SPaCE - 2

Spacecraft Procedures and Concepts Evaluator - 2

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I. FORWARD

This report presents a conceptual architecture and preliminary process definition for a knowledge based Spacecraft Procedures and Concepts Evaluator (SPaCE-2). SPaCE-2 is a postulated tool intended to support the Space Station Systems engineering process. It is an extension of the SPaCE-I work conducted in support of the Goddard Space Flight Center (GSFC) Advanced Earth Orbital Spacecraft Systems Technology RTOP and the GSFC space Station Office Engineering Data Base (EDB) system development effort.

The detailed design, construction and operation of the Space station System will provide unprecedented systems engineering challenges. The detailed design phase (Phase C) will require an efficient means of iterating the design process for multiple components in parallel while maintaining consistency with all approved requirements and specified interfaces. The construction phase (Phase D) requires the preceding as well as capture of the detailed knowledge associated with the design and construction of each component. The operations phase (Phase E) requires ready access to the knowledge of what was constructed and why in order to support operations planning, fault prevention, fault isolation, and fault correction.

These fundamental challenges must be met in order to minimize the Space station System lifecycle cost. In addition, when coupled with a real-time command and control capability down to the Orbital-Replaceable-Unit (ORU) level they provide the basis for supporting an evolving level of automation and autonomy within the Space Station System.

However, meeting the challenges will require an evolution in how the spacecraft systems engineering process is conducted. A succession of increasing more capable knowledge based systems designed to function in an operational environment are necessary.

The SPaCE-2 conceptual architecture and preliminary process definition is intended to be a starting point for discussion and impetus for commitment to the task of building the required knowledge based systems.

II. INTRODUCTION

A "knowledge based system" is a higher level user/component of an "information system" which allows problems within a restricted domain to be worked with incomplete and potentially inconsistent information.

A knowledge based system has three primary components. The first is the "knowledge base" which contains the expert knowledge of the problem domain. The second is the "inference mechanism" which provides the control structure required for operation. The third is the user interface, facilitates the input of knowledge into the knowledge base, interaction with the inference mechanism, and the production of output products.

Conventional programming systems that have been used for to spacecraft systems engineering have a numberof inherent limitations. The most critical limitation is that they require complete and specific information for the parameters that they consider. They cannot deal with missing parameters or variable parameters. They are totally dependent on the ability of the user to provide a suitable set of parameters for each case to be considered. Another severe limitation is that no explanation is available on how answers are arrived at short of tracing through the program code line by line. Lastly, they cannot generate comparison reports between potential designs. A knowledge based system need not be subject to these limitations.

For the purposes of this report the following definitions will be employed:

Knowledge = Information inperspective

Information = Datain context

Data = Set of formatted symbols

An "information system" is an integrated set of hardware and software which performs the following basic functions:

- Information Input
- Information storage
- Information Retrieval
- Information Access Control
- Information Output
- Information Transfer
- Information Display
- Information Manipulation
- Information Analysis
- Information Inference

This report provides an outline of the procedures required in the SPaCE-2 system for each of the knowledge based system components in each information system functional area.

SPaCE-2 is intended to function as an integrated Space Station engineering data base system capable of incorporating all Space Station engineering data regardless of the level of detail.

SPaCE-2 is intended to be useful throughout the lifecycle of the Space Station project. In the design phase it allows the ready simulation and iteration of engineering item design alternatives. In the construction phase it can facilitate the configuration management process and serve as a planning tool for operations procedures development. In the Operations phase it can assist in procedure validation, fault prevention, fault isolation and fault correction.

SPaCE-2 is intended to produce four types of custom data sets (Reference, Derived, Inferred and Optimized) which can be used by both internal procedures and external programs to provide a large range of output products.

The goal of the system is to facilitate the construction, use and iteration of engineering item models of varying degrees of fidelity. These models are then incorporated in data set for dynamic simulation of the Space Station System at the corresponding level of abstraction.

The text that follows uses the development of a plausible model of spacecraft systems engineering as a starting point for defining the SPaCE-2 system.

III. SPACECRAFT SYSTEMS ENGINEERING

Spacecraft systems engineering is the discipline concerned with assuring the ability of all systems/subsystems and the payload/instrument components to work together to achieve the spacecraft's purpose in the most effective manner.

Spacecraft systems engineering is a piecewise iterative process. It is accomplished by the dedicated efforts of highly experienced individuals and by multiple, and often redundant, review procedures.

NASA characterizes the spacecraft systems engineering process as a set of fairly discrete phases which can be associated with a number of factors. These factors include the degree of confidence in the design, the status of the funding, the level of resources committed and the level of detail of the current work.

THE NASA SYSTEMS ENGINEERING PROCESS PHASE BREAKDOWN

DESIGNATION	PHASES	SOME CHARACTERISTICS
CONCEPTUAL ENGINEERING	Prephase A (Conceptual Study) Phase A (Mission Analysis)	rough calculations 1X resource commitment 3-D Model length, width, mass functionality resources required
PRELIMINARY ENGINEERING	Prephase B (Advanced Definition) Phase B (Definition)	finite element work 10X resource commitment buy off point assessed multi-discipline work
DETAIL DESIGN	Phase C	every bolt and rivet
CONSTRUCTION	Phase D	
OPERATIONS	Phase E	

Spacecraft systems engineering is playing an increasingly major role throughout the lifecycle of spacecraft systems. This trend is being driven by a number of factors including: the increased use of spacecraft optimization constraints (design to cost, design to space available, etc.); efforts to expand the degree of autonomy/automation; provisions for servicing and/or repairing; allowing for a high degree of modularity and the use of standard interfaces; providing for the ability for the spacecraft to be evolved to suit future mission needs; and, to control overall system lifecycle costs.

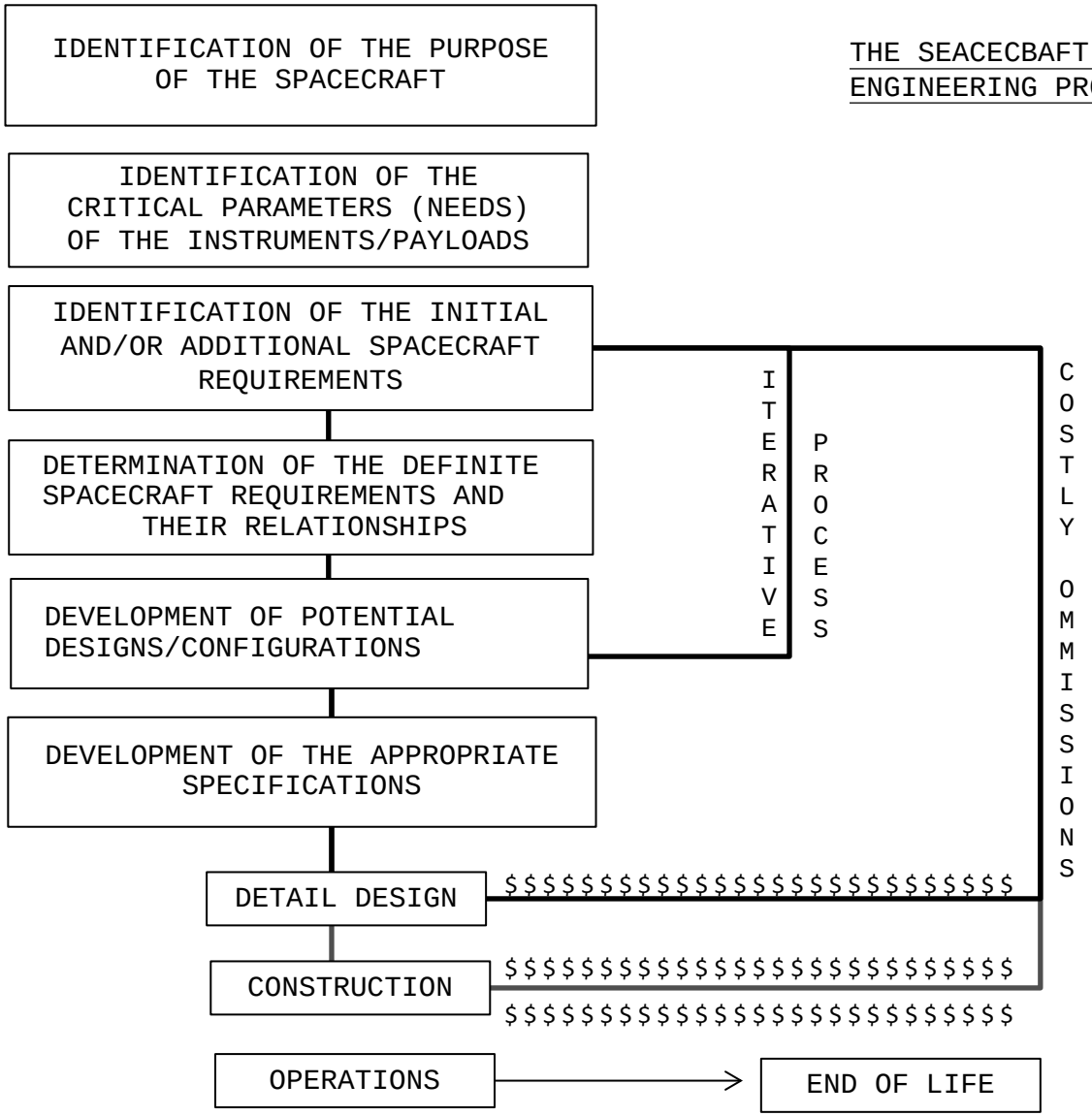
A high level diagrammatic view of the spacecraft systems engineering process is shown on the following page.

The design of a spacecraft system starts with a "purpose". The purpose provides the basis for understanding and evaluating the efficacy of the overall spacecraft system. The purpose serves to constrain the domain of possible spacecraft from a functionally infinite set to a finite set that have definable characteristics.

The next step in the process is the identification of critical instrument parameters (needs) of the proposed instruments/payloads. This information tends to be an ill-defined mixture, varying from extreme specificity to rather oblique generalizations. Quite often, there is competing if not contradictory information supplied. Yet, in spite of the tenuous nature of this information, it provides a necessary point of departure for the systems engineering process. Some of the critical parameters (also referred to as mission requirements and attributes) that often come into consideration are listed in Appendix A.

It is by the consideration of the implications of the critical parameters, in light of the spacecraft's purpose, that the definite spacecraft requirements and their relationships emerge. These requirements and relationships provide the basis for the generation of potential spacecraft designs/configurations. In the process of evaluating the potential designs/configurations, revised and/or additional spacecraft requirements emerge. The modifications in turn mandate another iteration of the systems engineering process.

When the project management has sufficient confidence in a given spacecraft system design/configuration, such that no further drastic changes are foreseen, the design can be converted into the appropriate specifications necessary for detail design and construction. Any changes in the specifications after construction has begun become increasingly more costly in terms of funds, time and political will.


IDENTIFICATION OF THE PURPOSE OF THE SPACECRAFT
THE SEACECBAFT SYSTEMS ENGINEERING PROCESS
IDENTIFICATION OF THE CRITICAL PARAMETERS (NEEDS) OF THE INSTRUMENTS/PAYLOADS
IDENTIFICATION OF THE INITIAL AND/OR ADDITIONAL SPACECRAFT REQUIREMENTS
DETERMINATION OF THE DEFINITE SPACECRAFT REQUIREMENTS AND THEIR RELATIONSHIPS
DEVELOPMENT OF POTENTIAL DESIGNS/CONFIGURATIONS
ITERATIVE PROCESS
COSTLY OMMISSIONS
DEVELOPMENT OF THE APPROPRIATE SPECIFICATIONS
DETAIL DESIGN
$$$$$$$$$$$$$$$$$$$$$$$$$$
CONSTRUCTION
$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$
OPERATIONS
END OF LIFE

As the complexity of the spacecraft being designed increases, the systems engineering process becomes ever more difficult and tedious. This trend of increasing difficulty, inherent in the systems engineering process, has been partially ameliorated by adding additional review levels and analytical depth to the analysis process. However, the difficulties with the current generation of spacecraft and associated hardware lend credence to the idea that new tools are needed to deal with the growing complexities of spacecraft systems both now and in the years to come.

Specifically, the challenge of building the Space Station System requires the development of a new set of tools to support the Space Station systems engineering process as well as a new approach which mandates the codification of the process.

The Space Station Program has established the basis for implementing these ideas by committing to a major initiative known as the Space Station Technical and Management Information System (TMIS).

The next sections outline the general requirements for building a knowledge based system as they apply to SPaCE-2.

IV. SPaCE-2 GENERAL REQUIREMENTS

NASA and the aerospace industry have built, launched and operated successfully a myriad of spacecraft systems over the past 25 years and continue to do so. Therefore, experts in spacecraft systems engineering do exist. Accordingly, the most fundamental requirement for the construction of an "expert" system is satisfied (i.e. experts have to exist in the domain under consideration).

A second requirement is that it must be possible to determine how the expert works in the domain. In the previous section, a plausible model of the overall spacecraft systems engineering process was presented. This model applies from the genesis of the spacecraft purpose through the actual construction process, and by analogy, through to the end of the lifecycle of the spacecraft system. This is because, after a spacecraft system is launched, decisions are continually made that have ramifications which often cascade throughout the entire system in a non-trivial manner; Hence, the continuing role of spacecraft systems engineering.

A third requirement for the construction of an expert system is a suitable knowledge base. In the case of spacecraft systems engineering, the knowledge base exists as many scattered elements in a variety of forms including rules, qualitative descriptions, and quantitative functions. Unfortunately a significant amount of the knowledge has never been codified; it exists only in the minds of the experts involved. Furthermore, the knowledge also exists at many different levels of refinement, particularly with respect to quantitative functions/tools. For the purposes of SPaCE-2, the knowledge base will be supplied on an on-going basis by the Space Station Program. The critical considerations are that the knowledge base required will be constructed as a necessary part of the systems engineering and integration process and that the Space Station Program is committed to the creation of a TMIS to utilize the knowledge base. In this sense, SPaCE-2 could serve as a powerful tool for generating, integrating, controlling and iterating the Space Station system engineering data.

A fourth requirement that must be satisfied is that a functional inference mechanism must be available. In order to deal with the incomplete information that will be presented to the system which must be manipulated in a variety of forms, a number of inference capabilities must be present. A number of domain independent expert system construction "toolkits" exist that may be applied directly or used in conjunction with other research programs as models for the construction of a suitable overall inference mechanism (or set of cooperating inference mechanisms).

The inference mechanism required for SPaCE-2 is considered to be well within the state-of-the-art, and by most assessments, a straight forward piece of AI applications work.

A fifth requirement that is often difficult to come to terms with, is deciding what the program is really expected to do. In artificial intelligence applications work, the capabilities that an expert system must have are clearly defined. The system either performs successfully or it does not. The success criterion is fundamentally different for artificial intelligence research work. For research work the capabilities of an expert system must have are fluid goals subject to revision as the researcher feels appropriate. Accordingly, both a conceptual understanding of the system's

purpose and a definite outline of the expected output is required. The SPaCE-2 system meets this requirement.

A sixth requirement is that a workable architecture/process can be defined. This involves defining what must be in the knowledge base, what capabilities the inference mechanism must have and how both must interrelate to function properly. The structure of the knowledge base, and the processes needed to produce a viable expert system, represent the most fundamental AI problem addressed by the SPaCE-2 system. Creating a system that can cope with incomplete and multiple levels of knowledge in a real time environment, and function as a meaningful aid in the space systems engineering domain is a non-trivial problem. Until now knowledge based technologies have not been applied in this domain.

The last requirement considered here is that a tractable implementation scheme exists. The hardware must support the knowledge based system within an operational environment that allows for the system to be developed, tested and evaluated without unreasonable constraints of memory space, CPU time or access. Furthermore, an adequate resource of qualified personnel and support funds is required to make the system operational. Due to the nature of the applications environment, SPaCE-2 must have early demonstrable capabilities and show noticeable growth as additional resources are committed to it. Currently no specific commitment of resources to build a "SPaCE-2 like" system exists. Hopefully, the consideration of this report will facilitate such a commitment.

The next section is a first-cut outline of the required procedures that would need to be coded to implement a viable SPaCE-2 system.

V. REQUIRED PROCEDURES FOR SPaCE-2

1. User Interface Procedures

1.1. Information Input

1.1.1. Values

1.1.1.1. Add

1.1.1.1.1. Menu Driven Single Entry
1.1.1.1.2. Command Driven Single/Multiple Entry
1.1.1.1.3. User Defined Menu/Command Sequence

1.1.1.2. Modify (add an alternate value)

1.1.1.2.1. Menu Driven Single Entry
1.1.1.2.2. Command Driven Single/Multiple Entry
1.1.1.2.3. User Defined Menu/Command Sequence

1.1.1.3. Delete

1.1.1.3.1. Menu Driven Single Entry
1.1.1.3.2. Command Driven Single/Multiple Entry
1.1.1.3.3. User Defined Menu/Command Sequence

1.1.2. Attributes

1.1.2.1. Add

1.1.2.1.1. Menu Driven Single Entry
1.1.2.1.2. Command Driven Single/Multiple Entry
1.1.2.1.3. User Defined Menu/Command Sequence

1.1.2.2. Modify

1.1.2.2.1. Menu Driven Single Entry
1.1.2.2.2. Command Driven Single/Multiple Entry
1.1.2.2.3. User Defined Menu/Command Sequence

1. 1.2.3. Delete

1.1.2.3.1. Menu Driven Single Entry
1.1.2.3.2. Command Driven Single/Multiple Entry
1.1.2.3.3. User Defined Menu/Command Sequence

1.1.3. Items

1.1.3.1. Add

1.1.3.1.1. Menu Driven Single Entry
1.1.3.1.2. Command Driven Single/Multiple Entry
1.1.3.1.3. User Defined Menu/Command Sequence

1.1.3.2. Modify

1.1.3.2.1. Menu Driven Single Entry
1.1.3.2.2. Command Driven Single/Multiple Entry
1.1.3.2.3. User Defined Menu/Command Sequence

1.1.3.3. Delete

1.1.3.3.1. Menu Driven Single Entry
1.1.3.3.2. Command Driven Single/Multiple Entry
1.1.3.3.3. User Defined Menu/Command Sequence

1.1.4. Models

1.1.4.1. Add

1.1.4.1.1. Menu Driven Single Entry
1.1.4.1.2. Command Driven Single/Multiple Entry
1.1.4.1.3. User Defined Menu/Command Sequence

1.1.4.2. Modify

1.1.4.2.1. Menu Driven Single Entry
1.1.4.2.2. Command Driven Single/Multiple Entry
1.1.4.2.3. User Defined Menu/Command Sequence

1.1.4.3. Delete

1.1.4.3.1. Menu Driven Single Entry
1.1.4.3.2. Command Driven Single/Multiple Entry
1.1.4.3.3. User Defined Menu/Command Sequence

1.1.5. Data Sets

1.1.5.1. Add

1.1.5.1.1. Menu Driven Single Entry
1.1.5.1.2. Command Driven Single/Multiple Entry

1.1.5.1.3. User Defined Menu/Command Sequence

1.1.5.2. Modify

1.1.5.2.1. Menu Driven Single Entry
1.1.5.2.2. Command Driven Single/Multiple Entry
1.1.5.2.3. User Defined Menu/Command Sequence

1.1.5.3. Delete

1.1.5.3.1. Menu Driven Single Entry
1.1.5.3.2. Command Driven Single/Multiple Entry
1.1.5.3.3. User Defined Menu/Command Sequence

1.2. Information Storage

None Identified

1.3. Information Retrieval

None Identified

1.4. Information Access Control

1.4.1. Value Level

1.4.1.1. Restrict access to an individual user
1.4.1.2. Restrict access to an individual user group
1.4.1.3. Restrict access to a single user group and SE&I
1.4.1.4. Restrict access to a selected list of user groups
1.4.1.5. Restrict access to authorized system users

1.4.2. Attribute Level

1.4.2.1. Restrict access to an individual user
1.4.2.2. Restrict access to an individual user group
1.4.2.3. Restrict access to a single user group and SE&I
1.4.2.4. Restrict access to a selected list of user groups
1.4.2.5. Restrict access to authorized system users

1.4.3. Item Level

1.4.3.1. Restrict access to an individual user
1.4.3.2. Restrict access to an individual user group
1.4.3.3. Restrict access to a single user group and SE&I

1.4.3.4. Restrict access to a selected list of user groups
1.4.3.5. Restrict access to authorized system users

1.4.4. Model Level

1.4.4.1. Restrict access to an individual user
1.4.4.2. Restrict access to an individual user group
1.4.4.3. Restrict access to a single user group and SE&I
1.4.4.4. Restrict access to a selected list of user groups
1.4.4.5. Restrict access to authorized system users

1.4.5. Data set Level

1.4.5.1. Restrict access to an individual user
1.4.5.2. Restrict access to an individual user group
1.4.5.3. Restrict access to a single user group and SE&I
1.4.5.4. Restrict access to a selected list of user groups
1.4.5.5. Restrict access to authorized system users

1.4.6. Command Level

1.4.6.1. Restrict access to an individual user
1.4.6.2. Restrict access to an individual user group
1.4.6.3. Restrict access to a single user group and SE&I
1.4.6.4. Restrict access to a selected list of user groups
1.4.6.5. Restrict access to authorized system users

1.4.7. User Table Level (access level)

1.4.7.1. Restrict access to an individual user
1.4.7.2. Restrict access to an individual user group
1.4.7.3. Restrict access to a single user group and SE&I
1.4.7.4. Restrict access to a selected list of user groups
1.4.7.5. Restrict access to authorized system users

1.5. Information output

1.5.1. Reports

1.5.1.1. Standard Reports

1.5.1.1.1. Source Data Set Format
1.5.1.1.2. Source Data Set Summary Format

1.5.1.2. Ad Hoc

1.5.1.2.1. Using Item & Attribute Criteria

1.5.1.2.2. Ad Hoc Report using Item, Attribute and Value Criteria

1.5.2. Files

1.5.2.1. Print
1.5.2.2. Data Set

1.6. Information Transfer

1.6.1. Source Data Set Input Format

1.6.1.1. Electronic Transfer
1.6.1.2. Magnetic Tape
1.6.1.3. Floppy Disk

1.6.2. Data Set Output Format

1.6.2.1. ASCII

1.7. Information Display

1.7.1. Tabular Reports

1.7.1.1. Value Frame

1.7.1.1.1. Status
1.7.1.1.2. Nature
1.7.1.1.3. Types
1.7.1.1.4. Validity
1.7.1.1.5. Data

1.7.1.2. Attribute Frame

1.7.1.2.1. Definitions
1.7.1.2.2. Applicability
1.7.1.2.3. Categories
1.7.1.2.4. Associations
1.7.1.2.5. Values

1.7.1.3. Item Frame

1.7.1.3.1. Purposes
1.7.1.3.2. Requirements
1.7.1.3.3. Hierarchies
1.7.1.3.4. Interfaces

1.7.1.3.5. Attributes

1.7.1.4. Model Frame

1.7.1.4.1. Fidelity
1.7.1.4.2. Rational
1.7.1.4.3. Schemas
1.7.1.4.4. Rules
1.7.1.4.5. Items

1.7.1.5. Data Set Frame

1.7.1.5.1. Utility
1.7.1.5.2. Domain
1.7.1.5.3. Order
1.7.1.5.4. Criteria
1.7.1.5.5. Models

1.7.1.6. Location within system

1.7.1.7. Current Path

1.7.2. Graphical Reports

1.7.2.1. Location within system
1.7.2.2. Current Path
1.7.2.3. Line Graph
1.7.2.4. Bar Graph
1.7.2.5. Stacked Bar
1.7.2.6. Pie Chart
1.7.2.7. Work Breakdown Structure
1.7.2.8. Organizational Chart
1.7.2.9. Interface Map

1.7.3. CAD Graphics

1.7.3.1. Item

1.7.3.1.1. Activities

1.7.3.1.1.1. Schedule

1.7.3.1.2. Hardware

1.7.3.1.2.1. View

1.7.3.1.2.2. Level

1.7.3.1.3. Functions

1.7.3.1.3.1. Interface Diagram

1.7.3.1.4. Software

1.7.3.1.4.1. Data Flow Diagram

1.7.3.2. Item and Parents

1.7.3.2.1. Activities

1.7.3.2.1.1. Schedule

1.7.3.2.2. Hardware

1.7.3.2.2.1. View
1.7.3.2.2.2. Level

1.7.3.2.3. Functions

1.7.3.2.3.1. System Diagram

1.7.3.2.4. Software

1.7.3.2.4.1. Data Flow Diagram

1.7.3.3. Item and Peers

1.7.3.3.1. Activities

1.7.3.3.1.1. Schedule

1.7.3.3.2. Hardware

1.7.3.3.2.1. View
1.7.3.3.2.2. Level

1.7.3.3.3. Functions

1.7.3.3.3.1. System Diagram

1.7.3.3.4. Software

1.7.3.3.4.1. Data Flow Diagram

1.7.3.4. Item and Children

1.7.3.4.1. Activities

1.7.3.4.1.1. Schedule

1.7.3.4.2. Hardware

1.7.3.4.2.1. View
1.7.3.4.2.2. Level

1.7.3.4.3. Functions

1.7.3.4.3.1. System Diagram

1.7.3.4.4. Software

1.7.3.4.4.1. Data Flow Diagram

1.7.3.4. Item and Children

1.7.3.4.1. Activities

1.7.3.4.1.1. Schedule

1.7.3.4.2. Hardware

1.7.3.4.2.1. View
1.7.3.4.2.2. Level

1.7.3.4.3. Functions

1.7.3.4.3.1. System Diagram

1.7.3.4.4. Software

1.7.3.4.4.1. Data Flow Diagram

1.8. Information Manipulation

1.8.1. Menu Selection

1.8.1.1. Data Set Criteria
1.8.1.2. Model Criteria

1.8.1.3. Item Criteria
1.8.1.4. Attribute Criteria
1.8.1.5. Value Criteria

1.8.2. Graphical Selection

1.8.2.1. Data Set Criteria

1.8.2.1.1. Data Set Taxonomy

1.8.2.2. Model criteria

1.8.2.2.1. Model Taxonomy

1.8.2.3. Item Criteria

1.8.2.3.1. Item Taxonomy

1.8.2.4. Attribute Criteria

1.8.2.4.1. Attribute Taxonomy

1.8.2.5. Value Criteria

1.8.2.5.1. Value Taxonomy

1.8.3. CAD Graphics Selection

1.8.3.1. Data Set criteria
1.8.3.2. Model Criteria
1.8.3.3. Item Criteria
1.8.3.4. Attribute criteria
1.8.3.5. Value Criteria

1.9. Information Analysis

None Identified

1.10. Information Inference

None Identified

2. Knowledge Base Procedures

2.1. Information Input

2.1.1. Value Frame

2.1.1.1. Status
2.1.1.2. Nature
2.1.1.3. Types
2.1.1.4. Validity
2. 1.1.5. Data

2.1.2. Attribute Frame

2.1.2.1. Definitions
2.1.2.2. Applicability
2.1.2.3. Categories
2.1.2.4. Associations
2.1.2.5. Values

2.1.3. Item Frame

2.1.3.1. Purposes
2.1.3.2. Requirements
2.1.3.3. Hierarchies
2.1.3.4. Interfaces
2.1.3.5. Attributes

2.1.4. Model Frame

2.1.4.1. Fidelity
2.1.4.2. Rational
2.1.4.3. Schemas
2.1.4.4. Rules
2.1.4.5. Items

2.1.5. Data Set Frame

2.1.5.1. Utility
2.1.5.2. Domain
2.1.5.3. Order
2.1.5.4. Criteria
2.1.5.5. Models

2.2. Information storage

2.2.1. Address Assignment

2.2.2. Access Control Assignment

2.3. Information Retrieval

None Identified

2.4. Information Access Control

None Identified

2.5. Information Output

None Identified

2.6. Information Transfer

None Identified

2.7. Information Display

None Identified

2.8. Information Manipulation

None Identified

2.9. Information Analysis

None Identified

2.10. Information Inference

None Identified

3. Inference Mechanism Procedures

3.1. Information Input

3.1.1. Request Verification

3.1.2. Request Additional Input

3.2. Information Storage

None Identified

3.3. Information Retrieval

3.3.1. Knowledge base access protocols

3.4. Information Access Control

3.4.1. Access Code Verification

3.5. Information output

3.5.1. Send to Workstation
3.5.2. Send to Storage

3.5.2.1. Online
3.5.2.2. Offline

3.5.3. Send to Printer/Plotter

3.6. Information Transfer

3.6.1. Link to Workstation

3.6.1.1. Upload
3.6.1.2. Download

3.6.2. Link to Local Area Network

3.6.2.1. Upload
3.6.2.2. Download

3.6.3. Link to Mainframe

3.6.3.1. Upload

3.6.3.2. Download

3.7. Information Display

3.7.1. Knowledge type interpreter
3.7.2. Knowledge Trace

3.8. Information Manipulation

3.8.1. Models

3.8.1.1. Expand a Model
3.8.1.2. Restrict a Model
3.8.1.3. List attributes in Model

3.8.2. Data Sets

3.8.2.1. Expand a Data Set
3.8.2.2. Restrict a Data Set
3.8.2.3. List Models in Data Set

3.9. Information Analysis

3.9.1. Comparison

3. 9.1.1. Models
3.9.1.2. Data Sets

3.9.2. Calculations

3.9.2.1. Values

3.9.3. Test Case Definition
3.9.4. Optimized Model
3.9.5. Optimized Data Set

3.10. Information Inference

3.10.1. Generate new initial model

3.10.1.1. Instantiate Item
3.10.1.2. Input Known Attributes from Source
3.10.1.3. Input Known Values from Source

3.10.2. Generate Derived Model

3.10.2.1. Obtain Associations from Knowledge Base
3.10.2.2. Check for other useful data that may be available
3.10.2.3. Request other useful data from source
3.10.2.4. Check for inconsistent data based on associations
3.10.2.5. Request removal of inconsistencies or justifications for override
3.10.2.6. Input modified values and/or justifications
3.10.2.7. Check for values which can be directly deduced from associations
3.10.2.8. Display possible inferences
3.10.2.9. Input source requests for justification
3.10.2.10. Display justification
3.10.2.11. Input deductions accepted by source
3.10.2.12. Input justification for deductions not accepted.

3.10.3. Generate Inferred Data Set

3.10.3.1. Obtain model selection criteria
3.10.3.2. Obtain models from knowledge base
3.10.3.3. Obtain known interfaces from knowledge base
3.10.3.4. Check for directly inferable interfaces
3.10.3.5. Display possible inferences
3.10.3.6. Input source requests for justification
3.10.3.7. Display justification
3.10.3.8. Input inferences accepted by source
3.10.3.9. Input justification for inferences not accepted.
3.10.3.10. Assess status of data set
3.10.3.11. Check for applicable analytical routines available for calculating interfaces based on status of models in data set
3.10.3.12. Display available analytical routines
3.10.3.13. Request selection of routines by source
3.10.3.14. Execute routine

3.10.3.14.1. Online
3.10.3.14.2. Offline

3.10.3.15. Obtain results from routine

3.10.3.16. Display results
3.10.3.17. Input source requests for justification
3.10.3.18. Display justification
3.10.3.19. Input results accepted by source
3.10.3.20. Input justification for results not accepted.

VI. SPaCE-2 SYSTEM ARCHITECTURE OVERVIEW

The domain of SPaCE-2 is intended to be the Space Station System flight segment. The system serves to integrate a diverse set of knowledge types which exist on multiple levels.

The taxonomy of the knowledge levels assumed by SPaCE-2 is:

	KNOWLEDGE LEVELS	DESCRIPTION OF LEVELS
1	LINGUISTIC	The linguistic level is the most abstract level of knowledge within a given framework. Understanding is predicated on the morphology and syntax of the language employed.
2	CONCEPTUAL	The conceptual level of knowledge consists of ideas expressed in structured syntax within a given framework.
3	EPISTOMOLOGICAL	The epistemological level of knowledge contains the structure and ordering of knowledge within a given framework.
4	LOGICAL	The logical level of knowledge consists of what are correct or reliable inferences within a given framework.
5	IMPLEMENTATION	The implementation level is the least abstract level of knowledge within a given framework.

Note: Knowledge levels adapted from work by Brachman.
Level descriptions are the responsibility of the author.

The knowledge representation structure chosen for the SPaCE-2 system is that of a series of interrelated knowledge frameworks developed for each knowledge type.

A matrix of the knowledge types keyed to knowledge levels follows:

KNOWLEDGE TYPES

KNOWLEDGE LEVEL	VALUES	ATTRIBUTES	ITEMS	MODELS	DATA SETS
LINGUISTIC	STATUS	DEFINITIONS	PURPOSES	FIDELITY	UTILITY
CONCEPTUAL	NATURE	APPLICABILITY	REQUIREMENTS	RATIONAL	DOMAIN
EPISTOMOLOGICAL	TYPES	CATEGORIES	HIERARCHIES	SCHEMAS	ORDER
LOGICAL	VALIDITY	ASSOCIATIONS	INTERFACES	RULES	CRITERIA
IMPLEMENTATION	DATA	VALUES	ATTRIBUTES	ITEMS	MODELS

Note: Knowledge levels adapted from work by Brachman.
Knowledge types are an independent construct of the author.

Visualizations (i.e. pictorial information} is treated as a knowledge representation mechanism rather than as a discrete knowledge type.

VALUESFRAME

STATUS	=	The known state of approval/stated intention of a value (e.g. Real, Preliminary, Archive, Proposed Change).
NATURE	=	The method by which the value was obtained by the system (e.g. Supplied, Derived, Inferred}.
TYPE	=	The classification of the value (e.g. Target, Upper Bound, Lower Bound, Fixed, Estimate, Measured).
VALIDITY	=	The criteria which establishes acceptability of a data (e.g. Range, Single Value, Multiple Value, Binary Value, Within Acceptable Range, outside of Acceptable Range).
DATA	=	Specified quantity or quality.

ATTRIBUTESFRAME

DEFINITION	=	Text articulation of the meaning of the attribute.
APPLICABILITY	=	What domain of items the attribute is defined for.
CATEGORIES	=	The taxonomy of attributes.
ASSOCIATIONS	=	Attribute-to-Attribute relationships.
VALUES	→	See Value Frame

ITEMS FRAME

PURPOSE	=	The intended use of a specified item.
REQUIREMENTS	=	The prescribed characteristics of an item and/or that an item must respect.
HIERARCHIES	=	The taxonomy of items.
INTERFACES	=	Item-to-item relationships.
ATTRIBUTES	→	See Attribute Frame

MODELS FRAME

FIDELITY	=	The degree to which a model simulates reality.
RATIONAL	=	The Explanation & Justification of functions/rules employed in a model.
SCHEMAS	=	The structure and ordering within a model.
RULES	=	The procedural knowledge which drives a model.
ITEMS	→	See Item Frame.

DATA SETS FRAME

UTILITY	=	The relative value of the data set in terms of its usefulness.
DOMAIN	=	The boundaries (Space, Time, Practicality) which define the set of models which were/are available for consideration of inclusion in a data set.
ORDER	=	The organization of the Models within a data set.
CRITERIA	=	The basis on which models were selected for inclusion in the data set.
MODELS	→	See Model Frame.

The specific analytical tools that are needed to allow the SPaCE-2 to function successfully are only alluded to in this paper. Considerable detail on the tools available can be found in the works cited in the bibliography (Appendix B.) both from a computer science and from systems engineering perspectives.

The determination of which qualitative and quantitative tools should be included is a continuing problem with "expert" system design. For a SPaCE-2 to serve as viable systems engineering support tool the user must be allowed some choice over which analytical routines are used to calculate and/or infer values. This choice must also allow for the ability to add new tools and to redefine how existing tools may be applied. SPaCE-2 addresses these problems by creating an environment where the user is given such choices, provided that they explain why. This provides a basis for continual revision of the system as appropriate. Accordingly, the question of which specific tools will be used becomes strictly an "expert" domain question rather than a program structure question.

The inference mechanism required for SPaCE-2 to function needs to be able to handle the following types of activities (grouped from highest level to lowest level):

1) Hypothesis & Test - required for coping with missing and/or incomplete information

2) Frame Based Deduction - required for making indirect inferences based the data supplied and open slots which have some data that can be related to them (i.e. by analogy)

3) Rule Based Deduction - required for making direct inferences from the rule base

4) Direct Calculation - required for executing sub-routine functions

5) LISP Function Execution - required for knowledge base manipulation

Should an activity prove to be at too low a level to achieve results on a given sub-problem, the next higher activity is invoked until some result can be produced.

The inference mechanism does not need to justify the absolute correctness of the paths of action undertaken. However, it must generate a re-constructible path for use by explanation procedures, and allow for the deactivation (either directly or indirectly) of paths which lead to identified errors. A spacecraft designer is concerned with producing useful results that are logically defensible. Only results that have been arrived at by a clearly understandable set of procedures will be used.

The typical user of the SPaCE-2 system is envisioned to be an engineer involved in the Space Station systems engineering and integration effort.

The SPaCE-2 product hierarchy is show on the following page.

The Optimized Data set is the collection of "engineering item" models which best satisfy the composite utility function. The composite utility function for a Spacecraft System includes both the Spacecraft (Subsystem) Design considerations as well as the External Constraints (Payload and Instrument Parameters, Retrofit and Refurbishment Requirements, as well as Environment Information).

The SPaCE II system uses the most capable spacecraft sub-system designs as the point of departure for optimization of the composite utility function (i.e., the assumed starting point for optimization is the local maximums of the composite functions).

Definition of Terms:

An Item is an identified unit of Hardware, Software, Function or Activity associated with the Space Station System.

An Attribute is a defined parameter used to characterize one or more items. There are both source attributes (which were obtained from the source of the item) and other attributes which are defined by users to further characterize an item.

A Value is the quantity/quality (an alpha-numeric string) equated to an attribute assigned to a specific item. Values re classified as being either Official, Preliminary, Proposed Change or Archive.

A Reference Model is a representation of an item at some degree of abstraction (i.e., an item at a selected hierarchy level, with specified attributes along with their assigned value of interest).

A Reference Data set is a set of models which have been collected by some user and/or source group (NASA HQ/Level A, GSFC/WP-3, SE&I, etc.) and named.

Associations are the known possible relationships between attributes which hold for one or more items.

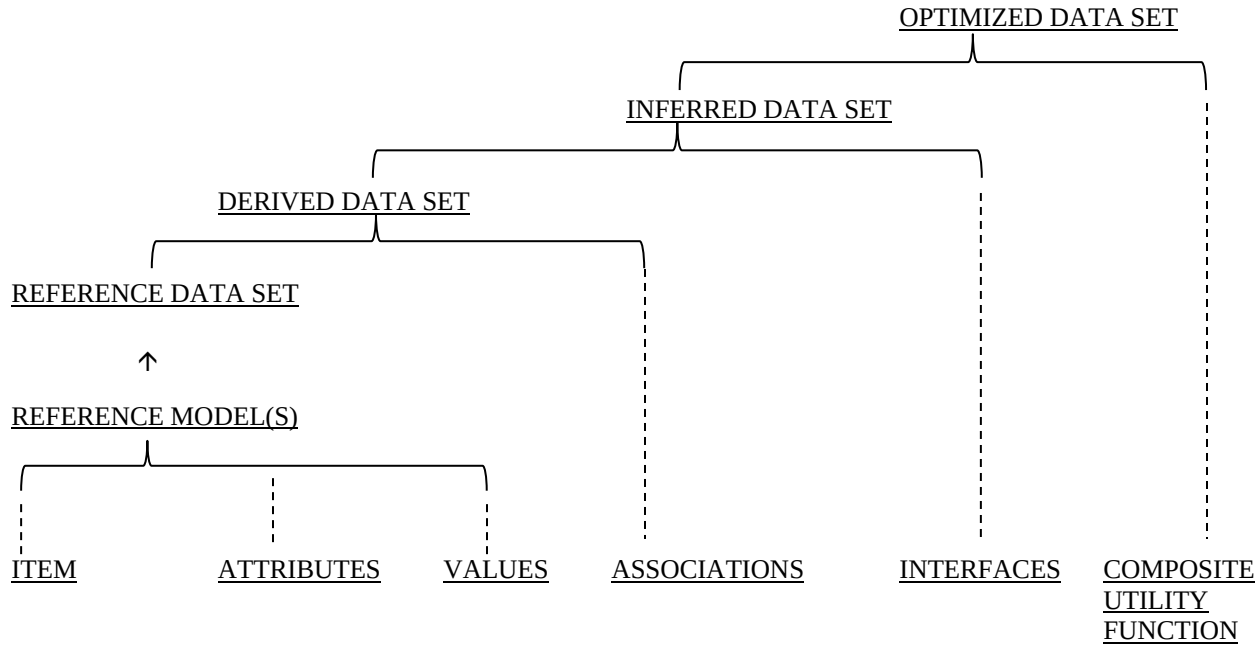
The Derived Data Set is the collection of "engineering item" models which result from the evaluation of the Reference Data Set with respect to the available knowledge base of possible Associations.

Interfaces are the known set of possible relationships between items which may hold for one or more models in the Derived Data Set being evaluated.

The Inferred Data Set is the collection of "engineering item" models which result from the analysis of the Derived Data Set with respect to the available knowledge base of possible Interfaces.

The Composite Utility Function is a collection of subsidiary functions subject to variable weighting which are intended to allow the relative value of each model contained within a Inferred Data Set to be expressed in numeric terms.

SPaCE II PRODUCT HIERARCHY



- Hardware
- Software
- Function
- Activity

- Source
- Other

- Official
- Preliminary
- Proposed Changes
- Archive

DATA SET (MODELS (ITEM (ATTRIBUTES (VALUES)))

VII. SPaCE-2 BASIC STRUCTURE

The basic structure of the item, attribute and value frames for SPaCE-2 is derived from the frameworks used in the GSFC Engineering Data Base (EDB) Release 2.0 system. This will allow the SPaCE-2 system to use the EDB as a data base manager until it becomes possible to build a more capable replacement.

The model and data set frameworks are implicit in the EDB. Therefore, the SPaCE-2 system will have to implement them as novel constructs.

There are currently two source data sets available. The first is the Mission Requirements (MRDB), which is the set of all approved Space Station Activities.. The MRDB consists of approximately 340 missions/experiments and over 500 attributes for which values are available. The second is the Reference configuration (REFCON) which is the set of identified hardware items and functions. The REFCON consists of approximately 1000 hardware items and 15 functions, and over 40 attributes of which only a limited number have values.

A short listing of the EDB attribute dictionary has been included as Appendix A.

The initial SPaCE-2 item, attribute and value framework follow:

CURRENT EDB ITEM FRAME

DATABASE	=	Data Base Identification
KEY	=	[index key]
SEQNO	=	[sequence number]
HIERTYPE	=	Hierarchy Type
HIERLVL	=	Hierarchy Level
ACCESSCD	=	Access Code
STATUS	=	Status Code
SOURCE	=	Source of Item
DATE	=	[date item entered]
TIME	=	[time item entered]
USER	=	[ID of user adding item]
SCOUNTRY	=	Activity Item Types
MSNCODE	=	Mission Code from MRDB
ITEM	=	Item Number from REFCON
UNIT	=	Unit Number of Item from REFCON
ITEMUNIT	=	Item/Unit combination from REFCON
ITEMTYPE	=	H/W, S/W, Function Item Types
HIERARCH	=	Item Hierarchy Number from REFCON

The current EDB item frame resulted from a series of compromises intended to minimize the amount of code requiring modification as the EDB system evolved. The annotated item frame (which is being implemented on an incremental basis in the EDB) for SPaCE-2 follows.

ITEM IDENTIFICATION FOR SPaCE-2

FIELD NAME		POSSIBLE VALUES	STORED VALUE
RECTYPE	=	ITEM	
DATABASE	=	MRDB	[M]
		REFCON	[R]
ACCESSCD	=	SOURCE ONLY	[1]
		SOURCE & SE&I	[2]
		ALL ATH. USERS	[3]
		SOURCE & LIST	[4]
SEQNO	=	EDB ASSIGNS [0000X] <reset for each HIERTYPE + HIERLVL pair>	
HIERTYPE	=	ACTIVITY	[A]
		HARDWARE	[H]
		FUNCTION	[F]
		SOFTWARE	[S]
HIERLVL	=	MISSION CODE	[1]
		EXPERIMENT CODE	[2]
		TASK CODE	[3]
		UNDEFINED ACTIVITY	[0]
		PROGRAM ELEMENT	[1]
		ELEMENT	[2]
		SUBELEMENT	[3]
		MAJOR ASSEMBLY	[4]
		SYSTEM INSTALLATION	[5]
		SUBSYSTEM INSTALLATION	[6]
		ASSEMBLY	[7]
		SUBASSEMBLY	[8]
		COMPONENT	[9]
		UNDEFINED HARDWARE	[0]
		SYSTEM	[1]
		SUBSYSTEM	[2]
		UNDEFINED FUNCTION	[0]
		LANGUAGE	[1]
		PROGRAM	[2]
		UNDEFINED SOFTWARE	[0]
KEY	=	EDB CONSTRUCTS CONTINUED SEE EXCEL	

SOURCE	=	ATTACHED PAYLOADS PROJECT	
		LEVEL B	
		LEVEL C PROJECT OFFICE	
		DATA SYSTEM ARCHITECTURE PROJECT	
		SCIENCE WORKING GROUP	
		CONTRACTOR GE	
		LABORATORY PROJECT	
		OPERATIONS OFFICE	
		PLATFORMS PROJECT	
		TESTING GROUP	
		CONTRACTOR RCA	
		SERVICING PROJECT	
		ADVANCED DEVELOPMENT PROJECT	
		SE&I OFFICE	
PHASE	=	MAN TENDED	
		INITIAL OPERATIONAL CAPABILITY	
		GROWTH STATION	
STATUS	=	REAL APPROVED VALUE	
		PRELIMINARY VALUE	
		PROPOSED CHANGE FOR CCB	
		ARCHIVE VALUE	
ITEMTYPE	=	SAAX	
		TDMX	
		COMM	
		NOAA	
		JAPAN	
		CANADA	
		ESA	
		DUAL KEEL	
		SCRUB MOTHER I	
		FRANKENSCRUB	
TRUENAME	=	NAME (for REFCON)	
		PAYLOAD ELEMENT (for MRDB}	
HPARENTS	=	Y	
		N	
PROGELEM	=	SPACE STATION	[01.XX.XX.XX.XX.XX.XX.XX.XX]
		PLATFORMS	[02.XX.XX.XX.XX.XX.XX.XX.XX]

ELEMENT	=	TRUSS STRUCTURE	
		PAYLOAD ACCOMMODATION	[01.01.XX.XX.XX.XX.XX.XX.XX]
		ISTF	[01.02.XX.XX.XX.XX.XX.XX.XX]
		UNDEFINED	[01.03.XX.XX.XX.XX.XX.XX.XX]
		HABITATION MODULE (ACTIVE)	[01.04.XX.XX.XX.XX.XX.XX.XX]
		HABITATION MODULE (QUIET)	[01.05.XX.XX.XX.XX.XX.XX.XX]
		SCIENCE MODULE	[01.06.XX.XX.XX.XX.XX.XX.XX]
		MATERIALS LABORATORY	[01.07.XX.XX.XX.XX.XX.XX.XX]
		OMV ACCOMMODATIONS	[01.08.XX.XX.XX.XX.XX.XX.XX]
		LOGISTICS MODULE	[01.09.XX.XX.XX.XX.XX.XX.XX]
		OMV ACCOMMODATIONS	[01.10.XX.XX.XX.XX.XX.XX.XX]
		OTV ACCOMMODATIONS	[01.11.XX.XX.XX.XX.XX.XX.XX]
		COLUMBIA LAB	[01.12.XX.XX.XX.XX.XX.XX.XX]
		COLUMBIA RESOURCE MODULE	[01.13.XX.XX.XX.XX.XX.XX.XX]
		JAPANESE EXPERIMENT MODULE	[01.14.XX.XX.XX.XX.XX.XX.XX]
		JEM LOGISTICS MODULE	[01.15.XX.XX.XX.XX.XX.XX.XX]
		MRMS	[01.16.XX.XX.XX.XX.XX.XX.XX]
		SOLAR POWER MODULE	[01.17.XX.XX.XX.XX.XX.XX.XX]
		SERVICE FACILITY	[01.18.XX.XX.XX.XX.XX.XX.XX]
		TUNNEL 1	[01.19.XX.XX.XX.XX.XX.XX.XX]
		TUNNEL 2	[01.20.XX.XX.XX.XX.XX.XX.XX]
		TUNNEL 3	[01.21.XX.XX.XX.XX.XX.XX.XX]
		NODE 1	[01.22.XX.XX.XX.XX.XX.XX.XX]
		NODE 2	[01.23.XX.XX.XX.XX.XX.XX.XX]
		NODE 3	[01.24.XX.XX.XX.XX.XX.XX.XX]
		NODE 4	[01.25.XX.XX.XX.XX.XX.XX.XX]
		NODE 5	[01.26.XX.XX.XX.XX.XX.XX.XX]
		NODE 6	[01.27.XX.XX.XX.XX.XX.XX.XX]
		AIRLOCK 1	[01.28.XX.XX.XX.XX.XX.XX.XX]
		AIRLOCK 2	[01.29.XX.XX.XX.XX.XX.XX.XX]
		CO-ORBITING PLATFORM	[02.01.XX.XX.XX.XX.XX.XX.XX]
		POLAR ORBITING PLATFORM	[02.02.XX.XX.XX.XX.XX.XX.XX]
SUBELEMEMT	=	TBD	[XX.XX.AA.XX.XX.XX.XX.XX.XX]
MAJASSY	=	TBD	[XX.XX.XX.BB.XX.XX.XX.XX.XX]
SYSTEMHDW	=	COMMUNICATIONS & TRACKING	[XX.XX.XX.XX.0l.XX.XX.XX.XX]
		DATA MANAGEMENT SYSTEM	[XX.XX.XX.XX.02.XX.XX.XX.XX]
		ECLS	[XX.XX.XX.XX.03.XX.XX.XX.XX]
		EVA	[XX.XX.XX.XX.04.XX.XX.XX.XX]
		FLUIDS	[XX.XX.XX.XX.05.XX.XX.XX.XX]
		GUIDANCE, NAV. & CNTL	[XX.XX.XX.XX.06.XX.XX.XX.XX]
		MAN SYSTEMS	[XX.XX.XX.XX.07.XX.XX.XX.XX]
		MECHANISMS	[XX.XX.XX.XX.08.XX.XX.XX.XX]
		POWER	[XX.XX.XX.XX.09.XX.XX.XX.XX]
		PROPULSION	[XX.XX.XX.XX.10.XX.XX.XX.XX]
		STRUCTURES	[XX.XX.XX.XX.1l.XX.XX.XX.XX]
		THERMAL	[XX.XX.XX.XX.12.XX.XX.XX.XX]
SUBSYSHDW	=	TBD	[XX.XX.XX.XX.AA.XX.XX.XX.XX]

ASSEMBLY	=	TBD	[XX.XX.XX.XX.XX.BB.XX.XX.XX]
SUBASSY	=	TBD	[XX.XX.XX.XX.XX.XX.XX.CC.XX]
COMPONENT	=	TBD	[XX.XX.XX.XX.XX.XX.XX.XX.DD]
HWUNDEF	=	UNIDENTIFIED HARDWARE ITEM	
APARENTS	=	Y	
		N	
MSNCODE	=	MISSION	[SAAX???,TDMX????,COMM????,
EXPCODE	=	EXPERIMENT	[SAAX???A]
TASKCOOE	=	TASK	[No tasks defined yet]
ACTUNOEF	=	UNIDENTIFIED ACTIVITY ITEM	
FPARENTS	=	Y	
		N	
SYSTEM	=	FUNCTIONAL SYSTEM	[REFCON "SYS" Items]
SUBSYST	=	FUNCTIONAL SUBSYSTEM	[REFCON "S-SYS" Items]
FCTUNDEF	=	UNIDENTIFIED FUNCTION ITEM	
SPARENTS	=	Y	
		N	
LANGUAGE	=	ADA	
		COMMON LISP	
		PROLOG	
		UNIQUE	
PROGRAM	=	TBD	
SWUNDEF	=	UNIDENTIFIED SOFTWARE ITEM	

Example applications of the item frame to the MRDB and REFCON source data sets follow.

EDB item definition for existing MRDB items in the EDB.

FIELD NAME			
RECTYPE	=	ITEM	
DATABASE	=	MRDB	
ACCESSCD	=	3	(ALL ATH. USERS)
SEQNO	=	(EDB has assigned)	
HIERTYPE	=	A	(ACTIVITY)
HIERLVL	=	1	(MISSION CODE)
KEY	=		(EDB has constructed)
SOURCE	=	LEVELB	
		IOC {INITIAL OPERATIONAL	
PHASE	=	CAPABILITY)	
STATUS	=	R	(REAL APPROVED VALUE)
ITEMTYPE	=	SAAX	
		TDMX	
		COMM	
		NOAA	
		JAPAN	
		CANADA	
		ESA	
TRUENAME	=	Payload Element Name	(ATTID 01002)
HPARENTS	=	N	(To be changed later)
PRG-ELM	=	**	(To be defined later)
ELEMENTS	=	**	
SUBELEM	=	**	
MAJASSY	=	**	
SYSTEMHDW	=	**	
SUBSYSHDW	=	**	
ASSEMBLY	=	**	

SUBASSY	=	**	
COMPT	=	**	
HWUNDEF	=	**	
APARENTS	=	N	
MSNCODE	=	aaaabbbb	(MISSION e.g. SAAX307)
EXPCODE	=	**	(EXPERIMENT)
TASKCODE	=	**	(TASK)
ACTUNDEF	=	**	(UNIDENTIFIED ACTIVITY ITEM)
FPARENTS	=	N	
SYSTEM	=	**	
SUBSYST	=	**	
FCTUNDEF	=	**	
SPARENTS	=	N	
LANGUAGE	=	**	
PROGRAM	=	**	
SWUNDEF	=	**	

EDB Item definition for REFCON items

FIELD NAME			
RECTYPE	=		
ITEM DATABASE	=		
REFCON	=		
ACCESSCD	=	3	(ALL ATH.USERS}
SEQNO	=	(assigned in sequence)	
HIERTYPE	=	H	(HARDWARE for "QUERY" items)
HIERLVL	=	1	PROGRAM ELEMENT (function of HIERARCH field)
		2	ELEMENT
		3	SUBELEMENT
		4	MAJOR ASSEMBLY
		5	SYSTEM INSTALLATION
		6	SUBSYSTEM INSTALLATION
		7	ASSEMBLY
		8	SUBASSEMBLY
		9	COMPONENT
		0	UNDEFINED HARDWARE
KEY	=		(constructed from HIERTYPE, HIERLVL, and SEQNO)
SOURCE	=	LEVELB	
PHASE	=	IOC	(INITIAL OPERATIONAL CAPABILITY)
STATUS	=	R	(REAL APPROVED VALUE)
ITEMTYPE	=	DUAL KEEL	
TRUENAME	=	from field "NAME" in QUERY	
HPARENTS	=	Y	
PRG-ELM	=		field "HIERARCH"
1	SPACE STATION		01.--.--.--.--.--.--.--
2	PLATFORMS		02.--.--.--.--.--.--.--
ELEMENTS	=		
1	TRUSS STRUCTURE		01.01.--.--.--.--.--.--
2	PAYLOAD ACCOMMODATION		01.02.--.--.--.--.--.--
3	ISTF		01.03.--.--.--.--.--.--
4	UNDEFINED		01.04.--.--.--.--.--.--

5	HABITATION MODULE (ACTIVE)	01.05.--.--.--.--.--.--.--
6	HABITATION MODULE (QUIET)	01.06.--.--.--.--.--.--.--
7	SCIENCE MODULE	01.07.--.--.--.--.--.--.--
8	MATERIALS LABORATORY	01.08.--.--.--.--.--.--.--
9	LOGISTICS MODULE	01.09.--.--.--.--.--.--.--
10	OMV ACCOMMODATIONS	01.10.--.--.--.--.--.--.--
11	OTV ACCOMMODATIONS	01.11.--.--.--.--.--.--.--
12	COLUMBIA LAB	01.12.--.--.--.--.--.--.--
13	COLUMBIA RESOURCE MODULE	01.13.--.--.--.--.--.--.--
14	JAPANESE EXPERIMENT MODULE	01.14.--.--.--.--.--.--.--
15	JEM LOGISTICS MODULE	01.15.--.--.--.--.--.--.--
16	MRMS	01.16.--.--.--.--.--.--.--
17	SOLAR POWER MODULE	01.17.--.--.--.--.--.--.--
18	SERVICE FACILITY	01.18.--.--.--.--.--.--.--
19	TUNNEL 1	01.19.--.--.--.--.--.--.--
20	TUNNEL 2	01.20.--.--.--.--.--.--.--
21	TUNNEL 3	01.21.--.--.--.--.--.--.--
22	NODE 1	01.22.--.--.--.--.--.--.--
23	NODE 2	01.23.--.--.--.--.--.--.--
24	NODE 3	01.24.--.--.--.--.--.--.--
25	NODE 4	01.25.--.--.--.--.--.--.--
26	NODE 5	01.26.--.--.--.--.--.--.--
27	NODE 6	01.27.--.--.--.--.--.--.--
28	AIRLOCK 1	01.28.--.--.--.--.--.--.--
29	AIRLOCK 2	01.29.--.--.--.--.--.--.--
1	CO-ORBITING PLATFORM	02.01.--.--.--.--.--.--.--
2	POLAR ORBITING PLATFORM	02.02.--.--.--.--.--.--.--
SUBELEM	= AA (TBD)	--.--.AA.--.--.--.--.--.--
MAJASSY	= BB (TBD)	--.--.--.BB.--.--.--.--.--
SYSTEMHW	=	
1	COMMUNICATIONS & TRACKING	--.--.--.--.01.--.--.--.--
2	DATA MANAGEMENT SYSTEM	--.--.--.--.02.--.--.--.--
3	ECLS	--.--.--.--.03.--.--.--.--
4	EVA	--.--.--.--.04.--.--.--.--
5	FLUIDS	--.--.--.--.05.--.--.--.--
6	GUIDANCE, NAV. & CNTL	--.--.--.--.06.--.--.--.--
7	MAN SYSTEMS	--.--.--.--.07.--.--.--.--
8	MECHANISMS	--.--.--.--.08.--.--.--.--
9	POWER	--.--.--.--.09.--.--.--.--
10	PROPULSION	--.--.--.--.10.--.--.--.--
11	STRUCTURES	--.--.--.--.11.--.--.--.--
12	THERMAL	--.--.--.--.12.--.--.--.--
SUBSYSRDW	= CC (TBD)	--.--.--.--.--.CC.--.--.--
ASSEMBLY	= DD (TBD)	--.--.--.--.--.--.DD.--.--
SUBASSY	= EE {TBD)	--.--.--.--.--.--.--.EE.--
COMPT	= FF (TBD)	--.--.--.--.--.--.--.--.FF

HWUNDEF	=	** (UNIDENTIFIED HARDWARE ITEM)	
APARENTS	=	N	
MSNCODE	=	**	
EXPCODE	=	**	
TASKCODE	=	**	
ACTUNDEF	=	**	
FPARENTS	=	N	(to be changed later)
SYSTEM	=	**	(TBD)
SUBSYST	=	**	(TBD)
FCTUNDEF	=	**	
SPARENTS	=	**	
LANGUAGE	=	**	
PROGRAM	=	**	
SWUNDEF	=	**	

The current EDB attribute and value frames provide a good starting point for SPaCE-2 implementation. However, they require extension to facilitate the integration of the additional knowledge types on identifiable levels required for the SPaCE-2 system. The current EDB attribute and value frames follow.

ATTRIBUTE FRAME

CATEGORY	=	General type of data (i.e, DESCRIPTION)
ATTRIBUTE	=	Name of the data element (i.e., status)
ATTID	=	Unique 5-digit number of data element
DESCRIPTION DATABASE	=	Description of the data element
SOURCE	=	Single character code; links the data element to a source data set
VALREP	=	One character code signifying the organization that created the data element
FLDLEN	=	Type of data stored in data element
UNITS	=	Length of data held in data element
SIGDIG	=	Number of significant digits for numeric data elements only.
ATTRMENU	=	Menu selection for menu data elements only
LANGFLD	=	Source data set field name
RPTTITLE	=	Title of data element used in selection menus
COLHEAD1	=	Column Heading for reports
COLHEAD2	=	2nd line of Column Heading /(Units)

VALUE FRAME

KEY	=	Key from Item
ATTID	=	Attribute ID Number
SOURCE	=	Source Group of the Value
STATUS	=	Status of the Value
ACCESSCD	=	Access Code
DATAVAL	=	Data Value
DATE	=	Date Value was entered
TIME	=	Time Value was entered
USER	=	User ID of Value Source

Mapping the relationships between attributes (known as associations) can be accomplished both as quantitative formula and qualitative rules is a reasonably straight forward process. However, mapping the relationships between items (known as interfaces) is an extremely difficult n-dimensional problem. In order to make the problem tractable a taxonomy of possible interface relationships independent of specific items has been developed (Reference l). Physical interfaces can be mapped as a set of flows (mass, energy and information) which can be characterized by a finite number of flow type specification frames. An outline of the required association and interface frames follows.

RELATIONSHIPS

ASSOCIATION FRAMES (Attribute-to-Attribute)

QUANTITATIVE

QUALITATIVE

INTERFACE FRAMES (Item-to-Item)

PHYSICAL INTERFACES

MASS FLOWS

SOLID-FLOW ATTRIBUTES

LIQUID-FLOW ATTRIBUTES

GAS-FLOW ATTRIBUTES

ENERGY-FLOWS

KINETIC-FLOW ATTRIBUTES

MAGNETIC-FLOW ATTRIBUTES

ELECTRICAL-FLOW ATTRIBUTES

THERMAL-FLOW ATTRIBUTES

LIGHT-FLOW ATTRIBUTES

RADIATION-FLOW ATTRIBUTES

INFORMATION FLOWS

COMMAND-FLOW ATTRIBUTES

DATA-FLOW ATTRIBUTES

TELEMETRY-FLOW ATTRIBUTES

Another type of interface is a functional interface. These consist of potential parent and child relationships which may exist between items.

The taxonomy of possible functional interfaces between defined Space Station system item hierarchy levels follows.

FUNCTIONAL INTERFACES

PARENT ITEMS

HARDWARE
SOFTWARE
FUNCTIONS
ACTIVITIES

CHILDREN

HARDWARE
SOFTWARE
FUNCTIONS
ACTIVITIES

GSFC EDB
ITEM PARENT/CHILD
RELATIONSHIPS

POSSIBLE PARENTS	ITEM	POSSIBLE CHILDREN
	PROGRAM ELEMENT	ELEMENT UNDEFINED HARDWARE SYSTEM UNDEFINED FUNCTION MISSION EXPERIMENT TASK UNDEFINED ACTIVITY
PROGRAM ELEMENT UNDEFINED HARDWARE	ELEMENT	SUBELEMENT MAJOR ASSEMBLY SYSTEM HARDWARE UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY
ELEMENT UNDEFINED HARDWARE	SUBELEMENT	MAJOR ASSEMBLY SYSTEM HARDWARE UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY
ELEMENT SUBELEMENT UNDEFINED HARDWARE	MAJOR ASSEMBLY	SYSTEM HARDWARE ASSEMBLY SUBASSEMBLY UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY

POSSIBLE PARENTS	ITEM	POSSIBLE CHILDREN
ELEMENT SUBELEMENT MAJOR ASSEMBLY UNDEFINED HARDWARE SYSTEM UNDEFINED FUNCTION	SYSTEM HARDWARE	SUBSYSTEM HARDWARE UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE
SYSTEM HARDWARE UNDEFINED HARDWARE SUBSYSTEM UNDEFINED FUNCTION	SUBSYSTEM HARDWARE	ASSEMBLY UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE
MAJOR ASSEMBLY MISSION EXPERIMENT TASK UNDEFINED ACTIVITY SUBSYSTEM HARDWARE UNDEFINED HARDWARE	ASSEMBLY ACTIVITY EQUIPMENT	SUBASSEMBLY UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE
MAJOR ASSEMBLY ASSEMBLY UNDEFINED HARDWARE	SUBASSEMBLY	COMPONENT UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE
SUBASSEMBLY UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY	COMPONENT	LANGUAGE PROGRAM UNDEFINED SOFTWARE

POSSIBLE PARENTS	ITEM	POSSIBLE CHILDREN
PROGRAM ELEMENT ELEMENT SUBELEMENT MAJOR ASSEMBLY SYSTEM HARDWARE ASSEMBLY SUBASSEMBLY UNDEFINED HARDWARE SYSTEM SUBSYSTEM UNDEFINED FUNCTION	UNDEFINED HARDWARE	ELEMENT SUBELEMENT MAJOR ASSEMBLY SYSTEM HARDWARE SUBSYSTEM HARDWARE ASSEMBLY SUBASSEMBLY COMPONENT UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY SYSTEM SUBSYSTEM UNDEFINED FUNCTION LANGUAGE PROGRAM UNDEFINED SOFTWARE
PROGRAM ELEMENT ELEMENT SUBELEMENT MAJOR ASSEMBLY UNDEFINED HARDWARE	MISSION	ASSEMBLY UNDEFINED HARDWARE EXPERIMENT TASK UNDEFINED ACTIVITY LANGUAGE PROGRAM UNDEFINED SOFTWARE
PROGRAM ELEMENT UNDEFINED HARDWARE MISSION UNDEFINED ACTIVITY	EXPERIMENT	ASSEMBLY UNDEFINED HARDWARE TASK UNDEFINED ACTIVITY LANGUAGE PROGRAM UNDEFINED SOFTWARE
PROGRAM ELEMENT UNDEFINED HARDWARE MISSION EXPERIMENT UNDEFINED ACTIVITY	TASK	ASSEMBLY UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE

POSSIBLE PARENTS	ITEM	POSSIBLE CHILDREN
PROGRAM ELEMENT ELEMENT SUBELEMENT MAJOR ASSEMBLY UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY	UNDEFINED ACTIVITY	ASSEMBLY UNDEFINED HARDWARE EXPERIMENT TASK UNDEFINED ACTIVITY LANGUAGE PROGRAM UNDEFINED SOFTWARE
PROGRAM ELEMENT UNDEFINED HARDWARE	SYSTEM	SYSTEM HARDWARE UNDEFINED HARDWARE SUBSYSTEM UNDEFINED FUNCTION LANGUAGE PROGRAM UNDEFINED SOFTWARE
SYSTEM UNDEFINED FUNCTION	SUBSYSTEM	SUBSYSTEM HARDWARE UNDEFINED HARDWARE LANGUAGE PROGRAM UNDEFINED SOFTWARE
PROGRAM ELEMENT UNDEFINED HARDWARE SYSTEM UNDEFINED FUNCTION	UNDEFINED FUNCTION	UNDEFINED HARDWARE SUBSYSTEM UNDEFINED FUNCTION LANGUAGE PROGRAM UNDEFINED SOFTWARE
SYSTEM HARDWARE SUBSYSTEM HARDWARE ASSEMBLY SUBASSEMBLY COMPONENT UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY SYSTEM SUBSYSTEM UNDEFINED FUNCTION	LANGUAGE	PROGRAM UNDEFINED SOFTWARE

POSSIBLE PARENTS	ITEM	POSSIBLE CHILDREN
SYSTEM HARDWARE SUBSYSTEM HARDWARE ASSEMBLY SUBASSEMBLY COMPONENT UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY SYSTEM SUBSYSTEM UNDEFINED FUNCTION LANGUAGE UNDEFINED SOFTWARE	PROGRAM	
SYSTEM HARDWARE SUBSYSTEM HARDWARE ASSEMBLY SUBASSEMBLY COMPONENT UNDEFINED HARDWARE MISSION EXPERIMENT TASK UNDEFINED ACTIVITY SYSTEM SUBSYSTEM UNDEFINED FUNCTION LANGUAGE UNDEFINED SOFTWARE	UNDEFINED SOFTWARE	PROGRAM UNDEFINED SOFTWARE

Two other types of interfaces have been defined, Managerial and organizational interfaces.A listing of the required mapping systems follows.

MANAGERIAL INTERFACES

WORK BREAKDOWN STRUCTURE

ENGINEERING MASTER SCHEDULE

ORGANIZATIONAL INTERFACES

ORGANIZATIONAL TREE

SPACE STATION PROGRAM

LEVEL A

LEVEL B

LEVEL C WORK PACKAGES

WP-1 MSFC

WP-2 JSC

WP-3 GSFC

WP-4 LeRC

JAPAN

ESA

CANADA

KSC

LEVEL D CENTERS

LaRC

ARC

JPL

PHASE C/D CONTRACTORS

VIII. SAMPLE APPLICATION PROBLEM

In order to proceed with the development of an appropriate process description and facilitate the iteration of the required procedures list a sample application problem has been identified.

This problem is modeling the Space Station System assembly sequence.

The problem givens are a catalog of hardware items down to the element level, associated mass and dimensional information, the Space Shuttle launch capacity, potential alternate launch capabilities and a set of requirements which apply to the items.

The required products are an assembly sequence which conforms to all the requirements and minimizes the number of Space Shuttle launches required.

The development of the appropriate assembly sequence requires the propagation of a large number of implied constraints.

The problem can be worked on an iterative basis, integrating both additional knowledge types and successively more detailed knowledge within a given knowledge type.

Future versions of this paper will include a detailed review of this problem as it would be worked using a SPaCE-2 system.

The current approved Space Station System assembly sequence, known as the critical Evaluation Task Force (CETF) configuration is included as Appendix B.

IX. CONCLUSION

The implementation of the SPaCE-2 system as part of a distributed heterogeneous TMIS represents a practical application of knowledge based systems technology to the discipline of Space Station systems engineering and integration. An appropriate implementation would allow the a wide range of analysis tools (both on-line and off-line) and data base systems to be integrated (on a virtual basis) into a single procedure and concept evaluation tool.

The system can be implemented on an incremental basis. Each version of the system can provide needed capabilities in a realistic time frame which could keep pace with the overall Space Station Program.

The detailed design phase (Phase C) will require an efficient means of iterating the design process for multiple components in parallel while maintaining consistency with all approved requirements and specified interfaces. The Space Station Program is in the process of developing massive documents and data bases which will be the starting point for the Phase C activity. A SPaCE-2 system could greatly facilitate the design iteration process.

The construction phase (Phase D) requires the preceding as well as capture of the detailed knowledge associated with the design and construction of each component. As each component moves into construction the number of fixed interfaces in the Space Station system that must be adhered to increases. In order to support the future operations planning activities as well as meet the requirements of advanced automation tools to be included in the station the "as-built" knowledge of each component is mandatory. The SPaCE-2 system can provide a resource for capturing, managing and manipulating that knowledge.

The operations phase (Phase E) requires ready access to the knowledge of what was constructed and why in order to support operations planning, fault prevention, fault isolation, and fault correction. The SPaCE-2 could evolve into an all-up dynamic operations simulator of the entire Space Station System at multiple levels of abstraction.

These fundamental challenges must be met in order to minimize the Space station System lifecycle cost. Coupled with a real time command and control capability down to the Orbital-Replaceable-Unit (ORU) level they provide the basis for supporting an evolving level of automation and autonomy within the Space Station System.

However, meeting the challenges will require an evolution- in how the spacecraft systems engineering process is conducted. A succession of increasing more capable knowledge based systems designed to function in an operational environment are necessary.

This report is intended to be a starting point for discussion and impetus for commitment to the task of building a SPaCE-2 like system.

It will be iterated and submitted as a formal proposal to the Space Station Program in the appropriate timeframe.

X. REFERENCES

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XI. BIBLIOGRAPHY

This bibliography covers works which have been consulted during the initial definition of SPaCE-2 but are not specifically cited in the body of the paper. This list is not all inclusive. It is intended to provide entry points into the two main subjects which have considerable bearing on the SPaCE-2 system. The works are classified on the basis of their primary subject area; artificial intelligence or systems engineering.

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APPENDIX A

EDB ATTRIBUTE DICTIONARY

SPACE STATION TECHNICAL AND MANAGEMENT INFORMATION SYSTEM

ENGINEERING DATA BASE SYSTEM (EDB 2.0)

ATTRIBUTE DICTIONARY

NOVEMBER 5, 1986

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
DESCRIPTION	01001	MISSION CODE	8	TEXT			
DESCRIPTION	01002	PAYLOAD ELEMENT NAME	32	TEXT			
DESCRIPTION	01003	COUNTRY	32	TEXT			
DESCRIPTION	01004	CONTACT	32	TEXT		5	
DESCRIPTION	01005	PHONE	32	TEXT			
DESCRIPTION	01006	STATUS	1	MENU			
DESCRIPTION	01007	MISSION OBJECTIVE	72	TEXT		7	
DESCRIPTION	01008	DESCRIPTION	72	TEXT		14	
DESCRIPTION	01009	TYPE NUMBER	2	MENU			
DESCRIPTION	01010	IMPORTANCE OF SPACE STATION	2	MENU			
DESCRIPTION	01011	DATE	5	TEXT	YY/MM		
DESCRIPTION	01012	ELEMENT	1	MENU			
DESCRIPTION	01013	ITEM	8	TEXT			
DESCRIPTION	01014	UNIT	3	INTEGER			
DESCRIPTION	01015	SERIAL NUMBER	20	TEXT			
DESCRIPTION	01016	HIERARCHY	28	TEXT			
DESCRIPTION	01017	LEVEL	4	INTEGER		4	
DESCRIPTION	01018	CONFIGURATION	8	TEXT			
DESCRIPTION	01019	PHASE	8	MENU			
DESCRIPTION	01020	VERSION	6	TEXT			
DESCRIPTION	01021	NAME	60	TEXT			
DESCRIPTION	01022	WBS-NO	30	TEXT			
DESCRIPTION	01023	ABBREV	5	TEXT			
DESCRIPTION	01024	LAST NAME	30	TEXT			
DESCRIPTION	01025	FIRST NAME	15	TEXT			
DESCRIPTION	01026	MIDDLE NAME	15	TEXT			

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
DESCRIPTION	01027	AREA CODE	3	TEXT			
DESCRIPTION	01028	EXCHANGE	3	TEXT			
DESCRIPTION	01029	FTS EXCHANGE	3	TEXT			
DESCRIPTION	01030	PHONE EXTENSION	4	TEXT			
DESCRIPTION	01031	DATA ENTRY DATE	8	YY/MM/DD	DATE		
DESCRIPTION	01032	DATA MODIFICATION DATE	8	YY/MM/DD	DATE		
DESCRIPTION	01033	PART NUMBER	15	TEXT			
DESCRIPTION	01034	DESCRIPTION	400	TEXT			
DESCRIPTION	01035	DRAWING NUMBER	15	TEXT			
DESCRIPTION	01036	DRAWING DATE	8	YY/MM/DD	DATE		
DESCRIPTION	01037	USAGE	1	MENU			
DESCRIPTION	01038	CHANGE	1	MENU			
LOCATION	02001	LOCATION X	10	SCI NOTATION	METERS		5
LOCATION	02002	LOCATION Y	10	SCI NOTATION	METERS		5
LOCATION	02003	LOCATION Z	10	SCI NOTATION	METERS		5
DIMENSIONS	03001	INTERNAL/PRESSURIZED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03002	EXTERNAL/ATTACHED PRESSURIZED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03003	EXTERNAL/ATTACHED UNPRESSURIZED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03004	FREE FLYER (REMOTE) LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03005	FREE FLYER (CO-ORBITING) LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03006	28.5 DEGREE PLATFORM LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03007	SUN SYNC/POLAR PLATFORM LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03008	INTERNAL/PRESURRIZED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03009	EXTERNAL/ATTACHED PRESURRIZED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03010	EXTERNAL/ATTACHED UNPRESSURIZED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
DIMENSIONS	03011	FREE FLYER (REMOTE) WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03012	FREE FLYER (CO-ORBITING) WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03013	28.5 DEGREE PLATFORM WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03014	SUN SYNC/POLAR PLATFORM WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03015	INTERNAL PRESSURIZED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03016	EXTERNAL/ATTACHED PRESSURIZED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03017	EXTERNAL/ATTACHED UNPRESSURIZED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03018	FREE FLYER (REMOTE) HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03019	FREE FLYER (CO-ORBITING) HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03020	28.5 DEGREE PLATFORM HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03021	SUN SYNC/POLAR PLATFORM HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03022	INTERNAL PRESSURIZED PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03023	EXTERNAL/ATTACHED PRESSURIZED PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03024	EXTERNAL/ATTACHED UNPRESSURIZED PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03025	FREE FLYER (REMOTE) PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03026	FREE FLYER (CO-ORBITING) PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03027	28.5 DEGREE PLATFORM PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03028	SUN SYNC/POLAR PLATFORM PACKAGED LENGTH	10	SCI NOTATION	METERS		5
DIMENSIONS	03029	INTERNAL PRESSURIZED PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03030	EXTERNAL/ATTACHED PRESSURIZED PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03031	EXTERNAL/ATTACHED UNPRESSURIZED PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03032	FREE FLYER (REMOTE) PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03033	FREE FLYER (CO-ORBITING) PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03034	28.5 DEGREE PLATFORM PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03035	SUN SYNC/POLAR PLATFORM PACKAGED WIDTH OR DIAM.	10	SCI NOTATION	METERS		5
DIMENSIONS	03036	INTERNAL PRESSURIZED PACKAGED HEIGHT	10	SCI NOTATION	METERS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
DIMENSIONS	03037	EXTERNAL/ATTACHED PRESSURIZED PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03038	EXTERNAL/ATTACHED UNPRESSURIZED PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03039	FREE FLYER (REMOTE) PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03040	FREE FLYER (CO-ORBITING) PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03041	28.5 DEGREE PLATFORM PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03042	SUN SYNC/POLAR PLATFORM PACKAGED HEIGHT	10	SCI NOTATION	METERS		5
DIMENSIONS	03043	DIMENSION X	10	SCI NOTATION	METERS		5
DIMENSIONS	03044	DIMENSION Y	10	SCI NOTATION	METERS		5
DIMENSIONS	03045	DIMENSION Z	10	SCI NOTATION	METERS		5
VOLUMES	05001	INTERNAL PRESSURIZED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05002	EXTERNAL/ATTACHED PRESSURIZED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05003	EXTERNAL/ATTACHED UNPRESSURIZED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05004	FREE FLYER (REMOTE) VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05005	FREE FLYER (CO-ORBITING) VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05006	28.5 DEGREE PLATFORM VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05007	SUN SYNC/POLAR PLATFORM VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05008	INTERNAL PRESSURIZED PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05009	EXTERNAL/ATTACHED PRESSURIZED PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05010	EXTERNAL/ATTACHED UNPRESSURIZED PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05011	FREE FLYER (REMOTE) PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05012	FREE FLYER (CO-ORBITING) PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05013	28.5 DEGREE PLATFROM PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05014	SUN SYNC/POLAR PLATFORM PACKAGED VOLUME	10	SCI NOTATION	CUBIC METERS		5
VOLUMES	05015	VOLUME	10	SCI NOTATION	CUBIC METERS		5
EQUIPMENT	06001	PRESSURIZED MODULE CODE	1	MENU			

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
EQUIPMENT	06002	SHARED FACILITY CODE	1	MENU			
EQUIPMENT	06003	MISSION CODE OF SHARED MISSION	8	TEXT		4	
EQUIPMENT	06004	ATTACH POINTS	3	INTEGER			3
EQUIPMENT	06005	SET UP CODE	1	MENU		3	
EQUIPMENT	06006	HARDWARE DESCRIPTION	72	TEXT		4	
MASS	07001	INTERNAL PRESSURIZED LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07002	EXTERNAL/ATTACHED PRESSURIZED LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07003	EXTERNAL/ATTACHED UNPRESSURIZED LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07004	FREE FLYER (REMOTE) LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07005	FREE FLYER (CO-ORBITING) LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07006	28.5 DEGREE PLATFORM LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07007	SUN SYNC/POLAR PLATFORM LAUNCH MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07008	CENTER OF GRAVITY - X	10	SCI NOTATION	METERS		5
MASS	07009	CENTER OF GRAVITY - Y	10	SCI NOTATION	METERS		5
MASS	07010	CENTER OF GRAVITY - Z	10	SCI NOTATION	METERS		5
MASS	07011	IXX	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07012	IYY	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07013	IZZ	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07014	IXY	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07015	IXZ	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07016	IYZ	10	SCI NOTATION	KG-SQ.METERS		5
MASS	07017	MASS	10	SCI NOTATION	KILOGRAMS		5
MASS	07018	PERCENTAGE MASS ESTIMATED	10	INTEGER	%		5
MASS	07019	PERCENTAGE MASS CALCULATED	10	INTEGER	%		5
MASS	07020	PERCENTAGE MASS WEIGHED	10	INTEGER	%		5
MASS	07021	PROGRAM ASSIGNED MASS	10	SCI NOTATION	KILOGRAMS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
WEIGHT	08001	INTERNAL PRESSURIZED ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08002	EXTERNAL/ATTACHED PRESSURIZED ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08003	EXTERNAL/ATTACHED UNPRESSURIZED ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08004	FREE FLYER (REMOTE) ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08005	FREE FLYER (CO-ORBITING) ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08006	28.5 DEGREE PLATFORM ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
WEIGHT	08007	SUN SYNC/POLAR PLATFORM ACCELERATION MAX	10	SCI NOTATION	GRAMS		5
ORIENTATION/POINTING	09001	POINTING	2	MENU			
ORIENTATION/POINTING	09002	VIEW DIRECTION	1	MENU		4	
ORIENTATION/POINTING	09003	IF VIEW DIRECTION=OTHER, DESCRIBE	16	TEXT			
ORIENTATION/POINTING	09004	POINTING HOURS	10	SCI NOTATION	HOURS		5
ORIENTATION/POINTING	09005	POINTING ACCURACY	10	SCI NOTATION	ARC SEC		5
ORIENTATION/POINTING	09006	POINTING KNOWLEDGE	10	SCI NOTATION	ARC SEC		5
ORIENTATION/POINTING	09007	FIELD OF VIEW	10	SCI NOTATION	DEGREES		5
ORIENTATION/POINTING	09008	POINTING STABILITY RATE (JITTER)	10	SCI NOTATION	ARC SEC/SEC		5
ORIENTATION/POINTING	09009	POINTING STABILITY (ARC SEC)	10	SCI NOTATION	ARC SEC		5
ORIENTATION/POINTING	09010	PLACEMENT	10	SCI NOTATION	ARC SEC		5
ORIENTATION/POINTING	09011	SPECIAL CONSIDERATIONS (POINTING)	72	TEXT		4	
ORIENTATION/POINTING	09012	TRUTH SITES	72	TEXT			
ORIENTATION/POINTING	09013	PSI (PITCH ROTATION ANGLE)	10	SCI NOTATION	DEGREES		5
ORIENTATION/POINTING	09014	THETA (ROLL ROTATION ANGLE)	10	SCI NOTATION	DEGREES		5
ORIENTATION/POINTING	09015	PHI (YAW ROTATION ANGLE)	10	SCI NOTATION	DEGREES		5
ORBIT	11001	ORBIT (REQUIREMENT LEVEL)	1	MENU			
ORBIT	11002	APOGEE (NOMINAL)	10	SCI NOTATION	KILOMETERS		5
ORBIT	11003	APOGEE (+ TOLERANCE)	10	SCI NOTATION	KILOMETERS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
ORBIT	11004	APOGEE (- TOLERANCE)	10	SCI NOTATION	KILOMETERS		5
ORBIT	11005	PERIGEE (NOMINAL)	10	SCI NOTATION	KILOMETERS		5
ORBIT	11006	PERIGEE (+ TOLERANCE)	10	SCI NOTATION	KILOMETERS		5
ORBIT	11007	PERIGEE (- TOLERANCE)	10	SCI NOTATION	KILOMETERS		5
ORBIT	11008	INCLINATION (NOMINAL)	10	SCI NOTATION	DEGREES		5
ORBIT	11009	INCLINATION (+ TOLERANCE)	10	SCI NOTATION	DEGREES		5
ORBIT	11010	INCLINATION (- TOLERANCE)	10	SCI NOTATION	DEGREES		5
ORBIT	11011	LOCAL TIME TO EQUATOR CROSSING NODE	2	INTEGER	HOURS/MINUTES		2
ORBIT	11012	LOCAL TIME TO EQUATOR CROSSING NODE	2	INTEGER	HOURS/MINUTES		2
ORBIT	11013	ASCENDING OR DESCENDING (EQUATOR CROSSING NODE)	1	MENU			
ORBIT	11014	ORBIT SPECIAL CONSIDERATIONS	72	TEXT		4	
POWER/ELECTRICAL	12001	AC OPERATING POWER	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12002	DC OPERATING POWER	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12003	AC OPERATING HOURS PER DAY	10	SCI NOTATION	HOURS		5
POWER/ELECTRICAL	12004	DC OPERATING HOURS PER DAY	10	SCI NOTATION	HOURS		5
POWER/ELECTRICAL	12005	AC VOLTAGE	10	SCI NOTATION	VOLTS		5
POWER/ELECTRICAL	12006	DC VOLTAGE	10	SCI NOTATION	VOLTS		5
POWER/ELECTRICAL	12007	FREQUENCY	10	SCI NOTATION	HERTZ		5
POWER/ELECTRICAL	12008	PEAK AC POWER	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12009	PEAK DC POWER	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12010	PEAK (AC POWER) HOURS PER DAY	10	SCI NOTATION	HOURS		5
POWER/ELECTRICAL	12011	PEAK (DC POWER) HOURS PER DAY	10	SCI NOTATION	HOURS		5
POWER/ELECTRICAL	12012	STANDBY POWER (AC)	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12013	STANDBY POWER (DC)	10	SCI NOTATION	KILOWATTS		5
POWER/ELECTRICAL	12014	SPECIAL CONSIDERATIONS	72	TEXT		4	
POWER/ELECTRICAL	12015	POWER REQUIREMENT	1	MENU			

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
THERMAL	13001	THERMAL	1	MENU			
THERMAL	13002	MINIMUM TEMPERATURE/ACTIVE OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13003	MINIMUM TEMPERATURE/ACTIVE NON-OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13004	MINIMUM TEMPERATURE/PASSIVE OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13005	MINIMUM TEMPERATURE/PASSIVE NON-OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13006	MAXIMUM TEMPERATURE/ACTIVE OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13007	MAXIMUM TEMPERATURE/ACTIVE NON-OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13008	MAXIMUM TEMPERATURE/PASSIVE OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13009	MAXIMUM TEMPERATURE/PASSIVE NON-OPERATIONAL	10	SCI NOTATION	DEGREES		5
THERMAL	13010	MINIMUM HEAT REJECTION/ACTIVE OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13011	MINIMUM HEAT REJECTION/ACTIVE NON-OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13012	MINIMUM HEAT REJECTION/PASSIVE OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13013	MINIMUM HEAT REJECTION/PASSIVE NON-OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13014	MAXIMUM HEAT REJECTION/ACTIVE OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13015	MAXIMUM HEAT REJECTION/ACTIVE NON-OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13016	MAXIMUM HEAT REJECTION/PASSIVE OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13017	MAXIMUM HEAT REJECTION/PASSIVE NON-OPERATIONAL	10	SCI NOTATION	KILOWATTS		5
THERMAL	13018	SPECIAL CONSIDERATIONS (THERMAL)	72	TEXT		4	
COMMUN. + TRACKING	14001	ON BOARD DATA PROCESSING REQUIRED	1	MENU			
COMMUN. + TRACKING	14002	IF YES, THEN DESCRIPTION	72	TEXT			
COMMUN. + TRACKING	14003	ON-BOARD STORAGE	10	SCI NOTATION	MEGABIT		5
COMMUN. + TRACKING	14004	STATION DATA REQUIRED	72	TEXT		2	
COMMUN. + TRACKING	14005	STATION TO GROUND DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		5
COMMUN. + TRACKING	14006	STATION TO GROUND DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14007	STATION TO GROUND DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14008	STATION TO GROUND DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14009	STATION TO GROUND DIGITAL DATA/SECURITY	1	TEXT	Y/N	1	
COMMUN. + TRACKING	14010	STATION TO GROUND DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14011	STATION TO GROUND DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14012	GROUND TO STATION DIGITAL DATA/GENREATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14013	GROUND TO STATION DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14014	GROUND TO STATION DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14015	GROUND TO STATION DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14016	GROUND TO STATION DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14017	GROUND TO STATION DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14018	GROUND TO STATION DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14019	STATION TO FREEFLYER DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14020	STATION TO FREEFLYER DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14021	STATION TO FREEFLYER DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14022	STATION TO FREEFLYER DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14023	STATION TO FREEFLYER DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14024	STATION TO FREEFLYER DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14025	STATION TO FREEFLYER DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14026	FREEFLYER TO STATION DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14027	FREEFLYER TO STATION DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14028	FREEFLYER TO STATION DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14029	FREEFLYER TO STATION DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14030	FREEFLYER TO STATION DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14031	FREEFLYER TO STATION DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14032	FREEFLYER TO STATION DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14033	STATION TO PLATFORM DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14034	STATION TO PLATFORM DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14035	STATION TO PLATFORM DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14036	STATION TO PLATFORM DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14037	STATION TO PLATFORM DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14038	STATION TO PLATFORM DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14039	STATION TO PLATFORM DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14040	PLATFORM TO STATION DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14041	PLATFORM TO STATION DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14042	PLATFORM TO STATION DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14043	PLATFORM TO STATION DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14044	PLATFORM TO STATION DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14045	PLATFORM TO STATION DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14046	PLATFORM TO STATION DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14047	PLATFORM TO GROUND DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14048	PLATFORM TO GROUND DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14049	PLATFORM TO GROUND DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14050	PLATFORM TO GROUND DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14051	PLATFORM TO GROUND DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14052	PLATFORM TO GROUND DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14053	PLATFORM TO GROUND DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14054	GROUND TO PLATFORM DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14055	GROUND TO PLATFORM DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14056	GROUND TO PLATFORM DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14057	GROUND TO PLATFORM DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14058	GROUND TO PLATFORM DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14059	GROUND TO PLATFORM DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14060	GROUND TO PLATFORM DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14061	STATION TO SHUTTLE DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14062	STATION TO SHUTTLE DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14063	STATION TO SHUTTLE DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14064	STATION TO SHUTTLE DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14065	STATION TO SHUTTLE DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14066	STATION TO SHUTTLE DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14067	STATION TO SHUTTLE DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14068	SHUTTLE TO STATION DIGITAL DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14069	SHUTTLE TO STATION DIGITAL DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14070	SHUTTLE TO STATION DIGITAL DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14071	SHUTTLE TO STATION DIGITAL DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14072	SHUTTLE TO STATION DIGITAL DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14073	SHUTTLE TO STATION DIGITAL DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14074	SHUTTLE TO STATION DIGITAL DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14075	STATION TO GROUND VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14076	STATION TO GROUND VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14077	STATION TO GROUND VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14078	STATION TO GROUND VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14079	STATION TO GROUND VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14080	STATION TO GROUND VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14081	STATION TO GROUND VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14082	GROUND TO STATION VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14083	GROUND TO STATION VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14084	GROUND TO STATION VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14085	GROUND TO STATION VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14086	GROUND TO STATION VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14087	GROUND TO STATION VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14088	GROUND TO STATION VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14089	STATION TO FREEFLYER VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14090	STATION TO FREEFLYER VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14091	STATION TO FREEFLYER VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14092	STATION TO FREEFLYER VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14093	STATION TO FREEFLYER VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14094	STATION TO FREEFLYER VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14095	STATION TO FREEFLYER VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14096	FREEFLYER TO STATION VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14097	FREEFLYER TO STATION VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14098	FREEFLYER TO STATION VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14099	FREEFLYER TO STATION VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14100	FREEFLYER TO STATION VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14101	FREEFLYER TO STATION VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14102	FREEFLYER TO STATION VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14103	STATION TO PLATFORM VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14104	STATION TO PLATFORM VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14105	STATION TO PLAFORM VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14106	STATION TO PLATFORM VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14107	STATION TO PLATFORM VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14108	STATION TO PLATFORM VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14109	STATION TO PLATFORM VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14110	PLATFORM TO STATION VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14111	PLATFORM TO STATION VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14112	PLATFORM TO STATION VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14113	PLATFORM TO STATION VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14114	PLATFORM TO STATION VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14115	PLATFORM TO STATION VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14116	PLATFORM TO STATION VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14117	PLATFORM TO GROUND VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14118	PLATFORM TO GROUND VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14119	PLATFORM TO GROUND VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14120	PLATFORM TO GROUND VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14121	PLATFORM TO GROUND VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14122	PLATFORM TO GROUND VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14123	PLATFORM TO GROUND VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14124	GROUND TO PLATFORM VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC	-	5
COMMUN. + TRACKING	14125	GROUND TO PLATFORM VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14126	GROUND TO PLATFORM VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14127	GROUND TO PLATFORM VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14128	GROUND TO PLATFORM VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14129	GROUND TO PLATFORM VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14130	GROUND TO PLATFORM VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14131	STATION TO SHUTTLE VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14132	STATION TO SHUTTLE VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14133	STATION TO SHUTTLE VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14134	STATION TO SHUTTLE VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14135	STATION TO SHUTTLE VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14136	STATION TO SHUTTLE VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14137	STATION TO SHUTTLE VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14138	SHUTTLE TO STATION VIDEO DATA/GENERATION RATE	10	SCI NOTATION	KILOBIT PER SEC		- 5
COMMUN. + TRACKING	14139	SHUTTLE TO STATION VIDEO DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14140	SHUTTLE TO STATION VIDEO DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14141	SHUTTLE TO STATION VIDEO DATA/DELIVERY TIME	10	SCI NOTATION	HOURS		5
COMMUN. + TRACKING	14142	SHUTTLE TO STATION VIDEO DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14143	SHUTTLE TO STATION VIDEO DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14144	SHUTTLE TO STATION VIDEO DATA/INTERACTIVE	1	TEXT	Y/N		
COMMUN. + TRACKING	14145	STATION TO GROUND VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14146	STATION TO GROUND VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14147	STATION TO GROUND VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14148	STATION TO GROUND VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14149	STATION TO GROUND VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14150	STATION TO GROUND VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14151	STATION TO GROUND VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14152	GROUND TO STATION VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14153	GROUND TO STATION VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14154	GROUND TO STATION VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14155	GROUND TO STATION VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14156	GROUND TO STATION VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14157	GROUND TO STATION VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14158	GROUND TO STATION VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14159	STATION TO FREEFLYER VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14160	STATION TO FREEFLYER VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14161	STATION TO FREEFLYER VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14162	STATION TO FREEFLYER VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14163	STATION TO FREEFLYER VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14164	STATION TO FREEFLYER VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14165	STATION TO FREEFLYER VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14166	FREEFLYER TO STATION VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14167	FREEFLYER TO STATION VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14168	FREEFLYER TO STATION VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14169	FREEFLYER TO STATION VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14170	FREEFLYER TO STATION VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14171	FREEFLYER TO STATION VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14172	FREEFLYER TO STATION VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14173	STATION TO PLATFORM VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14174	STATION TO PLATFORM VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14175	STATION TO PLATFORM VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14176	STATION TO PLATFORM VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14177	STATION TO PLATFORM VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14178	STATION TO PLATFORM VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14179	STATION TO PLATFORM VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14180	PLATFORM TO STATION VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14181	PLATFORM TO STATION VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14182	PLATFORM TO STATION VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14183	PLATFORM TO STATION VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14184	PLATFORM TO STATION VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14185	PLATFORM TO STATION VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14186	PLATFORM TO STATION VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14187	PLATFORM TO GROUND VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14188	PLATFORM TO GROUND VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14189	PLATFORM TO GROUND VOICE DATA/FREQUENCY					
COMMUN. + TRACKING	14190	PLATFORM TO GROUND VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14191	PLATFORM TO GROUND VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14192	PLATFORM TO GROUND VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14193	PLATFORM TO GROUND VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14194	GROUND TO PLATFORM VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14195	GROUND TO PLATFORM VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14196	GROUND TO PLATFORM VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14197	GROUND TO PLATFORM VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14198	GROUND TO PLATFORM VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14199	GROUND TO PLATFORM VOICE DATA/RELIABILITY	7	SCI NOTAION	%		2
COMMUN. + TRACKING	14200	GROUND TO PLATFORM VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14201	STATION TO SHUTTLE VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
COMMUN. + TRACKING	14202	STATION TO SHUTTLE VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14203	STATION TO SHUTTLE VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14204	STATION TO SHUTTLE VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14205	STATION TO SHUTTLE VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14206	STATION TO SHUTTLE VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14207	STATION TO SHUTTLE VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14208	SHUTTLE TO STATION VOICE DATA/GENERATION RATE	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14209	SHUTTLE TO STATION VOICE DATA/DURATION	7	SCI NOTATION	HOURS		2
COMMUN. + TRACKING	14210	SHUTTLE TO STATION VOICE DATA/FREQUENCY	7	SCI NOTATION	PER DAY		2
COMMUN. + TRACKING	14211	SHUTTLE TO STATION VOICE DATA/DELIVERY TIME	0	SCI NOTATION	NA		0
COMMUN. + TRACKING	14212	SHUTTLE TO STATION VOICE DATA/SECURITY	1	TEXT	Y/N		
COMMUN. + TRACKING	14213	SHUTTLE TO STATION VOICE DATA/RELIABILITY	7	SCI NOTATION	%		2
COMMUN. + TRACKING	14214	SHUTTLE TO STATION VOICE DATA/INTERACTIVE	1	TEXT	Y		
COMMUN. + TRACKING	14215	DATA COMMUNICATION COMMENTS	72	TEXT		4	
COMMUN. + TRACKING	14216	COMMUNICATION LINKS	2	MENU		10	
OPERATING CYCLE	15001	EQUIPMENT UP 1992	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15002	EQUIPMENT UP 1993	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15003	EQUIPMENT UP 1994	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15004	EQUIPMENT UP 1995	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15005	EQUIPMENT UP 1996	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15006	EQUIPMENT UP 1997	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15007	EQUIPMENT UP 1998	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15008	EQUIPMENT UP 1999	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15009	EQUIPMENT UP 2000	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15010	EQUIPMENT UP 2001	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15011	EQUIPMENT DOWN 1992	3	INTEGER	LAUNCHES		3

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
OPERATING CYCLE	15012	EQUIPMENT DOWN 1993	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15013	EQUIPMENT DOWN 1994	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15014	EQUIPMENT DOWN 1995	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15015	EQUIPMENT DOWN 1996	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15016	EQUIPMENT DOWN 1997	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15017	EQUIPMENT DOWN 1998	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15018	EQUIPMENT DOWN 1999	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15019	EQUIPMENT DOWN 2000	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15020	EQUIPMENT DOWN 2001	3	INTEGER	LAUNCHES		3
OPERATING CYCLE	15021	OPERATING DAYS/1992	3	INTEGER	DAYS		3
OPERATING CYCLE	15022	OPERATING DAYS/1993	3	INTEGER	DAYS		3
OPERATING CYCLE	15023	OPERATING DAYS/1994	3	INTEGER	DAYS		3
OPERATING CYCLE	15024	OPERATING DAYS/1995	3	INTEGER	DAYS		3
OPERATING CYCLE	15025	OPERATING DAYS/1996	3	INTEGER	DAYS		3
OPERATING CYCLE	15026	OPERATING DAYS/1997	3	INTEGER	DAYS		3
OPERATING CYCLE	15027	OPERATING DAYS/1998	3	INTEGER	DAYS		3
OPERATING CYCLE	15028	OPERATING DAYS/1999	3	INTEGER	DAYS		3
OPERATING CYCLE	15029	OPERATING DAYS/2000	3	INTEGER	DAYS		3
OPERATING CYCLE	15030	OPERATING DAYS/2001	3	INTEGER	DAYS		3
SCHEDULE	16001	EARLY FLIGHT	4	INTEGER	YEAR		4
SCHEDULE	16002	LATE RETURN	4	INTEGER	YEAR		4
SCHEDULE	16003	NUMBER OF OTV FLIGHTS/1992	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16004	NUMBER OF OTV FLIGHTS/1993	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16005	NUMBER OF OTV FLIGHTS/1994	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16006	NUMBER OF OTV FLIGHTS/1995	10	SCI NOTATION	FLIGHTS		5

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
SCHEDULE	16007	NUMBER OF OTV FLIGHTS/1996	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16008	NUMBER OF OTV FLIGHTS/1997	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16009	NUMBER OF OTV FLIGHTS/1998	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16010	NUMBER OF OTV FLIGHTS/1999	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16011	NUMBER OF OTV FLIGHTS/2000	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16012	NUMBER OF OTV FLIGHTS/2001	10	SCI NOTATION	FLIGHTS		5
SCHEDULE	16013	NON-SERVICING OMV FLIGHTS	3	INTEGER	FLIGHTS		3
SCHEDULE	16014	ADD RESOURCES	1	MENU			
SCHEDULE	16015	RESOURCE REFERENCE	8	INTEGER			8
CREW	17001	INITIAL SET UP	1	MENU			
CREW	17002	TASK/INITIAL SET UP	72	TEXT			
CREW	17003	PERIOD (DAYS)/INITIAL SET UP	8	SCI NOTATION	DAYS		3
CREW	17004	IVA TOTAL CREW TIME/INITIAL SET UP	10	SCI NOTATION	MANHOURS		5
CREW	17005	EVA PRODUCTIVE CREW TIME/INITIAL SET UP	10	SCI NOTATION	MANHOURS		5
CREW	17006	NO SPECIAL SKILL/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17007	NO SPECIAL SKILL/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17008	NO SPECIAL SKILL/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17009	MEDICAL BIOLOGICAL/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17010	MEDICAL BIOLOGICAL/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17011	MEDICAL BIOLOGICAL/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17012	PHYSICAL SCIENCES/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17013	PHYSICAL SCIENCES/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17014	PHYSICAL SCIENCES/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17015	EARTH OCEANS/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17016	EARTH OCEANS/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17017	EARTH OCEANS/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
CREW	17018	ENGINEERING/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17019	ENGINEERING/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17020	ENGINEERING/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17021	ASTRONOMY/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17022	ASTRONOMY/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17023	ASTRONOMY/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17024	SPACECRAFT SYSTEMS/TASK TRAINABLE - INITIAL SET UP	1	INTEGER			1
CREW	17025	SPACECRAFT SYSTEMS/TECHNICIAN - INITIAL SET UP	1	INTEGER			1
CREW	17026	SPACECRAFT SYSTEMS/PROFESSIONAL - INITIAL SET UP	1	INTEGER			1
CREW	17027	DAILY OPERATIONS	1	MENU			
CREW	17028	TASK/DAILY OPERATIONS	72	TEXT			
CREW	17029	IVA CREW TIME/DAILY OPERATIONS	8	SCI NOTATION	MANHOURS		3
CREW	17030	NO SPECIAL SKILL/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17031	NO SPECIAL SKILL/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17032	NO SPECIAL SKILL/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17033	MEDICAL BIOLOGICAL/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17034	MEDICAL BIOLOGICAL/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17035	MEDICAL BIOLOGICAL/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17036	PHYSICAL SCIENCES/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17037	PHYSICAL SCIENCES/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17038	PHYSICAL SCIENCES/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17039	EARTH OCEANS/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17040	EARTH OCEANS/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17041	EARTH OCEANS/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17042	ENGINEERING/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
CREW	17043	ENGINEERING/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17044	ENGINEERING/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17045	ASTRONOMY/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17046	ASTRONOMY/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17047	ASTRONOMY/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17048	SPACECRAFT SYSTEMS/TASK TRAINABLE - DAILY OPERATIONS	1	INTEGER			1
CREW	17049	SPACECRAFT SYSTEMS/TECHNICIAN - DAILY OPERATIONS	1	INTEGER			1
CREW	17050	SPACECRAFT SYSTEMS/PROFESSIONAL - DAILY OPERATIONS	1	INTEGER			1
CREW	17051	PERIODIC OPERATIONS	1	MENU			
CREW	17052	TASK/PERIODIC OPERATIONS	72	TEXT		1	
CREW	17053	IVA OCCURRENCES/PERIODIC OPERATIONS	8	SCI NOTATION			3
CREW	17054	CREW TIME/OCCURRENCE/PERIODIC OPERATIONS	7	SCI NOTATION	MANHOURS		2
CREW	17055	EVA OCCURRENCES/PERIODIC OPERATIONS	8	SCI NOTATION			3
CREW	17056	PRODUCTIVE CREW TIME PER OCCURRENCE/PERIODIC OPERATIONS	7	SCI NOTATION	MANHOURS		2
CREW	17057	NO SPECIAL SKILL/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17058	NO SPECIAL SKILL/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17059	NO SPECIAL SKILL/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17060	MEDICAL BIOLOGICAL/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17061	MEDICAL BIOLOGICAL/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17062	MEDICAL BIOLOGICAL/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17063	PHYSICAL SCIENCES/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17064	PHYSICAL SCIENCES/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17065	PHYSICAL SCIENCES/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17066	EARTH OCEANS/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17067	EARTH OCEANS/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17068	EARTH OCEANS/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
CREW	17069	ENGINEERING/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17070	ENGINEERING/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17071	ENGINEERING/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17072	ASTRONOMY/TASK TRAINABLE - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17073	ASTRONOMY/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17074	ASTRONOMY/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17075	SPACECRAFT SYSTEMS/TASK TRAINABLE - PERIOD OPERATIONS	1	INTEGER			1
CREW	17076	SPACECRAFT SYSTEMS/TECHNICIAN - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17077	SPACECRAFT SYSTEMS/PROFESSIONAL - PERIODIC OPERATIONS	1	INTEGER			1
CREW	17078	TEARDOWN AND STOW	1	MENU			
CREW	17079	TASK/TEARDOWN AND STOW	72	TEXT			
CREW	17080	PERIOD/TEARDOWN AND STOW	8	SCI NOTATION	DAYS		3
CREW	17081	IVA TOTAL CREW TIME/TEARDOWN AND STOW	10	SCI NOTATION	MANHOURS		5
CREW	17082	EVA PRODUCTIVE CREW TIME/TEARDOWN AND STOW	10	SCI NOTATION	MANHOURS		5
CREW	17083	NO SPECIAL SKILL/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17084	NO SPECIAL SKILL/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17085	NO SPECIAL SKILL/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17086	MEDICAL BIOLOGICAL/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17087	MEDICAL BIOLOGICAL/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17088	MEDICAL BIOLOGICAL/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17089	PHYSICAL SCIENCES/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17090	PHYSICAL SCIENCES/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17091	PHYSICAL SCIENCES/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17092	EARTH OCEANS/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17093	EARTH OCEANS/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
CREW	17094	EARTH OCEANS/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17095	ENGINEERING/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17096	ENGINEERING/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17097	ENGINEERING/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17098	ASTRONOMY/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17099	ASTRONOMY/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17100	ASTRONOMY/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17101	SPACECRAFT SYSTEMS/TASK TRAINABLE - TEARDOWN AND STOW	1	INTEGER			1
CREW	17102	SPACECRAFT SYSTEMS/TECHNICIAN - TEARDOWN AND STOW	1	INTEGER			1
CREW	17103	SPACECRAFT SYSTEMS/PROFESSIONAL - TEARDOWN AND STOW	1	INTEGER			1
CREW	17104	COMMENTS (CREW OPERATIONS)	72	TEXT		4	
SERVICING	18001	SERVICING REQUIREMENT	1	MENU			
SERVICING	18002	SERVICE INTERVAL	8	SCI NOTATION	DAYS		3
SERVICING	18003	EVA HOURS PER SERVICE	8	SCI NOTATION	HOURS		3
SERVICING	18004	CONS./EQP., WEIGHT	10	SCI NOTATION	KILOGRAMS		5
SERVICING	18005	CONS./EQP., RETURN	10	SCI NOTATION	KILOGRAMS		5
SERVICING	18006	CONS./EQP., VOLUME UP	10	SCI NOTATION	CU METERS		5
SERVICING	18007	CONS./EQP., VOLUME DOWN	10	SCI NOTATION	CU METERS		5
SERVICING	18008	HOURS FOR POWER	10	SCI NOTATION	HOURS		5
SERVICING	18009	CONSUMABLES TYPE	72	TEXT			
SERVICING	18010	POWER (KW)	10	SCI NOTATION	KILOWATTS		5
SERVICING	18011	IVA HOURS PER SERVICE	8	SCI NOTATION	HOURS		3
SERVICING	18012	LOCATION OF SERVICING	1	MENU			
SERVICING	18013	EVA TASK DESCRIPTION	72	TEXT			
SERVICING	18014	IVA TASK DESCRIPTION	72	TEXT			
SERVICING	18015	SPECIAL CONSIDERATIONS (SERVICING)	72	TEXT		4	

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
SERVICING	18016	CONFIGURATION CHANGES	1	MENU			
SERVICING	18017	CONFIGURATION CHANGES/INTERVAL	10	SCI NOTATION	DAYS		5
SERVICING	18018	CONFIGURATION CHANGES/DELIVERABLES	10	SCI NOTATION	KILOGRAMS		5
SERVICING	18019	CONFIGURATION CHANGES/RETURNABLES	10	SCI NOTATION	KILOGRAMS		5
SERVICING	18020	CONFIGURATION CHANGES/VOLUME UP	10	SCI NOTATION	CU METERS		5
SERVICING	18021	CONFIGURATION CHANGES/VOLUME DOWN	10	SCI NOTATION	CU METERS		5
SERVICING	18022	CONFIGURATION CHANGES/POWER	10	SCI NOTATION	KILOWATTS		5
SERVICING	18023	CONFIGURATION CHANGES/HOURS FOR POWER	10	SCI NOTATION	HOURS		5
SERVICING	18024	CONFIGURATION CHANGES/EVA HOURS PER CHANGE	10	SCI NOTATION	HOURS		5
SERVICING	18025	TYPICAL EVA TASKS	72	TEXT			
SERVICING	18026	CONFIGURATION CHANGES/IVA HOURS PER CHANGE	10	SCI NOTATION	HOURS		5
SERVICING	18027	CONFIGURATION CHANGES/LOCATION OF CHANGE	1	MENU			
SERVICING	18028	CONFIGURATION CHANGES/TYPICAL IVA TASKS	72	TEXT			
SERVICING	18029	CONFIGURATION CHANGES/SPECIAL CONSIDERATIONS	72	TEXT		4	
SERVICING	18030	CHANGE-OUT EQUIPMENT TYPE	72	TEXT		1	
SPECIAL NOTES	19001	CONTAMINATION	72	TEXT		2	
SPECIAL NOTES	19002	STRUCTURES	72	TEXT		2	
SPECIAL NOTES	19003	MATERIALS	72	TEXT		2	
SPECIAL NOTES	19004	RADIATION	72	TEXT		2	
SPECIAL NOTES	19005	SAFETY	72	TEXT		2	
SPECIAL NOTES	19006	STORAGE	72	TEXT		2	
SPECIAL NOTES	19007	OTHER	72	TEXT		2	
SPECIAL NOTES	19008	OPTICAL WINDOWS	72	TEXT		2	
SPECIAL NOTES	19009	SCIENTIFIC AIRLOCK NOTES	72	TEXT		2	
SPECIAL NOTES	19010	TETHER NOTES	72	TEXT		2	

EDB DICTIONARY LISTING FOR MISSION REQUIREMENTS

CATEGORY	ATTID	ATTRIBUTE NAME	LEN	VAL REP	UNITS	OCC	DIG
SPECIAL NOTES	19011	VACUUM VENTING NOTES	72	TEXT		2	

APPENDIX B

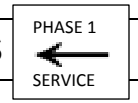
CETF SPACE STATION SYSTEM ASSEMBLY SEQUENCE

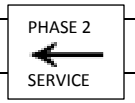
Critical Evaluation Task Force

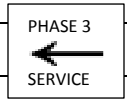
RESOURCE NODE OPTION

FLIGHT SEQUENCE OVERVIEW

FLIGHT			FLIGHT		
NO.	ASSEMBLY		NO.	ASSEMBLY	
1	✓	1/2 PV,NODE,TRUSS,RCS,TANK	17		LOGISTICS
2	✓	1/2 PV,NODE,TRUSS,RCS	18	✓	SERV.FAC.,PAYLOADS
3	✓	TCS,AIRLOCK,P/L, SSRMS,RCS,TANK	19		LOGISTICS
4	✓	AIRLOCK,TANK,SSRMS	20		SERV.FAC., OUTFITT.
5		U.S.POLAR PLATFORM (WTR)	21		LOGISTICS
6	✓	U.S.LAB MODULE	22	✓	JEM EF #2,ELM
7	✓	LAB MODULE OUTFITTING	23		LOGISTICS
8	✓	U.S.HAB MODULE	24		MSCITRANSPORTER
9		ESA POLAR PLATFORM (WTR)	25		LOGISTICS
10	✓	NODES,CUPOLAS	26		PLATFORM SERV.(WTR)
11	✓	CREW (4), LOGISTICS	27		LOGISTICS
12	✓	SDPOWER	28	✓	UPPER & LOWER BOOMS
13		LOGISTICS	29		LOGISTICS
14	✓	JEM, EF#1	30	✓	FAC.PAYLOADS IOC, MMD
15		LOGISTICS	31		LOGISTICS
16	✓	ESAMODULE	32		CO-ORBITING PLATFORM {ETA)







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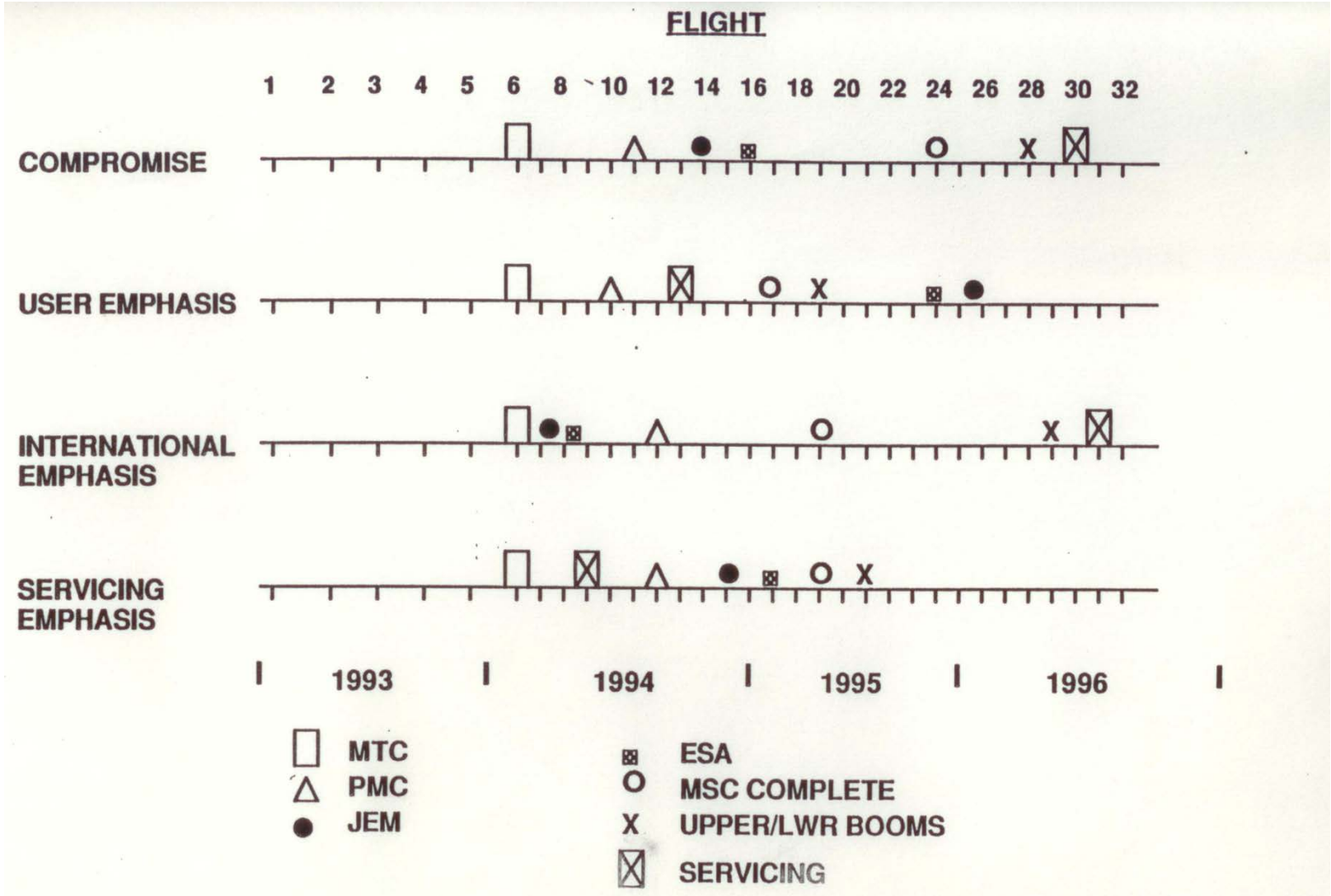
ASSEMBLY OPTIONS

(MAJOR MILESTONES)



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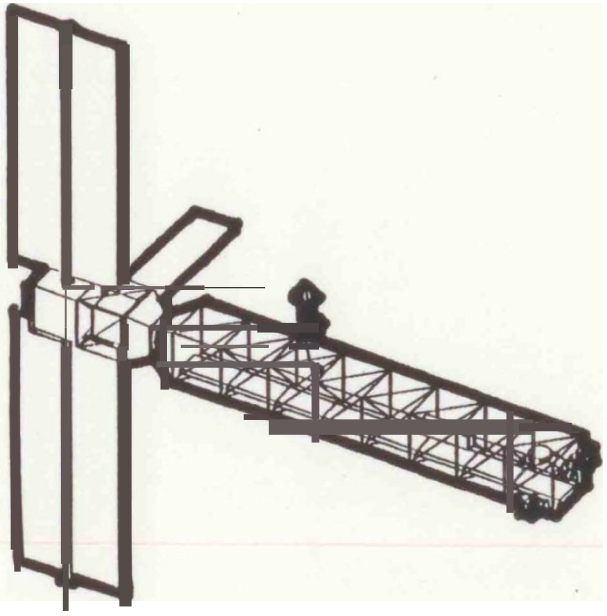
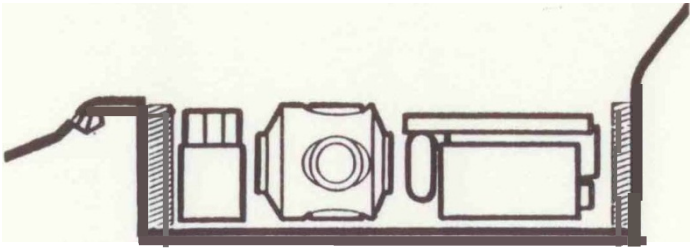
ASSEMBLY FLIGHT NO.1





EVA	:	24.4 MH
SS CREW	:	0

MANIFEST	MASS (LBS.)
PACKAGE	8,260
- α JOINT	
- RCS PACKAGE	
- ANTENNA	
- GN&C SENSORS & CTRLS	
AFTNODE#1	12,015
- SUBSYSTEMS	
- TCS,ACS,EPS,OMS	
- RCS ELECTROLYSIS	
- OUTSIDE TO INSIDE EQP	
- C&I, OMS,FMAD,GN&C ELECTRONICS,HRT&T &EPS	
TRUSS/ASSEMBLY	19222
- POWER MODULE	
- TRUSS	
- UTILITIES	
- ERECTOR JIG	
FSE	2410
ATTACH FITTINGS	3700
	45607

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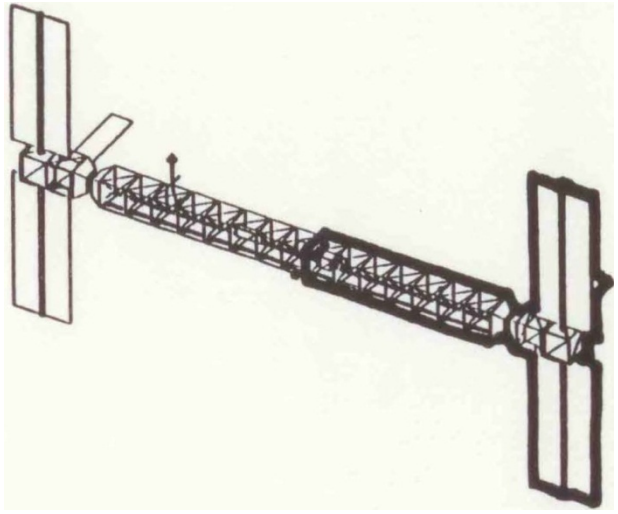
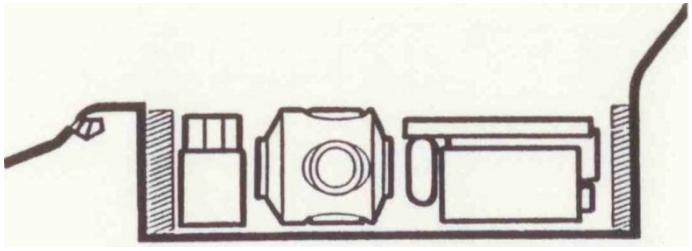
ASSEMBLY FLIGHT NO.2





MANIFEST	MASS (LBS.)
AFTNODE#2	10,525
- SUBSYSTEMS	
- TCS,ACS,EPS,OMS	
- OUTSIDE TO INSIDE EQP.	
- C&T,OMS,EMAD, GN&C ELECTRONICS, HR&T& EPS TRUSS DOCKING ADAPT	
PACKAGE	5,615
- α JOINT	
- RCSMODULE	
- CMG'S	
TRUSS/ASSEMBLY	
- POWER MODULE	
- TRUSS	
- UTILITIES	
FSE	2,130
ATTACH FITTINGS	4,625
TOTAL	38,840

EVA : 21.3MH

SS CREW : 0

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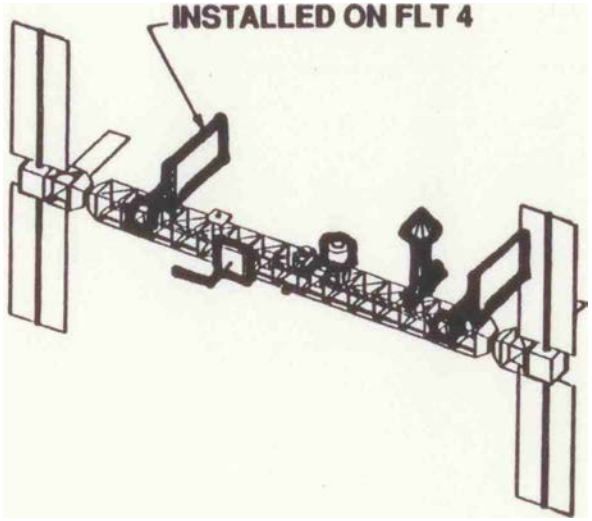
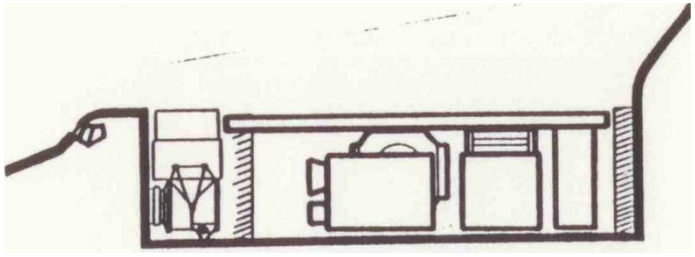
ASSEMBLY FLIGHT NO.3





MANIFEST		MASS (LBS.)
#1		11,140
	- RADIATORS	
	- SSRMS & TRANSPORTER UPGRADE	
#2		7,670
	- DOCKING ADAPTERS	
	- AIRLOCK	
	- ANTENNA	
#3	ATTACHED PAYLOADS	5,240
#4	RCSTANKAGE	4,700
FSE		2,330
ATTACH FITTINGS		5,550
	TOTAL	36,630

EVA	:	21.2MH
SS CREW	:	0

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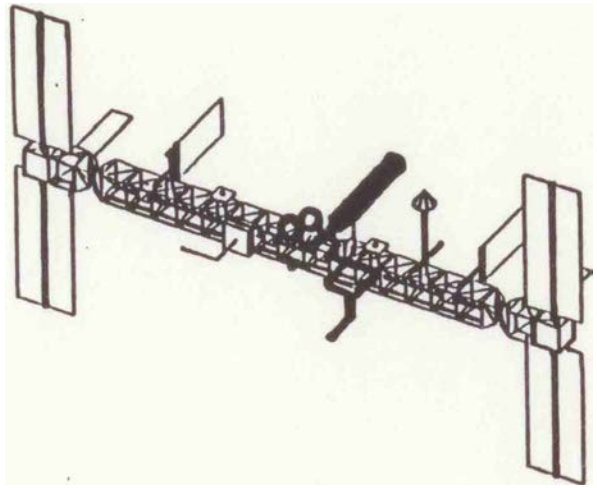
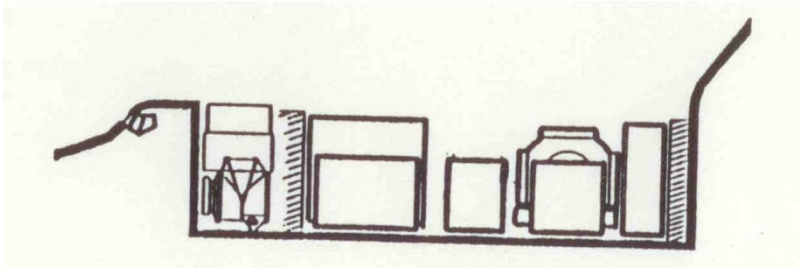
ASSEMBLY FLIGHT NO.4



MANIFEST	MASS (LBS.)
RCSTANKAGE	4,700
- AIRLOCK,HB	8,760
- STRUCTURE FOR SRMS	
PAYLOADS	6,000
ATTACHED PAYLOADS	12,000
FSE	1,330
ATTACH FITTINGS	3,700
TOTAL	36,630



EVA : 16

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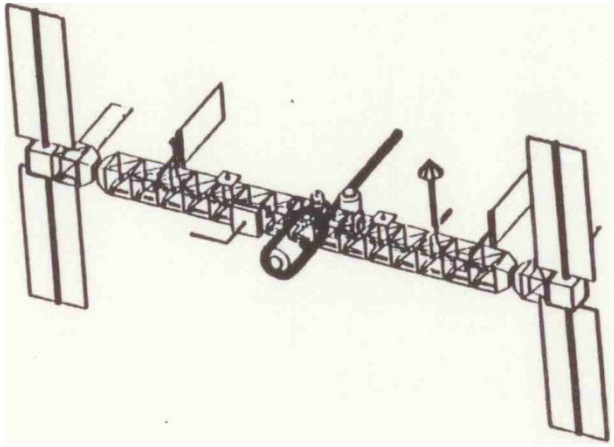
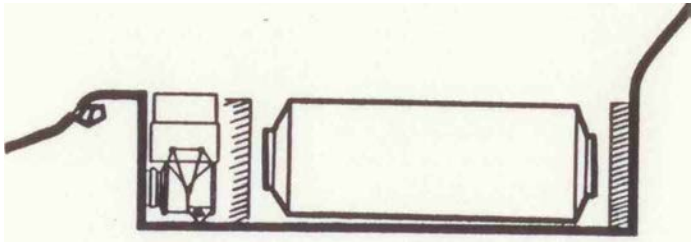
ASSEMBLY FLIGHT NO.5





MANIFEST	MASS (LBS.)
#1 U.S.LAB MODULE	34,230
FSE	0
ATTACH FITTINGS	1,100
TOTAL	35,330

EVA : 1611MH

SS CREW : 0

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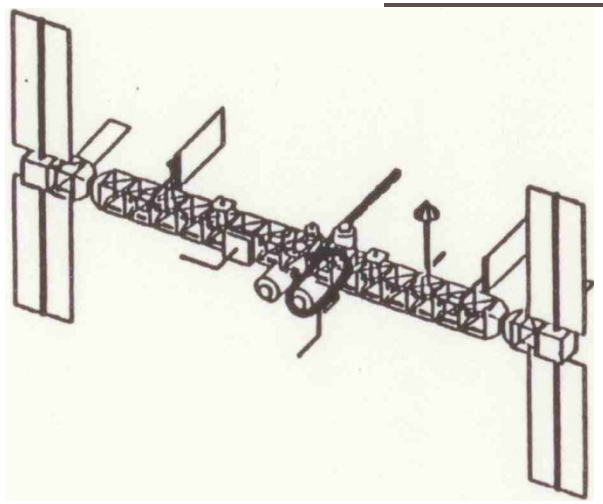
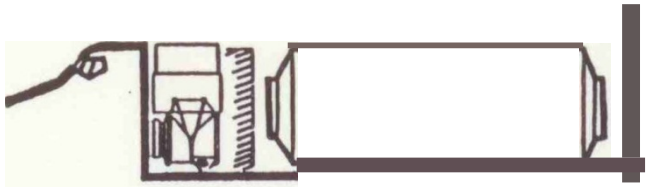
ASSEMBLY FLIGHT NO.6



MANIFEST	MASS (LBS.)
HAB MODULE	34,230
FSE	0
ATTACH FITTINGS	1,100
TOTAL	35,330
MARGIN	0



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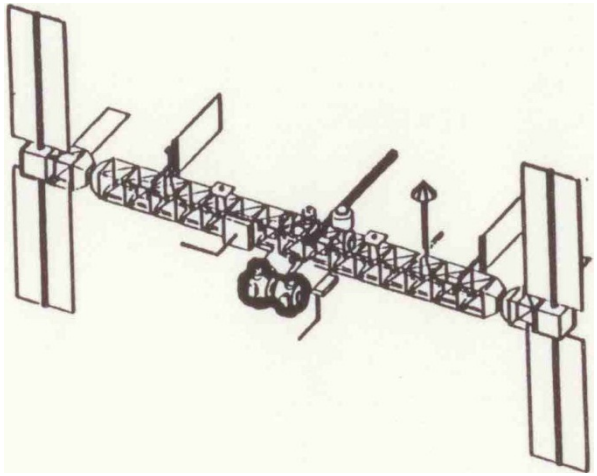
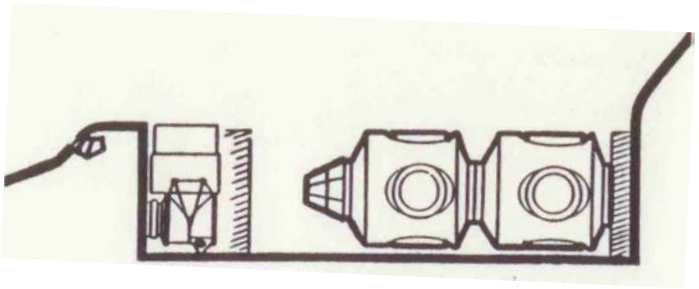
ASSEMBLY FLIGHT NO.7





MANIFEST	MASS (LBS.)
o FWD NODE,STARBOARD	9,540
o FWD NODE,PORT	9,040
o MODULE OFFLOAD$	3,200
o CUPOLAS(2)	3,200
o EVA SUPPORT EQUIP.	800
FSE	300
ATTACH FITTINGS	1,850
TOTAL	27,930

EVA	:	21.6MH
SS CREW	:	0

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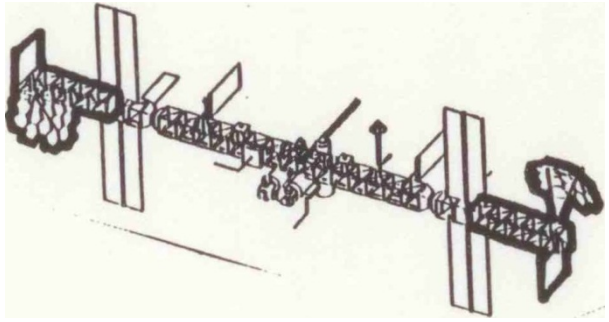
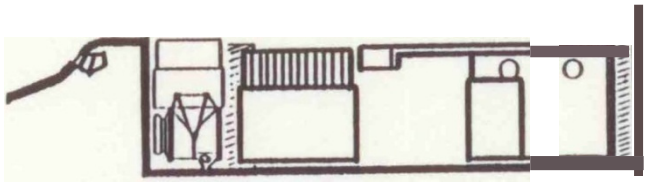
OPTION 3

ASSEMBLY FLIGHT NO.12 (MB-9)





MANIFEST	MASS (LBS.)
o SOLAR DYNAMIC. POWER MODULES (2)	30,470
o EMU	500
o FSE	3,500
ATTACH FITTINGS	1,800
TOTAL	36,320

EVA IS STATION BASED

SS CREW : 4

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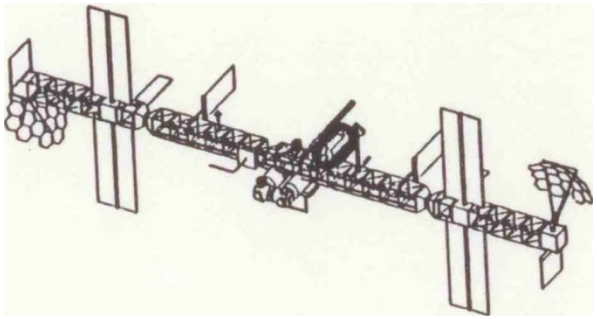
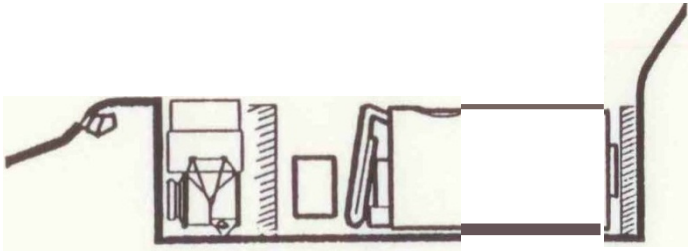
OPTION 3

ASSEMBLY FLIGHT NO.14 (MB-10)



MANIFEST	MASS (LBS.)
o JEM EXPOSED FACILITY	4,730
o JEM MODULE	30,475
o ATTACH FITTINGS	2,025
TOTAL	37,230



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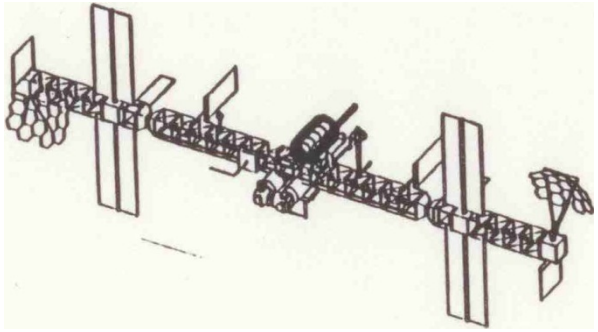
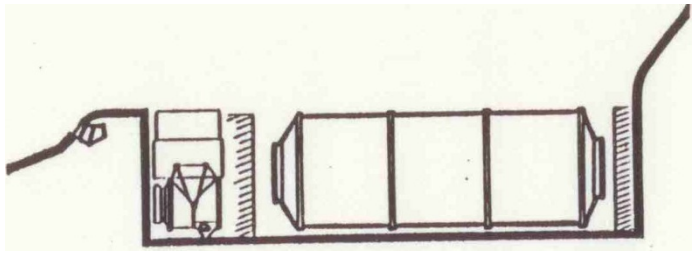
OPTION 3

ASSEMBLY FLIGHT NO.16 (MB-11)



MANIFEST	MASS (LBS.)
o ESA MODULE	36,130
o ATTACH H/W	1,100
TOTAL	37,230

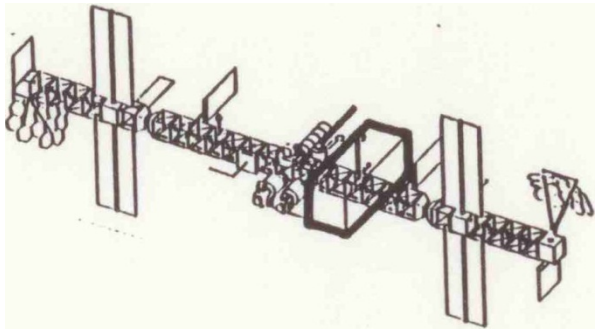


SS CREW : 6

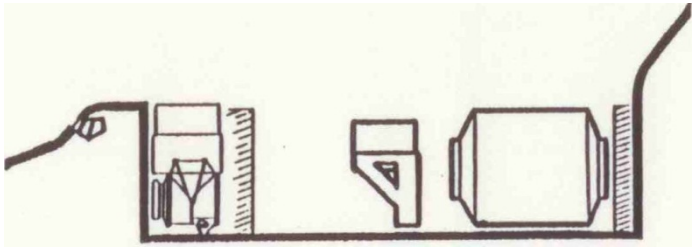
Critical Evaluation Task Force

OPTION 3

ASSEMBLY FLIGHT NO.20 (MB-13)



MANIFEST	MASS (LBS.)
o SERV. FACILITY PHASE 2	7,820
o LOGISTICS MODULE	19,220
o FSE	1,170
o ATTACH HARDWARE	1,850
TOTAL	30,060

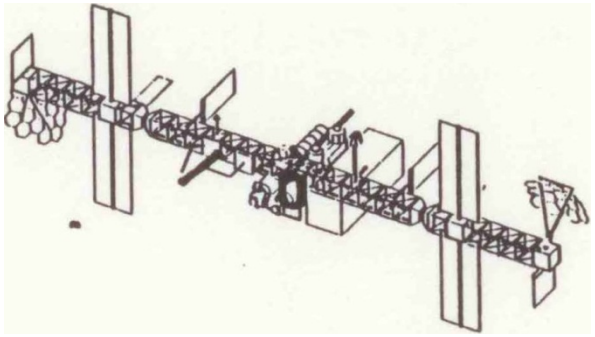


SS CREW : 6

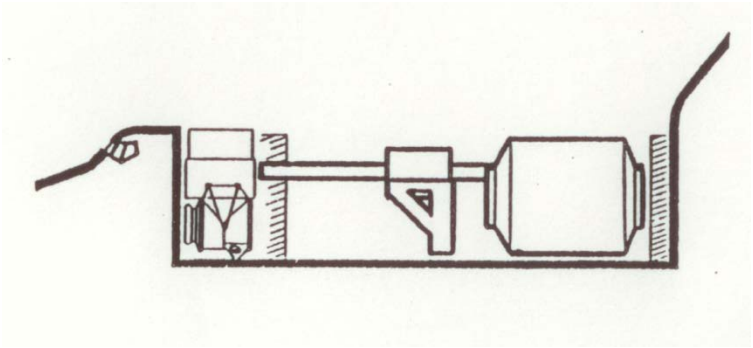
Critical Evaluation Task Force

OPTION 3

ASSEMBLY FLIGHT NO.24 (MB-15)



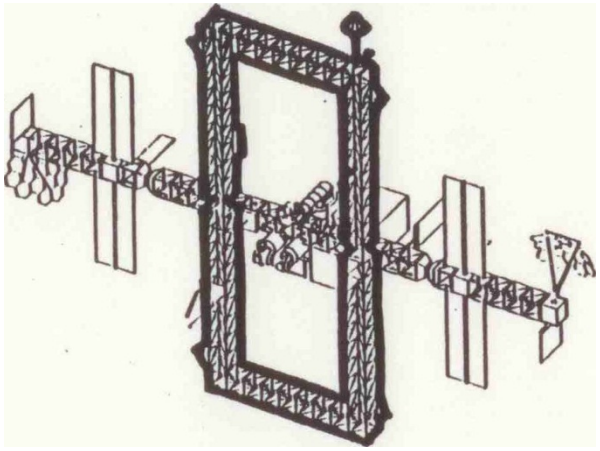
MANIFEST	MASS (LBS.)
o MSC & TRANSPORTER	7,310
o LOGISTICS MODULE	19,220
- MODULE OFFLOADS	
o FSE	720
o ATTACH HARDWARE	1,850
*TOTAL	30,030



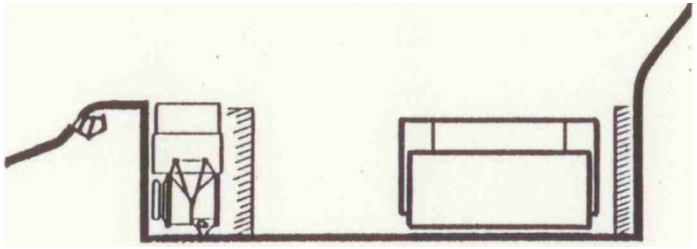
Critical Evaluation Task Force

OPTION 3

ASSEMBLY FLIGHT NO.28 (MB-16)



MANIFEST	MASS (LBS.)
o TRUSS	25,200
- UPPER BOOM	
- UPPER KEEL	
- LOWERKEEL	
- LOWERBOOM	
o FSE	3,730
o ATTACH HARDWARE	1,100
TOTAL	30,030



SS CREW : 8