL2 MARS METEOROLOGY RESAMPLED DAILY AVG PRESSURE V1.0
- VL1/VL2 MARS METEOROLOGY RESAMPLED DATA BINNED P-T-V V1.0

B - USA_NASA_PDS_VOMR_0001

Viking Orbiters and Mariner 9 Mars Cloud Catalog
- MR9/VO1/VO2 MARS IMAGING SCIENCE SUBSYSTEM/VIS 5 CLOUD V1.0

C - USA_NASA_PDS_VO_3002

Viking Orbiters Infrared Thermal Mapper Binned/Clouds
- VO1/VO2 MARS IRTM BINNED DATA AND DERIVED CLOUDS V1.0

D - USA_NASA_PDS_VO_3001

Viking Orbiters Mars Atmospheric Water Detector
- VO1/VO2 MARS ATMOSPHERIC WATER DETECTOR 4 V1.0

E - USA_NASA_PDS_VG_2001

IRIS Full Resolution Spectra (Jupiter, Saturn, Uranus, Neptune)
- VG1/VG2 JUPITER IRIS 3 RDR V1.0
- VG1/VG2 SATURN IRIS 3 RDR V1.0
- VG2 NEPTUNE IRIS 3 RDR V1.0
- VG2 URANUS IRIS 3 RDR V1.0

F - USA_NASA_PDS_ATMOS_0006

ATMOS Ancillary CD (not a real PDS archive product)
- albedo.dat
- inertial.dat
- topo.dat

G - USA_NASA_PDS_VG_2101

Voyager 1 and 2 Ultraviolet Spectrometer (UVS) Derived Maps of Hydrogen Lyman-Alpha and Molecular Hydrogen Bands
- VOYAGER 1&2 SATURN BRIGHTNESS NORTH/SOUTH MAP SET V1.0
- VOYAGER 1&2 JUPITER BRIGHTNESS NORTH/SOUTH MAP SET V1.0

H - USA_NASA_JPL_MOGC_0001

AMES Mars General Circulation Model Data Record
- AMES MARS GENERAL CIRCULATION MODEL 5 LAT VARIABLES V1.0
- AMES MARS GENERAL CIRCULATION MODEL 5 LAT LON VARIABLES V1.0
- AMES MARS GENERAL CIRCULATION MODEL 5 LAT PRES VARIABLE V1.0
- AMES MARS GENERAL CIRCULATION MODEL 5 LAT TIME VARIABLE V1.0
- AMES MARS GENERAL CIRCULATION MODEL 5 TIME VARIABLES V1.0
- AMES MARS GENERAL CIRCULATION MODEL 5 TOPOGRAPHY V1.0

I - USA_NASA_PDS_VG_2102

Voyager 1 and 2 Infrared Interferometer Spectrometer and Radiometer (IRIS) Maps of Derived Atmospheric Parameters.
- VOYAGER 1&2 JUPITER IRIS DERIVED NORTH/SOUTH PARAMETERS V1.0
- VOYAGER 1&2 SATURN IRIS DERIVED NORTH/SOUTH PARAMETERS V1.0
- VG1/VG2 JUPITER IRIS DERIVED GREAT RED SPOT PARAMETERS V1.0

J - USA_NASA_PDS_MG_2301

Magellan: Original Apoapsis Data Record
- MGN V RSS ORIGINAL APOAPSIS DATA RECORD

K - USA_NASA_PDS_PV01_1001
USA_NASA_PDS_PV01_1002

Pioneer Venus Orbiter Inbound Monochrome Images
- PVO V OUVS INBOUND MONOCHROME IMAGE DATA RECORD V1.0

L - ??