DECEMBER 1971

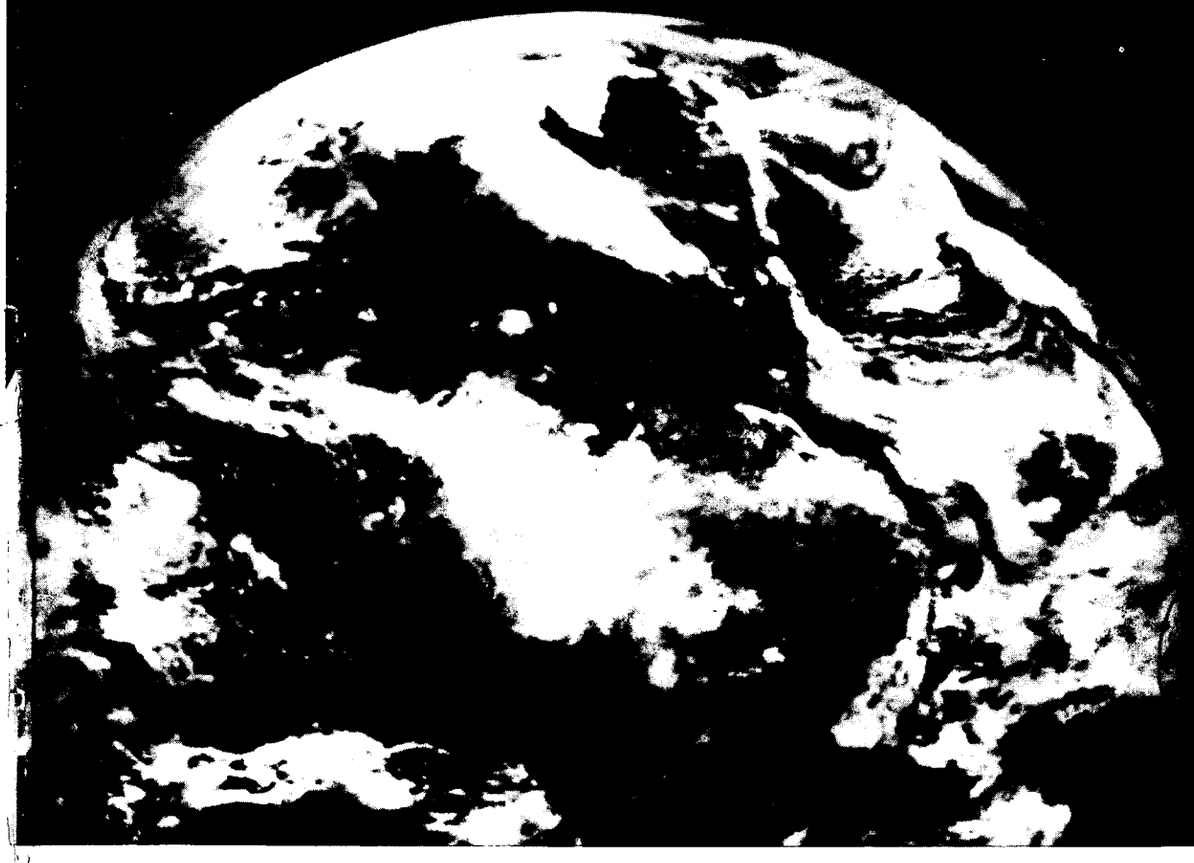
MDC G2578

SPACE STATION

MSFC-DPD-235/DR NO. CM-04

INTERFACE AND SUPPORT REQUIREMENTS

CONTRACT NAS8-25140



(NASA-CR-121081) SPACE STATION MSFC-DPD-235/DR NO. CM-04 INTERFACE AND SUPPORT REQUIREMENTS (McDonnell-Douglas Astronautics Co.) Dec. 1971 102 p
CSCL 22B

N72-15782

G3/31 13185

FACILITY FORM 602

(ACCESSION NUMBER)	(THRU)
102	G3
(PAGES)	(CODE)
CR-121081	31
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

102

MCDONNELL DOUGLAS

CONTRACT NAS8-25140
MSFC-DPD-235/DR NO. CM-04

INTERFACE AND SUPPORT REQUIREMENTS

NOVEMBER 1971

MDC G2578

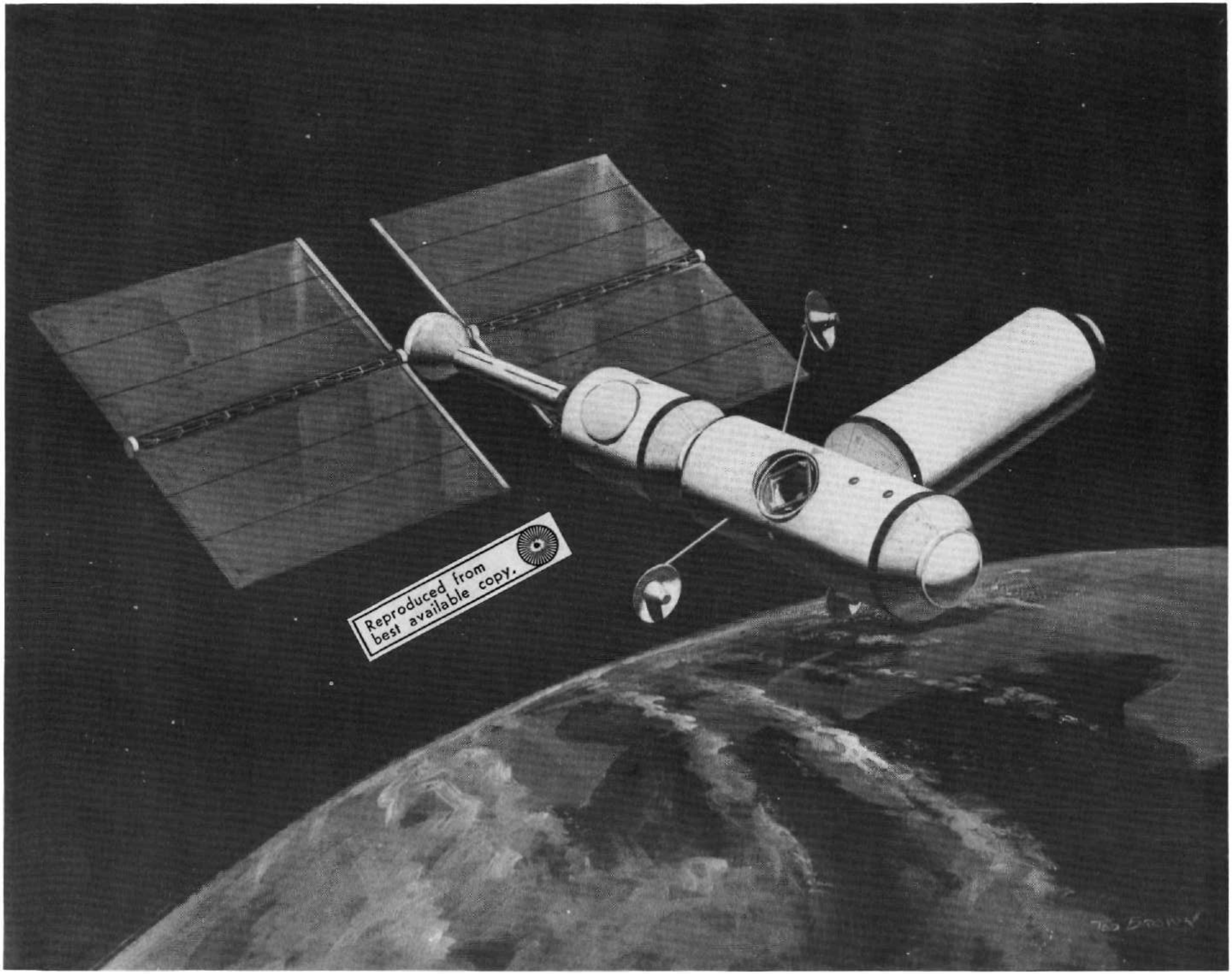
APPROVED BY:

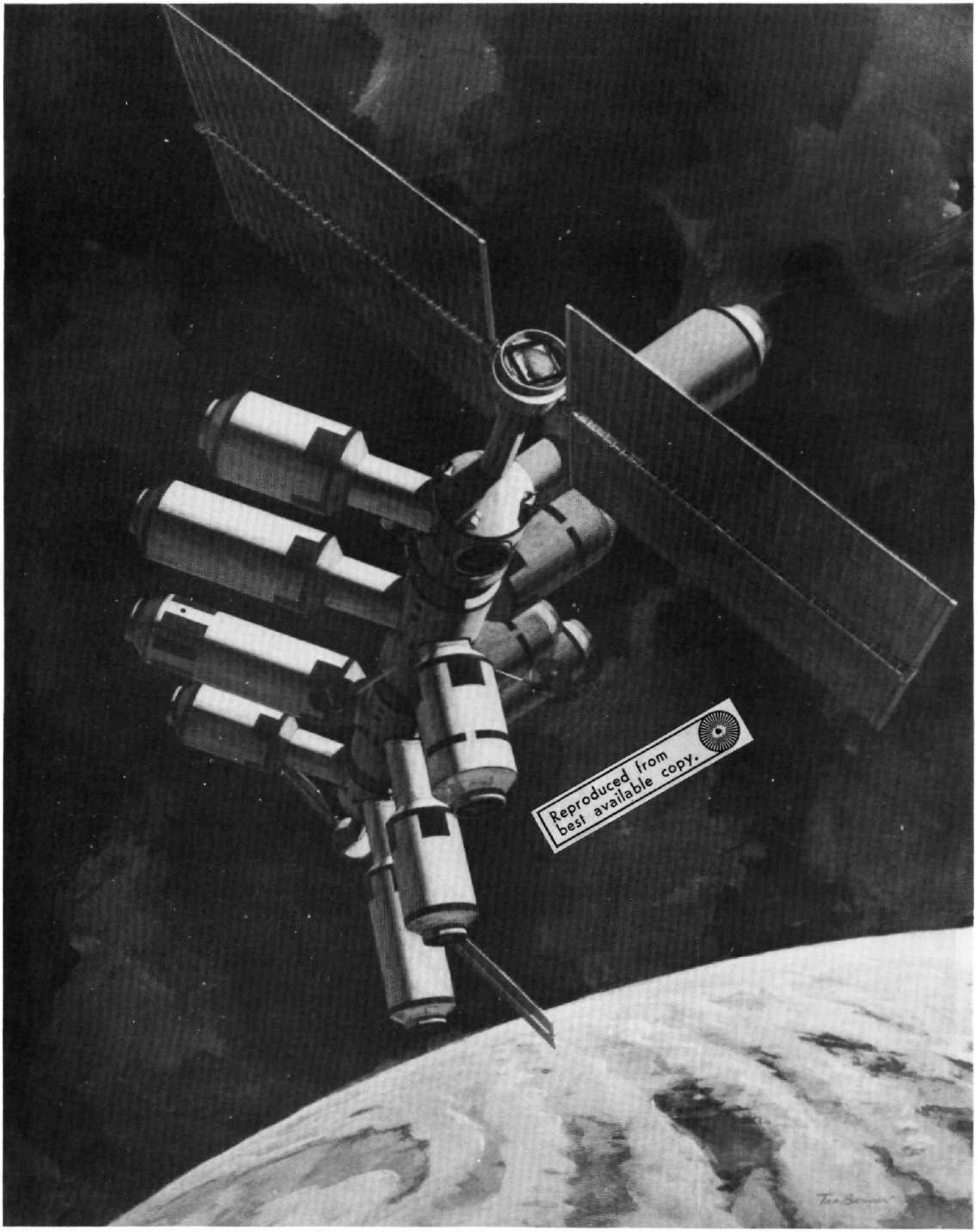
W. A. BROOKSBANK, JR.
MANAGER
SPACE STATION TASK TEAM

APPROVED BY:

T. D. SMITH
VICE PRESIDENT – PROGRAM MANAGER
SPACE STATION

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
5301 Bolsa Avenue, Huntington Beach, CA 92647





PREFACE

The work described in this document was performed under the Space Station Phase B Extension Period Study (Contract NAS8-25140). The purpose of the extension period has been to develop the Phase B definition of the Modular Space Station. The modular approach selected during the option period (characterized by low initial cost and incremental manning) was evaluated, requirements were defined, and program definition and preliminary design were accomplished to the depth necessary for a Phase B exit.

The initial 2-1/2-month effort of the extension period was used for analyses of the requirements associated with Modular Space Station Program options. During this time, a baseline, incrementally manned program and attendant experiment program options were derived. In addition, the features of the program that significantly affect initial development and early operating costs were identified, and their impacts on the program were assessed. This assessment, together with a recommended program, was submitted for NASA review and approval on 15 April 1971.

The second phase of the study (15 April to 3 December 1971) consisted of the program definition and preliminary design of the approved Modular Space Station configuration.

A subject reference matrix is included on page v to indicate the relationship of the study tasks to the documentation.

This report is submitted as Data Requirement CM-04.

DATA REQUIREMENTS (DR's)
MSFC-DPD-235/DR NOs.
(contract NAS8-25140)

Category	Desig-nation	DR Number	Title
Configuration Management	CM	CM-01	Space Station Program (Modular) Specification
		CM-02	Space Station Project (Modular) Specification
		CM-03	Modular Space Station Project Part 1 CEI Specification
		CM-04	Interface and Support Requirements Document
Program Management	MA	MA-01	Space Stations Phase B Extension Study Plan
		MA-02	Performance Review Documentation
		MA-03	Letter Progress and Status Report
		MA-04	Executive Summary Report
		MA-05	Phase D/D Program Development Plan
		MA-06	Program Option Summary Report
Manning and Financial	MF	MF-01	Space Station Program (modular) Cost Estimates Document
		MF-02	Financial Management Report
Mission Operations	MP	MP-01	Space Station Program (Modular) Mission Analysis Document
		MP-02	Space Station Program (Modular) Crew Operations Document
		MP-03	Integrated Mission Management Operations Document
System Engineering and Technical Description	SE	SE-01	Modular Space Station Concept
		SE-02	Information Management System Study Results Documentation
		SE-03	Technical Summary
		SE-04	Modular Space Station Detailed Preliminary Design
		SE-06	Crew/Cargo Module Definition Document
		SE-07	Modular Space Station Mass Properties Document
		SE-08	User's Handbook
		SE-10	Supporting Research and Technology Document
		SE-11	Alternate Bay Sizes

FOLDOUT FRAME 1

FOLDOUT FRAME 2

SUBJECT REFERENCE MATRIX

LEGEND:
- CM Configuration Management
- MA Program Management
- MF Manning and Financial
- MP Mission Operations
- SE System Engineering and Technical Description

	CM				MA		MF	MP			SE								
	CM-01 Space Station Program (Modular) Specification	**CM-02** Space Station Project (Modular) Specification	**CM-03** Modular Space Station Project Part I CEI Spec	**CM-04** Interface and Support Requirement Document	**MA-05** Phase C/D Program Development Plan	**MA-06** Program Option Summary Report	**MF-01** Space Station Program (Modular) Cost Estimates Document	**MP-01** Space Station Program (Modular) Mission Analysis Document	**MP-02** Space Station Program (Modular) Crew Operations Document	**MP-03** Integrated Mission Management Operations Document	**SE-01** Modular Space Station Concept	**SE-02** Information Management System Study Results	**SE-03** Technical Summary	**SE-04** Modular SS Detailed Preliminary Design	**SE-06** Crew/Cargo Module Definition Document	**SE-07** Modular Space Station Mass Properties Document	**SE-08** User's Handbook	**SE-10** Supporting Research and Technology	**SE-11** Alternate Bay Sizes
2.0 Contractor Tasks																			
2.1 Develop Study Plan and Review Past Effort (MA-01)																			
2.2 Space Station Program (Modular) Mission Analysis								●											
2.3 Modular Space Station Configuration and Subsystems Definition														●					
2.4 Technical and Cost Tradeoff Studies							●												
2.4.4 Modular Space Station Option Summary										●									
2.5 Modular Space Station Detailed Preliminary Design														●					
Mass Properties																●			
2.6 Crew Operational Analysis									●										
2.7 Crew Cargo Module															●				
Mass Properties																●			
2.8 Integrated Mission Management Operations										●									
2.9 Hardware Commonality Assessment													●						
2.10 Program Support					●														
2.11 Requirements Definition																			
Space Station Program (Modular)	●																		
Space Station Project (Modular)		●																	
Modular Space Station Project–Part 1 CEI			●																
Interface and Support Requirements				●															
2.12 Plans					●														
2.13 Costs and Schedules							●												
2.14 Special Emphasis Task Information Management (IMS)											●								
Modular Space Station Mass Properties																●			
User's Handbook																	●		
Supporting Research and Technology																		●	
Technical Summary													●						
MOD 29																			●
MOD 40						●													

CONTENTS

Section 1
INTRODUCTION

1.1 BACKGROUND

With the advent of the Space Shuttle in the late 1970's, providing a low cost means for inserting large payloads into various Earth orbits, a long-term manned scientific laboratory in Earth orbit will become feasible. Using the shuttle for orbital buildup, logistics delivery, and return of scientific data, this laboratory will provide many advantages to the scientific community and will make available to the United States a platform for application to the solution of national problems such as ecology research, weather observation and prediction, and research in medicine and the life sciences. It will be ideally situated for Earth and space observation, and its location above the atmosphere will be of great benefit to the field of astronomy.

This orbiting laboratory can take many forms and can be configured to house a crew of up to 12 men. The initial study of the 33-foot-diameter Space Station, launched by the Saturn INT-21 and supporting a complement of 12 crewmen, has been completed to a Phase B level and documented in the DRL-160 series. Recently completed studies are centered around a Modular Space Station comprised of smaller, shuttle-launched modules. These modules could ultimately be configured to provide for a crew of the same size as envisioned for the 33-foot-diameter Space Station—but buildup would be gradual, beginning with a small initial crew and progressing toward greater capability by adding modules and crewmen on a flexible schedule.

The Modular Space Station conceptual analyses are documented in the DRL-231 series. Recent Modular Space Station Phase B study results are documented in the DPD-235 series, of which this is a volume.

The Space Station will provide laboratory areas which, like similar facilities on Earth, will be designed for flexible, efficient changeover as research and experimental programs proceed. Provisions will be included

for such functions as data processing and evaluation, astronomy support, and test and calibration of optics. Zero gravity, which is desirable for the conduct of experiments, will be the normal mode of operation. In addition to experiments carried out within the station, the laboratories will support operation of experiments in separate modules that are either docked to the Space Station or free-flying.

Following launch and activation, Space Station operations will be largely autonomous, and an extensive ground support complex will be unnecessary. Ground activities will ordinarily be limited to long-range planning, control of logistics, and support of the experiment program.

The Initial Space Station (ISS) will be delivered to orbit by three Space Shuttle launches and will be assembled in space. A crew in the Shuttle orbiter will accompany the modules to assemble them and check interfacing functions.

ISS resupply and crew rotation will be carried out via round-trip Shuttle flights using Logistics Modules (Log M's) for transport and on-orbit storage of cargo. Of the four Log M's required, one will remain on orbit at all times.

Experiment modules will be delivered to the Space Station by the Shuttle as required by the experiment program. On return flights, the Shuttle will transport data from the experiment program, returning crewmen, and wastes.

The ISS configuration rendering is shown in the frontispiece. The Power/Subsystems Module will be launched first, followed at 30-day intervals by the Crew/Operations Module and the General Purpose Laboratory (GPL) Module. This configuration will provide for a crew of six. Subsequently, two additional modules (duplicate Crew/Operations and Power/Subsystems Modules) will be mated to the ISS to form the Growth Space Station (GSS) (shown in the frontispiece), which will house a crew of 12 and provide a capability equivalent to the 33-foot INT-21-launched Space Station. GSS logistics support will use a Crew Cargo Module capable of transporting a crew of six.

During ISS operations, a total of five Research Applications Modules (RAM's) will be attached to the Space Station for various intervals. Three of these will be returned prior to completion of the GSS. During GSS operation, 12 additional RAM's will augment the two remaining from the ISS phase. Three of the RAM's delivered to the GSS will be free-flying modules. The GSS has the capability for accomplishing as many as ten RAM's simultaneously.

During the baseline 10-year program, the Space Station will be serviced by Shuttle-supported Logistics Module or Crew Cargo Module flights.

1.2 SCOPE OF THIS VOLUME

The Program, Project, CEI Specifications and Interface and Support Requirements Documents constitute the baseline for all Phase C/D activities and thus Space Station Program development. As shown by Figure 1-1, these specifications have resulted from the orderly development and allocation of requirements which are concise statements of performance or constraints on performance. Guidelines, established by NASA Headquarters, formed the basis for program definition and are identifiable as asterisked paragraphs within the appropriate specifications. This definition was evaluated and further expanded by a systematic development of requirements and collected in Sections 3.1 through 3.5. As this process continued, requirements that affected an interface with other programs were identified in Section 3.6; and requirements which are to be accomplished by a program element (i.e., project) were allocated to that element through Section 3.7. The methods of verifying compliance with these requirements are set forth in Section 4 of the specification.

The requirements identified in Section 3.7 of the Program Specification formed the basis for project definition as the Headquarters Guidelines did for program definition. These requirements were further evaluated and expanded resulting in the allocation of requirements to project elements (i.e., system or CEI) and their interfaces. In a like manner, Section 3.7 of the Project Specification contains those allocated requirements which define system or CEI functional performance. These in turn were evaluated and

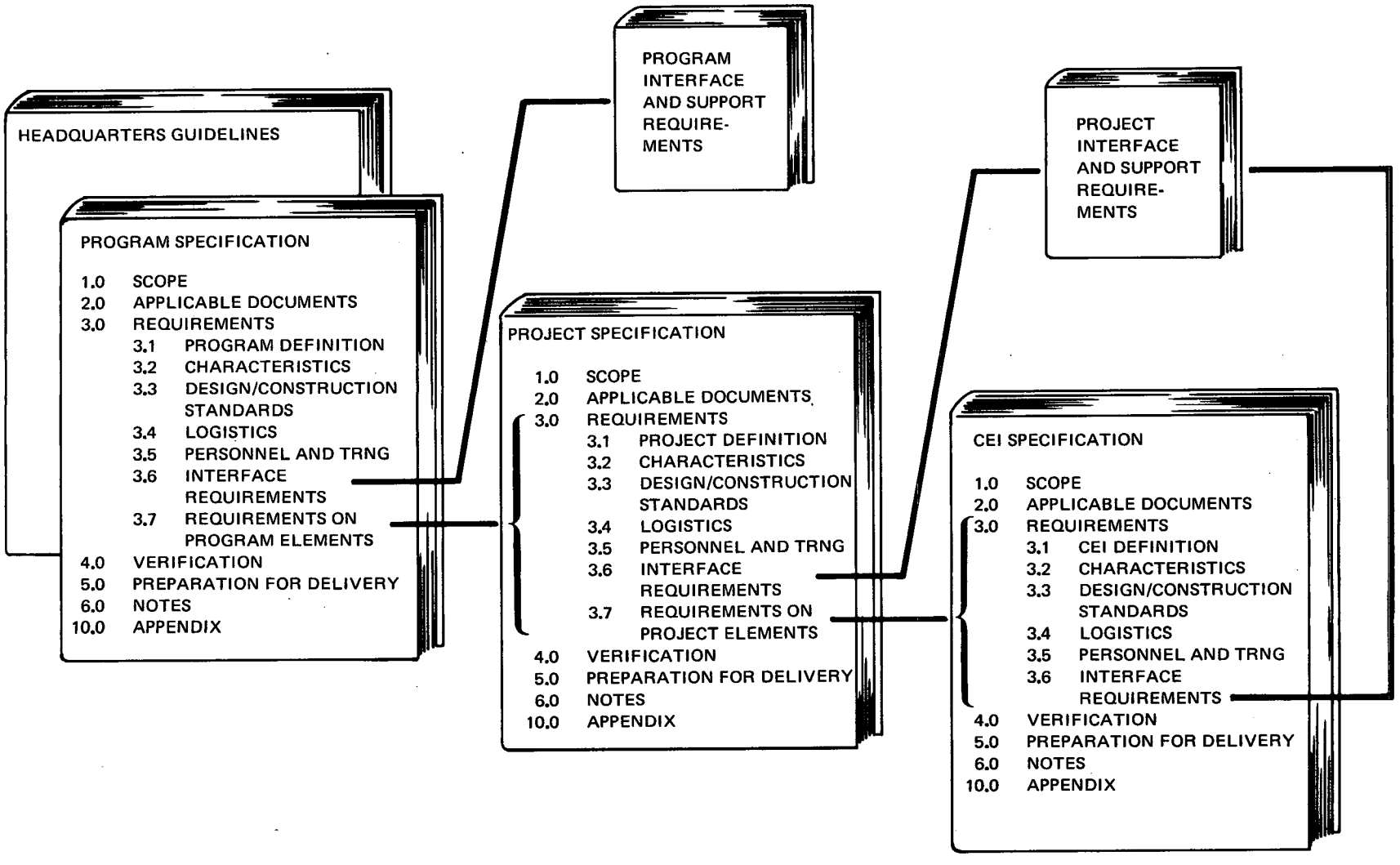


Figure 1-1. Specification Relationships

expanded in each CEI Specification, Part I. Requirements for the verification of design solutions compliance are established in Section 4 of both project and CEI Specifications.

The development and structuring of requirements is vital to the interrelationship of management analyses and controls and performance measurement at various management levels and thus warrants a joint contractor-customer responsibility for the process. The Performance Requirements Document (PRD) was an evolutionary document updated by the Phase B Study contractor, but under MSFC control, which contains all identifiable Space Station Program (Modular), project and system requirements that were defined at any point in time during the study.

This volume contains all requirements identified for the Space Station (Modular) Program. Other requirements are contained in:

CM-01 Space Station Program (Modular) Specification
CM-02 Modular Space Station Project Specification
CM-03 CEI Specifications

Figure 1-2 illustrates the specification hierarchy and the various levels of Interface Requirements for the Space Station Program (Modular).

1.3 GLOSSARY OF TERMS

ISS	Initial Space Station
CEI	Contract End Item
GSS	Growth Space Station
WBS	Work Breakdown Structure
FM	Functional Model
FIT	Flight Integration Tool
PRR	Preliminary Requirement Review
PDR	Preliminary Design Review
RAM	Research and Application Module
CPCEI	Computer Program Contract End Item
CDR	Critical Design Review
CPC	Computer Program Component

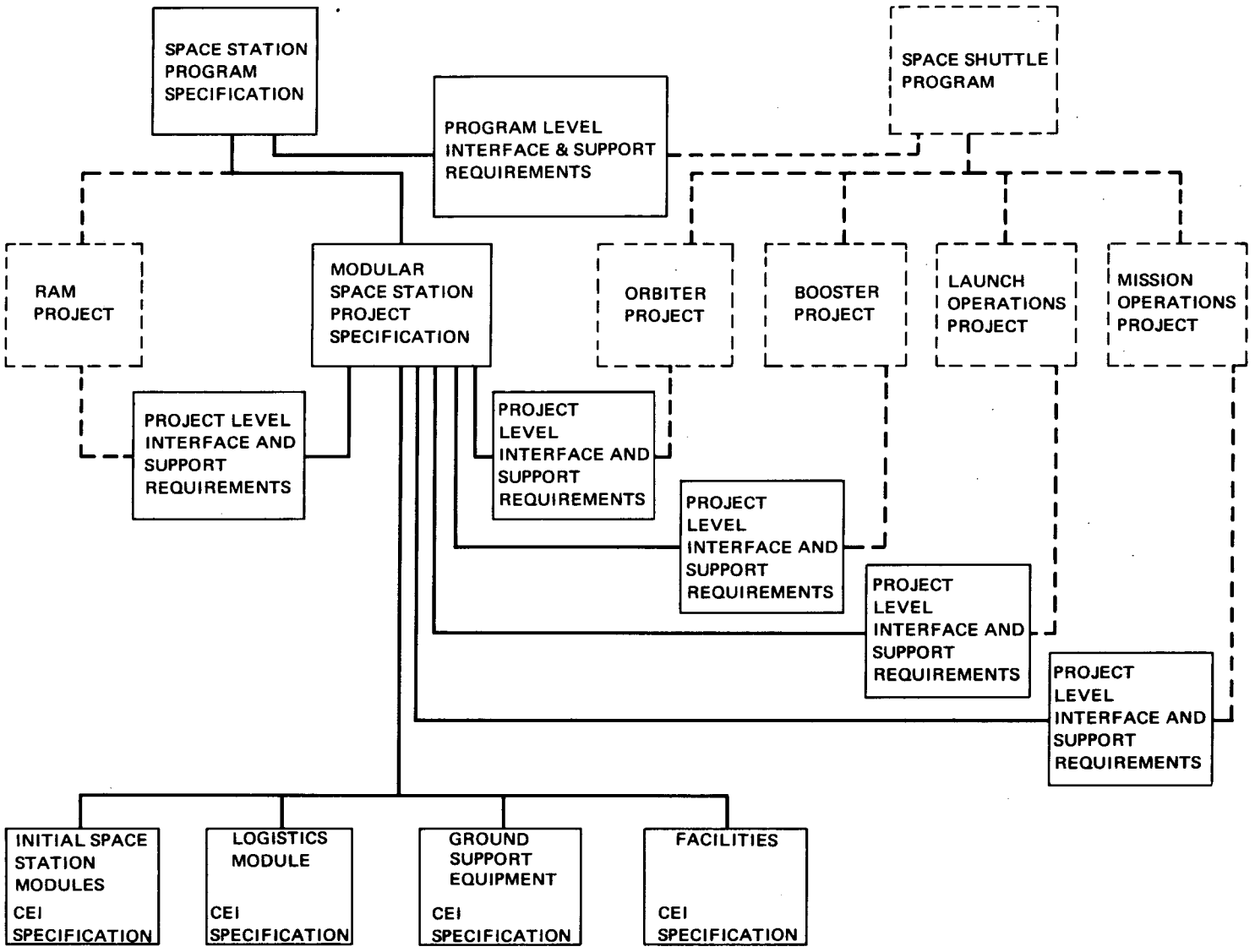


Figure 1-2. Space Station Program Specification Hierarchy

FACI	First Article Configuration Inspection
PPP	Phased Planning Project
FM	Functional Model
ICD	Interface Control Document
ER	Engineering Release
CMG	Control Moment Gyro
CH&P	Crew Habitability and Protection
GPL	General Purpose Laboratory
KSC	Kennedy Space Center
CDRL	Contract Data Requirements List
MSFN	Manned Space Flight Network
OCS	Onboard Checkout System
CIF	Central Instrumentation Facility
MSOB	Manned Spacecraft Operations Building
TDRSS	Tracking Data Relay Satellite System
DRS	Data Relay Satellite
ETR	Eastern Test Range
GBL	Government Bill of Lading
BOD	Beneficial Occupancy Date
FCEI	Facility Contract End Item
LV	Launch Vehicle
GOWG	Ground Operations Working Group
FMEA	Failure Mode, Effect Analysis
I&SR	Interface and Support Requirements
CII	Configuration Identification Index
CSAR	Configuration Status Accounting Report
DRD	Data Requirement Description
IMM	Integrated Mission Management
JOA	Joint Operating Agreement
JOP	Joint Operation Procedures
TWG	Test Working Group
GSI	Government Source Inspection
MRB	Material Review Board
COQ	Certification of Quality

INTERFACE AND SUPPORT REQUIREMENTS

SPACE STATION PROGRAM (MODULAR)/

SPACE SHUTTLE PROGRAM

PROGRAM LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
SPACE STATION PROGRAM (MODULAR)/SPACE SHUTTLE PROGRAM
Outline

1. SCOPE

This Interface and Support Requirement Document defines the interface and support performance, design and confirmation requirements for the Space Station and Space Shuttle Programs and their elements. All interfacing elements and Contract End Items shall conform with these requirements. All requirements shall be fully reflected in specifications for the interfacing elements. The requirements specified herein are limited to the specification of interface and support requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Program fall into two categories; those which are imposed by the Station on Interfacing Programs, and those imposed on the Station by these interfacing programs.

2. APPLICABLE DOCUMENTS

SE-D08-001-1 Project Apollo Co-ordinate System dated June 1965 - 3.6.1.1.1.2.2.

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Space Station (Modular) and Space Shuttle Programs. Each requirement is treated as a separate obligation against each program. Program to program requirements that do not require additional definition at the project interface level and/or will not require Interface Control Documents (ICD) between Contract End Items (CEI) to record and control implementation are contained in Sections 3.1 to 3.5. Program level requirements that do require further allocation at the project interface level are specified in Section 3.6. Appendices to this Interface and Support Requirements document record the specific project to project requirements between major projects of interfacing programs. Specific Requirements between projects are contained in the appendices as noted below:

Appendix A – Modular Space Station Project to Orbiter Project
Appendix B – Modular Space Station Project to Booster Project
Appendix C – Modular Space Station Project to Launch Operation Project

Appendix D—Modular Space Station Project to Mission Operations Project

Appendix E—RAM Project to Orbiter Project

Appendix F—RAM Project to Booster Project

Appendix G—RAM Project to Launch Operations Project

Appendix H—RAM Project to Mission Operations Project

3.1 Program Definition, General

3.1.1 The Space Station Program (Modular is defined by PS02925, Program Specification-Space Station Program (Modular), dated (TBD).

The Space Shuttle Program is defined by Space Shuttle Program Requirements Document Level 1, dated (TBD).

3.1.2 The Space Station Program (Modular) shall consist of the Modular Space Station (MSS) and Research and Applications Modules (RAM) projects.

The Space Shuttle Program shall consist of the Orbiter, Booster, Launch Operations, and Mission Operations projects.

3.1.3 The Space Shuttle Program shall provide transportation for Space Station Program modules to and from low-earth orbit.

3.1.4 The Space Shuttle Program shall provide transportation for Space Station Program modules to and from orbits of 28.5- to 55-degree inclinations and altitudes between 200 and 300 nmi.

3.1.5 The Space Shuttle Program shall be capable of supporting the Space Station Program commencing in CY 1980 and continuing for 10 years.

The Space Station Program shall be planned to provide modular payloads for operation with the Space Shuttle Program commencing in CY 1980.

3.1.6 A synchronous satellite communication system operating in VHF (136 MHz) and Ku (15 GHz) bands, will be available to the Space Shuttle and Space Station Programs to support the first Space Station module launch.

3.1.7 The Space Station Program shall not be required to provide payloads for both the up and down legs of any single Shuttle cycle.

The Space Shuttle Program shall supply an operational capability over the entire range from zero to maximum payload.

3.1.8 The Space Shuttle Program shall provide for the transportation of Space Station modules from the location of initial earth landing to the operating base that supports preparation and launch operations.

3.1.9 The Space Station Program shall be constrained to, and the Space Shuttle Program shall sustain a normal maximum launch rate of TBD per month.

3.2 Characteristics, General

3.2.1 The Space Shuttle Program shall be operationally constrained when carrying Space Station Program payloads to maintain load factors within the limits established in Table 3-1.

Space Station Program payloads shall be capable of withstanding as a minimum the load factors established in Table 3-1.

Table 3-1
LOAD FACTORS

Mission Phase	Axial	Lateral (+)	Vertical
Launch	1.5	0.5	0.5
High Q	1.9	1.0	±1.0
End Boost (Booster)	3.3	0.6	-0.6
End Boost (Orbiter)	3.3	0.5	-0.5
Entry	-0.5	1.0	-2.0
Flyback	-0.5	1.0	+1.0 -2.5
Landing	-1.3	0.5	-2.7
Emergency Landing*	-8.0 +1.5	1.5	-4.5 +2.0

*Emergency landing load factor is 2g ultimate restraint condition.

Load factors are in the direction of the acceleration (axial positive forward; vertical positive down); the resulting loads are in the opposite direction. The load factors for each condition can act simultaneously.

3.2.2 Space Station Program modules shall be capable of withstanding the cargo bay temperature and ambient pressure ranges specified below:

Prelaunch	0 to 100°F (14.7 psi)
Launch Phase	0 to 300°F (TBD psi)
On-Orbit (Doors Closed)	0 to 120°F (0 psi)
On-Orbit (Doors Open)	150 to 300°F (0 psi)
Entry	50 to 300°F (TBD psi)
Post-Entry and Landing	(TBD)

3.2.3 The Space Shuttle Program shall provide a capability to the Space Station Program for inserting payloads of up to 25,000 pounds into a 55°, 270 nmi orbit.

Space Station Module weight delivered to orbit shall not exceed 20,000 pounds. Those payload items located in the Orbiter crew compartment (i.e., passengers, removable provisions and display/control console, etc.) shall not be charged against the module weight.

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

3.4.1 Space Shuttle Program projects and Space Station Program projects shall make maximum use of the logistics facilities of the Mission Management Complex.

3.5 Personnel and Training, General

3.5.1 Space Station Program projects shall be responsible for training all flight personnel for their respective payloads, including remote control of an active element conducting rendezvous with a manned module or vehicle.

Space Shuttle Program projects shall participate in the training identified above and shall assign personnel to the class, as required for acquisition and maintenance of the associated skills.

3.5.2 The Space Shuttle projects shall be responsible for training all flight personnel for on-pad or in-flight emergencies (except those emergencies encountered during the period the payload is separated from the Shuttle).

Space Station projects shall participate in the training identified above and shall assign personnel to classes required for acquisition and maintenance of the associated skills.

3.6 Interface Requirements, Specific

This section records the program-to-program requirements that require project interface level definition.

3.6.1 Interprogram

3.6.1.1 Multilateral

This section contains all bilateral specific requirements which affect two or more interfaces. The appropriate project to project interfaces are noted by parenthetical reference to applicable appendices.

3.6.1.1.1 Requirements

3.6.1.1.1.1 Definition

3.6.1.1.1.1.1 General

3.6.1.1.1.1.1.1 The Space Shuttle shall provide the capability to accomplish rendezvous from a standby status with the orbiting Space Station within 48 hours of notification of an emergency.

The Space Station Programs projects shall provide and maintain in continuous ready condition a Logistics Module/Crew Cargo Module configured for the rescue mission so long as the capability for 48-hour rescue is required.

(Affected Appendices: A and E)

3.6.1.1.1.1.1.2 The Orbiter shall provide for effective and rapid egress of Space Station passengers.

The weight of demountable special equipment for emergency crew accommodation and consumables shall be charged to the Space Station.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.1.3 All passenger ground egress shall be through the Orbiter.

The Space Station equipment/functions shall not interfere with this ingress/egress for routine operations.

(Affected Appendices: A and E)

3.6.1.1.1.1.1.4 The Orbiter shall be capable of providing a habitable environment for the two crewmen and two passengers during normal and emergency modes for the nominal 7-day ground-to-ground mission.

(Affected Appendices: A and E)

3.6.1.1.1.1.1.5 Atmospheric nitrogen and oxygen, water, fuel cell reactant and attitude control propellant required to extend the mission beyond the nominal seven days shall be provided by the Orbiter.

(Affected Appendices: A and E)

3.6.1.1.1.1.1.6 The Orbiter project shall be responsible for the design, development, acquisition, and weight of all common onboard payload interfacing equipment used for module handling and deployment.

Space Station projects shall be responsible for the design, development, acquisition, and weight of peculiar payload handling equipment or adapters.

(Affected Appendices: A and E)

3.6.1.1.1.1.2 Preflight/Post Flight Operations

3.6.1.1.1.1.2.1 Space Station module processing, preflight test, and checkout to assure system performance and compatible payload/Orbiter interfaces shall be performed by the MSS project prior to loading in the Orbiter cargo bay.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.2 Checkout equipment and connections necessary to adapt the payload to the standard Orbiter interfaces and to condition the modules themselves, shall be provided by the payload.

Module checkout systems which might impair shuttle operations shall be controllable from the Orbiter and verified by Shuttle operational crew.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.3 Access to the module will be limited to those items directly accessible through the crew compartment up to TBD time before launch and through the cargo bay doors up to TBD time before launch.

Specialized access equipment beyond the standard interface shall be provided by the MSS/RAM project.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.4 The Orbiter shall provide means of venting module gases to the exterior.

Payload module gases shall be vented to the Orbiter exterior.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.5 The Orbiter shall provide access to MSS and RAM modules in the cargo bay for loading critical cargo up to (TBD) size and (TBD) weight. This access will be provided only prior to late-in-the-count shuttle loading.

The MSS/RAM projects shall minimize and identify late load cargo requirements. On-pad operations shall be scheduled so as to occur prior to shuttle fueling.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.6 The Orbiter shall provide electrical and fluid interface provisions for the Station modules.

Payload modules shall be constrained to utilize ground electrical and fluid connections provided in the Orbiter.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.7 The Orbiter shall provide for on-the-launch pad topping and dumping of hazardous fluids and gases, including cryogenics for all Space Station program modules.

(Affected Appendices: A, C and E)

3.6.1.1.1.1.2.8 The Orbiter shall provide for payload replacement in the vertical position in contingency modes.

Modules shall be designed to permit loading and unloading in both the vertical and horizontal positions.

(Affected Appendices: A and E)

3.6.1.1.1.1.2.9 The Orbiter shall provide for the access to and removal of payload modules in the horizontal position after Orbiter landing.

Payload modules shall be designed to facilitate access and removal in the horizontal position from the cargo bay after Orbiter landing.

(Affected Appendices: A and E)

3.6.1.1.1.1.3 Flight Operations

3.6.1.1.1.1.3.1 MSS/RAM modules shall be designed to interface with the standard deployment provisions and shall provide any supplementary, special purpose deployment equipment as payload support equipment.

The Orbiter shall provide the capability to retain modules in the cargo bay or to deploy the module out of the cargo bay TBD times during a nominal mission. Weight of the standard deployment mechanism shall be chargeable to the Orbiter.

(Affected Appendices: A and E)

3.6.1.1.1.1.3.2 Modules shall be installed and secured in the Orbiter cargo bay TBD hours prior to retro firing and return to earth.

3.6.1.1.1.1.3.3 The Orbiter shall not release liquid or gaseous products in the vicinity of the Space Station.

The Space Station shall be designed and operated to minimize the effect of the environmental contamination introduced by the Orbiter.

(Affected Appendices: A and E)

3.6.1.1.1.1.4 Mission Operations

3.6.1.1.1.1.4.1 The Orbiter shall perform rendezvous and docking maneuvers and shall be capable of docking with a stable, passive and non-cooperative module or station.

The Space Station shall maintain a stable attitude for docking.

(Affected Appendices: A and E)

3.6.1.1.1.1.4.2 The Space Station shall retain the responsibility and authority for all modules and/or spacecraft docking to the cluster and shall be in command (voice) of the docked configuration.

The Orbiter shall have the capability for docking a module to the space station cluster, translating to another port, docking with a second module and returning that module to earth.

(Affected Appendices: A and E)

3.6.1.1.1.1.4.3 The Orbiter project shall provide the capability to deploy payloads on orbit, including placing and abandoning or docking a payload to a stabilized third body. Placing shall include activating the payload systems through proper commands at the hardware interface.

The Space Station project and the RAM project shall supply payloads capable of being activated by proper commands at the hardware interface without requiring Orbiter flight crews to penetrate that interface.

(Affected Appendices: A and E)

3.6.1.1.1.1.4.4 The status of module life critical functions (atmosphere content, pressure, temperature) shall be monitored by the Orbiter up to the time the orbiter dedocks from the module.

(Affected Appendices: A and E)

3.6.1.1.1.1.4.5 The Space Station projects shall not, on a normal basis, plan to use Orbiter crew to assist the Station Crew.

The Orbiter shall not, on a normal basis, use station crew for Orbiter monitoring tasks.

(Affected Appendices: A and E)

3.6.1.1.1.1.4.6 Transfer of personnel or cargo through the docking port between a module and Orbiter shall be possible without removal of any part of the docking hardware.

(Affected Appendices: A and E)

3.6.1.1.1.2 Characteristics

3.6.1.1.1.2.1 Performance

3.6.1.1.1.2.1.1 The Orbiter deployment mechanism shall be capable of releasing the payload modules in a stable mode with minimum disturbing torques.

Payload module release mechanisms shall be capable of deployment while maintaining a stable mode with minimum disturbing torques.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.2 The Orbiter shall provide mechanisms for vibration isolation and load attenuation from the payload modules.

Payload modules shall be designed to accommodate mechanisms in the cargo bay for vibration isolation and load attenuation to meet requirements of 3.2.1.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.3 The Orbiter and Payload modules shall be capable of full duplex voice communications.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.4 The Orbiter shall be capable of monitoring critical MSS module functions which may be potentially hazardous to the mission.

MSS/RAM modules shall provide onboard capability to monitor critical functions to enable the status to be determined by the Orbiter.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.5 The Oribter shall be capable of rendezvousing with MSS/RAM modules and shall provide suitable braking, and/or wave-off response capability, to permit docking abort up to the point of contact. Initiation of abort shall be controlled either manually or automatically by the Orbiter and module crews. Docking/undocking shall be verified within both vehicles.

MSS/RAM modules, individually or collectively, shall maintain a stable orbit for rendezvous.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.6 MSS/RAM modules shall be designed so that they may be transported by the Orbiter without modification and extensive payload-transport integration or testing.

The Orbiter shall transport MSS/RAM modules without extensive integration testing.

(Affected Appendices: A and E)

3.6.1.1.1.2.1.7 The Orbiter shall not be required to provide active heating or cooling of Space Station modules but shall provide temperature control for the airlock and access passageways to the Station module.

Any thermal control required other than that stated above shall be provided by and charged to the Space Station module.

3.6.1.1.1.2.1.8 The Orbiter shall provide a minimum of 20 KW hours at the interface allocated at a nominal rate of 500 w and 800 w peak.

Space Station modules shall provide for any additional power capability.

(Affected Appendices: A and E)

3.6.1.1.1.2.2 Physical

3.6.1.1.1.2.2.1 The Space Shuttle Program shall provide emergency escape passageways with a minimum clearance of 30 inches wide by 78 inches high external to the flight vehicle plus (TBD) area to accommodate drag-on service cables, lines, ducts, etc.

Space Station Program modules shall be constrained in the provisioning of support equipment (drag-on hoses, adjacent equipment, or control boxes) and establishment of procedures so as to maintain the escape passageway clearances required in paragraph above.

(Affected Appendices: A and E)

3.6.1.1.1.2.2.2 The maximum external dimensions of the Space Station program modules shall be 14 feet in diameter and 58 feet in length. Mechanisms that are external but attached to the module, such as handling rings, attachments for deployment, storage fittings, or thrustors, shall be contained at launch within an envelope 15 feet in diameter and 60 feet in length.

The Orbiter cargo bay shall be sized to have a clear volume of 15 feet in diameter by 60 feet in length.

(Affected Appendices: A and E)

3.6.1.1.1.2.2.3 Orbiter Project shall specify the maximum c.g. limitations within which the payloads and cargo loading are to be restricted.

The MSS/RAM shall identify a maximum c.g. envelope for payload module increments and cargo loading which must be within the Shuttle capabilities.

(Affected Appendices: A and E)

3.6.1.1.1.2.2.4 The Orbiter shall provide the capability for determining mechanical alignment of modules to the reference axis system of the Orbiter.

Modules requiring positioning within the Orbiter cargo bay to satisfy center of gravity requirements shall provide any necessary adapter provisions to mate with standard Orbiter provisions. Reference SE-008-001-1 Project Apollo Coordinate System.

(Affected Appendices: A and E)

3.6.1.1.1.2.2.5 The Orbiter shall provide shirtsleeve access to the Space Station program module.

(Affected Appendices: A and E)

3.6.1.1.1.2.2.6 All Orbiter docking mechanisms shall be configured to permit mating with any module, inherently or with use of a standard adapter kit, and shall provide a hatch with a clear passage of 5 ft in diameter.

All MSS module docking ports shall be configured to permit mating with any other docking port or mechanism. Each port shall have one or more targets or devices to aid docking operations and shall provide a hatch with a clear passage of 5 ft in diameter. Any adapter kits shall be provided by the MSS project.

(Affected Appendices: A and E)

3.6.1.1.1.2.3 Reliability

None identified

3.6.1.1.1.2.4 Maintainability

None identified

3.6.1.1.1.2.5 Operational Availability

None identified

3.6.1.1.1.2.6 Safety

3.6.1.1.1.2.6.1 The Orbiter shall provide rapid egress for all payload passengers, support, service, or launch crews from the program hardware interface to a safe area or position.

Space Station program modules shall provide appropriate warning signals to the Orbiter interfaces for imminent peril originating from or identified from the payload side of the program interface.

(Affected Appendices: A and E)

3.6.1.1.1.2.6.2 Orbiter systems shall not utilize pyrotechnics which produce unusual loads on the payload modules or create hazards.

The Space Station program payloads shall be designed to withstand shock and vibration loads imposed by Shuttle operation.

(Affected Appendices: A and E)

3.6.1.1.1.2.7 Environment

None identified

3.6.1.1.1.2.8 Transportation/Transportability

None identified

3.6.1.1.1.2.9 Storage

None identified

3.6.1.1.1.3 Design and Construction Standards

None identified

3.6.1.1.1.4 Logistics

None identified

3.6.1.1.1.5 Personnel and Training

None identified

3.6.1.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.1.1.3 Exchange Services and Performance Periods

None identified

3.6.1.2 Modular Space Station Project/Orbiter Project

Reference Appendix A

3.6.1.3 Modular Space Station Project/Booster Project

Reference Appendix B (TBD)

3.6.1.4 Modular Space Station Project/Launch Operations Project

Reference Appendix C (TBD)

3.6.1.5 Modular Space Station Project/Mission Operations Project

Reference Appendix D (TBD)

3.6.1.6 RAM Project/Orbiter Project

Reference Appendix E (TBD)

3.6.1.7 RAM Project/Booster Project

Reference Appendix F (TBD)

3.6.1.8 RAM Project/Launch Operations Project

Reference Appendix G (TBD)

3.6.1.9 RAM Project/Mission Operations Project

Reference Appendix H (TBD)

3.6.2 Intraprogram

This paragraph is not applicable to this document.

3.6.3 Interproject

This paragraph is not applicable to this document.

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not specify the manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in Section 4 of the applicable specifications.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Program managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

With the guideline of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the program, project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

10. APPENDIX

Appendix A—Modular Space Station Project/Orbiter Project

PROGRAM LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
SPACE STATION PROGRAM (MODULAR)/SPACE SHUTTLE PROGRAM

APPENDIX A
MODULAR SPACE STATION PROJECT/ORBITER PROJECT

3.0 SPECIFIC REQUIREMENTS

3.1 Requirements

3.1.1 Definition

3.1.1.1 General

3.1.1.1.1 The Modular Space Station Project is defined by RS02927, Project Specification—Modular Space Station Program, dated (TBD).

The Orbiter Project is defined by (TBD) dated (TBD)

3.1.1.1.2 Reference paragraph 3.6.1.1.1.1.1.1

3.1.1.1.3 Reference paragraph 3.6.1.1.1.1.1.2

3.1.1.1.4 Reference paragraph 3.6.1.1.1.1.1.3

3.1.1.1.5 Reference paragraph 3.6.1.1.1.1.1.4

3.1.1.1.6 Reference paragraph 3.6.1.1.1.1.1.5

3.1.1.1.7 Reference paragraph 3.6.1.1.1.1.1.6

3.1.1.1.8 The Orbiter shall provide transport to and from orbit for MSS modules and support ISS and GSS orbital buildup.

3.1.1.2 Preflight/Post Flight Operations

3.1.1.2.1 Reference paragraph 3.6.1.1.1.1.2.1

3.1.1.2.2 Reference paragraph 3.6.1.1.1.1.2.2

3.1.1.2.3 Reference paragraph 3.6.1.1.1.1.2.3

3.1.1.2.4 Reference paragraph 3.6.1.1.1.1.2.4

3.1.1.2.5 Reference paragraph 3.6.1.1.1.1.2.5

3.1.1.2.6 Reference paragraph 3.6.1.1.1.1.2.6

3.1.1.2.7 Reference paragraph 3.6.1.1.1.1.2.7

3.1.1.2.8 Reference paragraph 3.6.1.1.1.1.2.8

3.1.1.2.9 Reference paragraph 3.6.1.1.1.1.2.9

3.1.1.3 Flight Operations

3.1.1.3.1 The Orbiter shall have responsibility for command when Space Station modules are in the cargo bay.

3.1.1.3.2 The Orbiter shall maintain a manned passenger compartment atmosphere and total pressure which is compatible with the Space Station.

After initial activation, the Space Station when docked with the Orbiter shall provide a shirtsleeve environment for all normal crew activities, i.e., 14.7 psia total, including access between habitable areas.

3.1.1.3.3 Reference paragraph 3.6.1.1.1.1.3.1

3.1.1.3.4 Reference paragraph 3.6.1.1.1.1.3.2

3.1.1.3.5 Reference paragraph 3.6.1.1.1.1.3.3

3.1.1.4 Mission Operations

3.1.1.4.1 During ISS orbital buildup operations the Orbiter shall remain docked to and in control of the module(s) while crewmen are onboard and until it is determined that the configuration is operational.

3.1.1.4.2 When supporting Space Station normal orbital operations, the Orbiter shall remain docked to or in the vicinity of the Space Station, not to exceed 5 days.

Space Station normal orbital operations shall not require Orbiter presence to exceed 5 days for any one mission.

3.1.1.4.3 The Space Station project shall establish safety requirements to be imposed upon clustered Space Station and RAM modules.

The Orbiter shall meet established cluster safety requirements when docked to the Space Station.

3.1.1.4.4 The Orbiter shall minimize release of liquid or gaseous products in the vicinity of the Space Station.

The Space Station shall be designed and operated to minimize the effect of the environmental contamination introduced by the Orbiter.

3.1.1.4.5 Reference paragraph 3.6.1.1.1.1.4.1

3.1.1.4.6 Reference paragraph 3.6.1.1.1.1.4.2

3.1.1.4.7 Reference paragraph 3.6.1.1.1.1.4.3

3.1.1.4.8 Reference paragraph 3.6.1.1.1.1.4.4

3.1.1.4.9 Reference paragraph 3.6.1.1.1.1.4.5

3.1.1.4.10 Reference paragraph 3.6.1.1.1.1.4.6

3.1.2 Characteristics

3.1.2.1 Performance

3.1.2.1.1 Reference paragraph 3.6.1.1.1.2.1.1

3.1.2.1.2 Reference paragraph 3.6.1.1.1.2.1.2

3.1.2.1.3 Reference paragraph 3.6.1.1.1.2.1.3

3.1.2.1.4 Reference paragraph 3.6.1.1.1.2.1.4

3.1.2.1.5 Reference paragraph 3.6.1.1.1.2.1.5

3.1.2.1.6 Reference paragraph 3.6.1.1.1.2.1.6

3.1.2.1.7 Reference paragraph 3.6.1.1.1.2.1.7

3.1.2.2 Physical

3.1.2.2.1 Reference paragraph 3.6.1.1.1.2.2.1

3.1.2.2.2 Reference paragraph 3.6.1.1.1.2.2.2

3.1.2.2.3 Reference paragraph 3.6.1.1.1.2.2.3

3.1.2.2.4 Reference paragraph 3.6.1.1.1.2.2.4

3.1.2.2.5 Reference paragraph 3.6.1.1.1.2.2.5

3.1.2.2.6 Reference paragraph 3.6.1.1.1.2.2.6

3.1.2.3 Reliability

None identified

3.1.2.4 Maintainability

None identified

3.1.2.5 Operational Availability

None identified

3.1.2.6 Safety

3.1.2.6.1 Reference paragraph 3.6.1.1.1.2.6.1

3.1.2.6.2 Reference paragraph 3.6.1.1.1.2.6.3

3.1.2.7 Environment

None identified

3.1.2.8 Transportation/Transportability

None identified

3.1.2.9 Storage

None identified

3.1.3 Design and Construction Standards

None identified

3.1.4 Logistics

None identified

3.1.5 Personnel and Training

None identified

3.2 Exchange Hardware and Delivery Dates

None identified

3.3 Exchange Services and Performance Periods

INTERFACE AND SUPPORT REQUIREMENTS

MODULAR SPACE STATION PROJECT/SHUTTLE ORBITER PROJECT

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/ORBITER PROJECT

Outline

1. SCOPE

This Interface and Support Requirements Document defines the interface and support performance, design and confirmation requirements for the Modular Space Station Project and Space Shuttle Orbiter Project and their respective end items. All interfacing end items shall conform with the bilaterally agreed upon requirements established in this document and referenced in their respective specifications. The requirements specified are limited to project level requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Project fall into two categories; those which are imposed by the Space Station Projects on the Shuttle Orbiter Projects, and those which are imposed on the Space Station Project by the Orbiter Project.

2. APPLICABLE DOCUMENTS

None identified

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Modular Space Station (MSS) and Orbiter Projects. Each requirement is treated as a separate obligation against each project. Project to project requirements that do not require additional definition at the Contract End Item (CEI) interface level and/or will not require Interface Control Documents (ICD) to record and control implementation are contained in Sections 3.1 to 3.5. Requirements whose design solutions are implemented at the CEI level by ICD's are specified in Section 3.6. Appendices to this Interface and Support Requirements Document record the specific CEI to CEI Requirements between CEI's of interfacing Programs. Specific Requirements between interfacing inter-program CEIs are contained in the appendices as noted below:

Appendix A	ISS Module CEI to Orbiter CEI
Appendix B	Logistics Module CEI to Orbiter CEI
Appendix C	Ground Support Equipment CEI to Orbiter CEI
Appendix D	Integral Experiments CEI to Orbiter CEI

3.1 Project Definition, General

3.1.1 The MSS Project is defined by RS02927, Project Specification – Modular Space Station Project, dated (TBD).

The Orbiter Project is defined by (TBD), dated (TBD).

3.2 Characteristics, General

None identified

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

None identified

3.5 Personnel and Training, General

None identified

3.6 Specific Requirements

3.6.1 Interprogram

3.6.1.1 Multilateral

This section contains all bilateral CEI level to CEI level requirements which affect two or more interfaces. The appropriate interfaces are noted by parenthetical reference to applicable appendices.

3.6.1.1.1 Requirements

3.6.1.1.1.1 Definition

None identified

3.6.1.1.1.2 Characteristics

3.6.1.1.1.2.1 Performance

None identified

3.6.1.1.1.2.2 Physical

None identified

3.6.1.1.1.2.3 Not Applicable

3.6.1.1.1.2.4 Not Applicable

3.6.1.1.1.2.5 Not Applicable

3.6.1.1.1.2.6 Safety

None identified

3.6.1.1.1.2.7 Not Applicable

3.6.1.1.1.2.8 Not Applicable

3.6.1.1.1.2.9 Not Applicable

3.6.1.1.1.3 Design/Construction Standards

None identified

3.6.1.1.1.4 Logistics

None identified

3.6.1.1.1.5 Personnel and Training

None identified

3.6.1.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.1.1.3 Exchange Services and Performance Periods

None identified

3.6.1.2 ISS Module CEI/Orbiter CEI

Reference Appendix A

3.6.1.3 Logistics Module CEI/Orbiter CEI

Reference Appendix B (TBD)

3.6.1.4 Ground Support Equipment/Orbiter CEI

Reference Appendix C (TBD)

3.6.1.5 Integral Experiments/Orbiter CEI

Reference Appendix D (TBD)

3.6.2 Not Applicable

3.6.3 Not Applicable

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not specify the manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in the respective specification.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Project managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

Within the guideline of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for

compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

None identified

10. APPENDIX

Appendix A, Interface and Support Requirements, ISS Modules CEI/Orbiter CEI

Appendix B, Logistics Module CEI/Orbiter CEI

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/ORBITER PROJECT

APPENDIX A
ISS MODULES CEI/ORBITER CEI

3. SPECIFIC REQUIREMENTS

3.1 Requirements

3.1.1 Definition

3.1.1.1 The initial Space Station Module's CEI is defined by CP02929 dated (TBD)

The Orbiter CEI is defined by (TBD) dated (TBD).

3.1.1.2 The Orbiter shall transport each ISS module to and from orbit. ISS equipment may be removed and delivered to orbit in the Log M and installed in appropriate ISS module to meet orbiter payload requirements.

3.1.1.3 Provisions shall be made for replacement or revision of onboard computer programs. These changes may be received uplink via the communications subsystem or carried aboard a Shuttle flight.

3.1.1.4 The ISS design shall be compatible with utilization of a direct docked Logistics Module for crew ingress and egress.

3.1.1.5 Each ISS module shall provide the Orbiter with the capability of monitoring critical functions during prelaunch, launch and activation.

3.1.2 Characteristics

3.1.2.1 Performance

3.1.2.1.1 Environmental Control and Life Support

3. 1. 2. 1. 1. 1 During activation, the Orbiter shall provide each module with (TBD) cfm air at the interface. The ISS EC/LS shall be compatible with this activation concept which requires temporary ducting to accomplish air distribution.

3. 1. 2. 1. 1. 2 The environmental control and life support subsystem shall provide an atmosphere which is compatible with the Orbiter atmosphere to the extent that crew transfer without use of the airlock shall be feasible during activation or rescue operations.

3. 1. 2. 1. 2 Structural/Mechanical

3. 1. 2. 1. 2. 1 The structural/mechanical subsystem docking and hatch mechanisms, located at the end of each ISS Module, shall interface with the Shuttle Orbiter, providing the capability for direct docking and shirtsleeve crew transfer, in support of contingency operations requirements as well as buildup operations.

3. 1. 2. 1. 2. 2 The structural/mechanical subsystem shall provide the Shuttle Orbiter attach fittings on each ISS module. These fittings shall be capable of providing the physical interface with the Orbiter during prelaunch, launch, erection, activation, and docking of one ISS module to another. In addition, they shall be compatible with the requirement to return any module from orbit to Earth.

3. 1. 2. 1. 3 Electrical Power

3. 1. 2. 1. 3. 1 During buildup, the Shuttle Orbiter shall provide the following services to the Crew/Operations and GPL Modules:

a) 0. 5 kw average power at 120 ± 10 vdc (nominal)
b) 0. 8 kw peak power
c) up to 20 kw hr of energy.

3. 1. 2. 1. 3. 2 The Power/Subsystems Module shall be launched with four internal batteries. During buildup, the Shuttle Orbiter shall provide backup power as specified in 3. 1. 2. 1. 3. 1 and the module internal batteries shall be the primary source.

3.1.2.1.3.3 The ISS modules shall be capable of accommodating the Shuttle Orbiter voltage which is higher than the Space Station source voltage.

3.1.2.1.4 Propulsion

3.1.2.1.4.1 The ISS Modules shall provide the Orbiter with a caution and warning system to inform the crew of any propulsion status change that indicates a hazard. Limited control functions such as venting and dumping shall be included if required. The status information and commands will be transferred on the data bus. The interface will be limited to the Power/Subsystems Module and shall include:

a) N_2H_4 tank pressure and temperature
b) GN_2 tank pressure and temperature
c) System status discretes
d) Vent valve controls

3.1.2.1.5 Stability and Attitude Control

3.1.2.1.5.1 ISS body attitudes and rates shall be maintained below 0.25 degrees and 0.005 degree per second respectively for all docking operations.

3.1.2.1.5.2 The ISS shall provide attitude and navigation data to the Orbiter via the data management subsystem for initialization prior to separation. Navigation information shall be within ±5.5 km (±3.0 n. mi).

3.1.2.1.6 Communications

3.1.2.1.6.1 The ISS shall be capable of receiving and demodulating the S-Band signal transmitted by the Orbiter and transmitting the S-Band signal to the Orbiter. The S-Band signal shall be (TBD).

3.1.2.1.6.2 Voice communications between the ISS and docked Orbiter shall be provided on the analog data bus.

3.1.2.1.6.3 While docked to the Orbiter, during buildup, the ISS VHF links shall be capable of being utilized.

3.1.2.1.6.4 During ISS buildup operations voice communications shall be provided between the module activation crew and the Shuttle Orbiter.

3.1.2.1.6.5 The ISS shall be capable of determining the Shuttle Orbiter range and range rate.

3.1.2.1.7 Data Management

3.1.2.1.7.1 ISS data management shall interface with the Shuttle Orbiter through hardwire connections to provide status of critical parameters of each ISS module to the Shuttle Orbiter crew and to permit crew initiation of activation and checkout of each ISS module. These hardwire connections are identified as: (TBD)

3.1.2.1.8 Crew Habitability and Protection

None identified

3.1.2.1.9 Onboard Checkout and Fault Isolation

The ISS onboard checkout and fault isolation subsystem shall interface electrically with the Shuttle Orbiter via the data management subsystem for purposes of monitoring critical parameters related to crew or equipment safety, and for conducting the ISS subsystem checkout required prior to crew entry into each module during buildup operations. This interface shall also be utilized during prelaunch and launch monitoring.

3.1.2.1.10 Experiment Support Equipment

None identified

3.1.2.2 Physical

3.1.2.2.1 Mechanisms that are attached to the module during launch but are external to the pressure shell, such as handling rings, attachments for deployment, docking mechanisms, thrustors, antenna deployment booms, etc., shall be contained, at launch, within an envelope of 4.6m (15 ft) diameter and 18.3m (60 ft) length. Exceptions are the structural support

fittings at the Shuttle payload interface support points which are outside of the 4.6m (15 ft) envelope.

3.1.2.2.2 Each ISS module shall not be designed to preclude limited ingress and egress to gain interior access after installation of the module in the orbiter with the Shuttle vertical. Crew support ladders, platforms, etc., shall be provided as ground support equipment.

3.1.2.3 Not Applicable

3.1.2.4 Not Applicable

3.1.2.5 Not Applicable

3.1.2.6 Safety

None identified

3.1.2.7 Not Applicable

3.1.2.8 Not Applicable

3.1.2.9 Not Applicable

3.1.3 Not Applicable

3.1.4 Logistics

None identified

3.1.5 Personnel and Training

None identified

3.2 Exchange Hardware and Delivery Dates

None identified

3.3 Exchange Services and Performance Periods

None identified

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/ORBITER PROJECT

APPENDIX B
LOGISTICS MODULE CEI/ORBITER CEI

3. SPECIFIC REQUIREMENTS

3.1 Requirements

3.1.1 Definition

3.1.1.1 The Logistics Module CEI is defined by CP02930, dated (TBD).

The Orbiter CEI is defined by (TBD) dated (TBD).

3.1.1.2 The Log M shall interface with the Space Shuttle Orbiter for delivery and return from orbit. In addition, the Log M shall provide the normal orbital interface for "Shuttle only" crew rotation.

3.1.1.3 As a design goal, it shall be possible to determine launch readiness status through the combination of Shuttle monitoring of the Log M and limited transfer of data through the Shuttle to GSE.

3.1.1.4 The Log M shall be designed to be compatible with Shuttle loading facilities, including provision for direct attachment of hoisting GSE used to install modules in the Shuttle.

3.1.1.5 The Log M shall be designed to be launched by the Shuttle with a minimum of active functions at the interface, to include the capability for redundant monitoring of critical functions by the Shuttle. Critical functions shall be limited to those which are safety-related.

3.1.1.6 The Log M shall be designed to be compatible with a maximum Shuttle on-orbit activation support time of 115 hours.

3.1.1.7 The Log M shall be designed for shirtsleeve activation. In addition, the design shall provide for the crew to enter in IVA pressure suits, maintaining atmospheric separation from the Shuttle by utilization of the docking port airlock. Equipment shall be designed for achieving and confirming module habitability as early as possible and completing activation in shirtsleeves with free access to the Shuttle.

3.1.2 Characteristics

3.1.2.1 Performance

3.1.2.1.1 Environmental Control and Life Support

3.1.2.1.1.1 The Log M environmental control and life support subsystem shall be compatible with the activation concept which requires the Orbiter to provide atmosphere during activation. This shall be accomplished with temporary ducting as required.

3.1.2.1.1.2 The Log M environmental control and life support subsystem shall provide an atmosphere which is compatible with the Orbiter atmosphere to the extent that crew transfer without use of the airlock shall be feasible during activation or rescue operations.

3.1.2.1.2 Crew Habitability and Protection

None identified

3.1.2.1.3 Structural/Mechanical

3.1.2.1.3.1 The structural/mechanical subsystem docking and hatch mechanisms, located at the end of the Log M, shall interface with the Shuttle Orbiter, providing the capability for direct docking and shirtsleeve crew transfer, in support of contingency operations requirements as well as buildup operations.

3.1.2.1.3.2 The structural/mechanical subsystem shall provide the Shuttle Orbiter attach fittings on each Log M. These fittings shall be capable of providing the physical interface with the Orbiter during prelaunch,

launch, erection, activation, and docking. In addition, they shall be compatible with the requirement to return the module from Orbit to Earth.

3.1.2.1.4 Propulsion

The propulsion interface with the Orbiter shall provide caution and warning system to inform the crew of any propulsion status change that indicates a hazard. Limited control functions such as venting an and dumping shall be included if required. The status information and commands will be transferred on the data bus. The interface shall include:

a) N_2H_4 tank pressure and temperature
b) GN_2 tank pressure and temperature
c) System status discretes
d) Vent valve controls

3.1.2.1.5 Electrical Power

3.1.2.1.5.1 The Shuttle Orbiter shall provide the following services to the Logistics Module:

a) 0.5 kw average power at 120 ± 10 vdc (nominal)
b) 0.8 kw peak power
c) up to 20 kw hr of energy

3.1.2.1.5.2 The Log M shall be capable of accommodating the Shuttle Orbiter voltage which is higher than the Space Station source voltage.

3.1.2.1.6 Data Management

3.1.2.1.6.1 Data management shall interface with the Shuttle Orbiter through hardwire connections to provide status of critical parameters of the Log M to the Shuttle Orbiter crew and to permit crew initiation of activation.

3.1.2.1.7 Onboard Checkout and Fault Isolation

3.1.2.1.7.1 The Log M onboard checkout and fault isolation subsystem shall interface electrically with the Shuttle Orbiter via the data management subsystem for purposes of monitoring critical parameters

related to crew or equipment safety, and for conducting the ISS subsystem checkout required prior to crew entry into each module during activation. This interface shall also be utilized during prelaunch and launch monitoring.

3. 1. 2. 2 Physical

None identified

3. 1. 2. 3 Not Applicable

3. 1. 2. 4 Not Applicable

3. 1. 2. 5 Not Applicable

3. 1. 2. 6 Safety

None identified

3. 1. 2. 7 Not Applicable

3. 1. 2. 8 Not Applicable

3. 1. 2. 9 Not Applicable

3. 1. 3 Not Applicable

3. 1. 4 Logistics

None identified

3. 1. 5 Personnel and Training

None identified

3. 2 Exchange Hardware and Delivery Dates

None identified

3. 3 Exchange Services and Performance Periods

None identified

Document No. RS02933
Date 15 December 1971

INTERFACE AND SUPPORT REQUIREMENTS

MODULAR SPACE STATION PROJECT/BOOSTER PROJECT

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/BOOSTER PROJECT
Outline

1. SCOPE

This Interface and Support Requirements Document defines the interface and support performance, design and confirmation requirements for the Modular Space Station Project and Space Shuttle Booster Project and their respective end items. All interfacing end items shall conform with the bilaterally agreed upon requirements established in this document and referenced in their respective specifications. The requirements specified are limited to project level to project level requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Project fall into two categories; those which are imposed by the Space Station Project on the Shuttle Booster Project, and those imposed by the Shuttle Booster Project on the Space Station Project.

2. APPLICABLE DOCUMENTS

None identified.

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Modular Space Station (MSS) and Booster Projects. Each requirement is treated as a separate obligation against each project. Project to project requirements that do not require additional definition at the Contract End Item (CEI) interface level and/or will not require Interface Control Documents (ICD) to record and control implementation are contained in Sections 3.1 to 3.5. Requirements whose design solutions are implemented at the CEI level by ICD's are specified in Section 3.6.

3.1 Project Definition, General

3.1.1 The MSS Project is defined by PSO2927, Project Specification - Modular Space Station Project, dated (TBD).

The Booster Project is defined by (TBD), dated (TBD).

3.2 Characteristics, General

None identified

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

None identified

3.5 Personnel and Training, General

None identified

3.6 Specific Requirements

3.6.1 Interprogram

3.6.1.1 Multilateral

This section contains all bilateral CEI level to CEI level requirements which affect two or more interfaces. The appropriate interfaces are noted by parenthetical reference to applicable appendices.

3.6.1.1.1 Requirements

3.6.1.1.1.1 Definition

None identified

3.6.1.1.1.2 Characteristics

3.6.1.1.1.2.1 Performance

None identified

3.6.1.1.1.2.2 Physical

None identified

3.6.1.1.1.2.3 Not Applicable

3.6.1.1.1.2.4 Not Applicable

3.6.1.1.1.2.5 Not Applicable

3.6.1.1.1.2.6 Safety

None identified

3.6.1.1.1.2.7 Not Applicable

3.6.1.1.1.2.8 Not Applicable

3.6.1.1.1.2.9 Not Applicable

3.6.1.1.1.3 Design/Construction Standards

None identified

3.6.1.1.1.4 Logistics

None identified

3.6.1.1.1.5 Personnel and Training

None identified

3.6.1.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.1.1.3 Exchange Services and Performance Periods

None identified

3.6.1.2 ISS Modules/Booster CEI - Appendix A (TBD)

3.6.1.3 Logistics Module/Booster CEI - Appendix B (TBD)

3.6.1.4 GSE/Booster CEI - Appendix C (TBD)

3.6.2 Not Applicable

3.6.3 Not Applicable

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not specify the manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in the respective specification.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Project managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

Within the guideline of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the Project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

None identified

10. APPENDIX

Document No. RS02934
Date 15 December 1971

INTERFACE AND SUPPORT REQUIREMENTS

MODULAR SPACE STATION PROJECT/LAUNCH OPERATIONS PROJECT

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/LAUNCH OPERATIONS PROJECT

Outline

1. SCOPE

This Interface and Support Requirements Document defines the interface and support performance, design and confirmation requirements for the Modular Space Station Project and Space Shuttle Launch Operations Project and their respective end-items. All interfacing end-items shall conform with the bilaterally agreed upon requirements established in this document and referenced in their respective specifications. The requirements specified are limited to project level to project level requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Project fall into two categories; those which are imposed by the Space Station Project on the Space Shuttle Launch Operations Project, and those which are imposed on the Space Station Project by the Space Shuttle Launch Operations Project.

2. APPLICABLE DOCUMENTS

None identified.

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Modular Space Station (MSS) and Launch Operations Projects. Each requirement is treated as a separate obligation against each project. Project to project requirements that do not require additional definition at the Contract End Item (CEI) interface level and/or will not require Interface Control Documents (ICD) to record and control implementation are contained in Sections 3.1 to 3.5. Requirements whose design solutions are implemented at the CEI level by ICD's are specified in Section 3.6.

3.1 Project Definition, General

3.1.1 The MSS Project is defined by RS02927, Project Specification—Modular Space Station Project, dated (TBD).

The Launch Operations Project is defined by (TBD), dated (TBD). Payloads shall be installed while the orbiter is in a horizontal position.

3.2 Characteristics, General

3.2.1 During launch, the Electrical Power Switching and Control functional assemblies shall be capable of operation, using internal batteries and/or regulated Space Shuttle power. The battery line regulators shall be utilized for voltage regulation when internal batteries are used.

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

None identified

3.5 Personnel and Training, General

None identified

3.6 Specific Requirements

3.6.1 Interprogram

3.6.1.1 Multilateral

This section contains all bilateral CEI level to CEI level requirements which affect two or more interfaces. The appropriate interfaces are noted by parenthetical reference to applicable appendices.

3.6.1.1.1 Requirements

3.6.1.1.1.1 Definition

None identified

3.6.1.1.1.2 Characteristics

3.6.1.1.1.2.1 Performance

None identified

3.6.1.1.1.2.2 Physical

None identified

3.6.1.1.1.2.3 Not Applicable

3.6.1.1.1.2.4 Not Applicable

3.6.1.1.1.2.5 Not Applicable

3.6.1.1.1.2.6 Safety

None identified

3.6.1.1.1.2.7 Not Applicable

3.6.1.1.1.2.8 Not Applicable

3.6.1.1.1.2.9 Not Applicable

3.6.1.1.1.3 Design/Construction Standards

None identified

3.6.1.1.1.4 Logistics

None identified

3.6.1.1.1.5 Personnel and Training

None identified

3.6.1.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.1.1.3 Exchange Services and Performance Periods

None identified

3.6.2 Not Applicable

3.6.3 Not Applicable

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not specify the

manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in the respective specification.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Project managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

Within the guideline of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

None identified

10. APPENDIX

None identified

Document No. RS02935
Date 15 December 1971

INTERFACE AND SUPPORT REQUIREMENTS

MODULAR SPACE STATION PROJECT/MISSION OPERATIONS PROJECT

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/MISSION OPERATIONS PROJECT

Outline

1. SCOPE

This Interface and Support Requirements Document defines the interface and support performance, design and confirmation requirements for the Modular Space Station Project and Space Shuttle Mission Operation Project and their respective end items. All interfacing end-items shall conform with the bilaterally agreed upon requirements established in this document and referenced in their respective specifications. The requirements specified are limited to project level to project level requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Project fall into two categories; those imposed by the Space Station Project on the Space Shuttle Mission Operations Project, and those imposed by the Shuttle Mission Operations Project on the Space Station Project.

2. APPLICABLE DOCUMENTS

None identified

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Modular Space Station (MSS) and Mission Operations Projects. Each requirement is treated as a separate obligation against each project. Project to project requirements that do not require additional definition at the Contract End Item (CEI) interface level and/or will not require Interface Control Documents (ICD) to record and control implementation are contained in Sections 3.1 to 3.5. Requirements whose design solutions are implemented at the CEI level by ICD's are specified in Section 3.6.

3.1 Project Definition, General

3.1.1 The MSS Project is defined by RS02927, Project Specification - Modular Space Station Project, dated (TBD).

The Mission Operations Project is defined by (TBD), dated (TBD).

3.2 Characteristics, General

None identified

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

None identified

3.5 Personnel and Training, General

None identified

3.6 Specific Requirements

3.6.1 Interprogram

3.6.1.1 Multilateral

This section contains all bilateral CEI level to CEI level requirements which affect two or more interfaces. The appropriate interfaces are noted by parenthetical reference to applicable appendices.

3.6.1.1.1 Requirements

3.6.1.1.1.1 Definition

None identified

3.6.1.1.1.2 Characteristics

3.6.1.1.1.2.1 Performance

None identified

3.6.1.1.1.2.2 Physical

None identified

3.6.1.1.1.2.3 Not Applicable

3.6.1.1.1.2.4 Not Applicable

3.6.1.1.1.2.5 Not Applicable

3.6.1.1.1.2.6 Safety

None identified

3.6.1.1.1.2.7 Not Applicable

3.6.1.1.1.2.8 Not Applicable

3.6.1.1.1.2.9 Not Applicable

3.6.1.1.1.3 Design/Construction Standards

None identified

3.6.1.1.1.4 Logistics

None identified

3.6.1.1.1.5 Personnel and Training

None identified

3.6.1.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.1.1.3 Exchange Services and Performance Periods

None identified

3.6.2 Not Applicable

3.6.3 Not Applicable

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not

specify the manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in the respective specification.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Project managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

Within the guideline of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the Project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

None identified

10. APPENDIX

Document No. RS02936
Date 15 December 1971

INTERFACE AND SUPPORT REQUIREMENTS

MODULAR SPACE STATION PROJECT/RAM PROJECT

PROJECT LEVEL
INTERFACE AND SUPPORT REQUIREMENTS
MODULAR SPACE STATION PROJECT/RAM PROJECT

Outline

1. SCOPE

This interface and Support Requirements Document defines the interface and support performance, design and confirmation requirements for the Modular Space Station Project and Research and Applications Module (RAM) Project and their respective end items. All interfacing end items shall conform with the bilaterally agreed upon requirements established in this document and referenced in their respective specifications. The requirements specified are limited to project level to project level requirements and do not address a detailed description of the subject interface. Interface and Support Requirements as viewed from the Space Station Project fall into two categories; those which are imposed by the Space Station Project on the RAM Project, and those imposed by the RAM Project on the Space Station Project.

2. APPLICABLE DOCUMENTS

None identified

3. REQUIREMENTS

This section records bilateral requirements with regard to Interface and Support Requirements of the Modular Space Station (MSS) and RAM Projects. Each requirement is treated as a separate obligation against each project. Project to project requirements that do not require additional definition at the Contract End Item (CEI) interface level and/or will not require Interface Control Documents (ICD) to record and control implementation are contained in Sections 3.1 to 3.5. Requirements whose design solutions are implemented at the CEI level by ICD's are specified in Section 3.6.

3.1 Project Definition, General

3.1.1 The MSS Project is defined by RS02927, Project Specification - Modular Space Station Project, dated (TBD).

The RAM Project is defined by (TBD), dated (TBD).

3.2 Characteristics, General

None identified

3.3 Design and Construction Standards, General

None identified

3.4 Logistics, General

None identified

3.5 Personnel and Training, General

None identified

3.6 Specific Requirements

3.6.1 Not Applicable

3.6.2 Intraprogram

3.6.2.1 Multilateral

3.6.2.1.1 Requirements

3.6.2.1.1.1 Definition

3.6.2.1.1.1.1 The ISS Modules are defined by CP02929, dated (TBD).

The RAM's are defined by (TBD), dated (TBD).

3.6.2.1.1.1.2 The physical and functional interface between the ISS and the RAM's shall be identical at the three radial docking ports of the Power/Subsystems Module and the radial docking ports of the Crew/Operations Module.

3.6.2.1.1.1.3 The ISS and RAM shall be capable of docking at any docking port and the interface shall provide for crew access to the habitable compartment of the RAM.

Each attached RAM shall provide an EVA airlock capability.

3.6.2.1.1.1.4 The ISS shall have the capability of monitoring, activating, and deactivating any RAM or RAM experiment.

3.6.2.1.1.2 Characteristics

3.6.2.1.1.2.1 Performance

3.6.2.1.1.2.1.1 Environment Control and Life Support

3.6.2.1.1.2.1.1.1 The ISS shall provide 540 cc/sec (136 cfm) conditioned air to each docked RAM. The RAM's shall provide distribution and circulation.

3.6.2.1.1.2.1.1.2 The ISS shall provide each docked RAM depressurization and repressurization within the limitations of the following paragraphs.

(a) Pumpdown storage capacity shall be 1.7 m^3 (60 ft^3) at 2070 kN/m^2 (300 lb/in^2).

(b) Pumpdown and repressurization flow rate shall be at least 0.135 Kg/sec (17.8 lb/min).

(c) Repressurization shall be limited by the volume limitations (TBD) in conjunction with the pumpdown storage capacity of 3.6.2.1.1.2.2.1.

3.6.2.1.1.2.1.1.3 Oxygen and Nitrogen shall be provided at a pressure of 410 kN/m^2 (60 psia) for tank pressurization and other equipment needs.

3.6.2.1.1.2.1.2 Structural/Mechanical

3.6.2.1.1.2.1.2.1 The structural/mechanical subsystem docking and hatch mechanisms on the ISS modules shall interface with the RAM modules, providing the capability for direct docking of RAM's by the Shuttle Orbiter and for completion of an airlock at the interface. This shall provide shirtsleeve crew access to the habitable compartments of the RAM modules.

3.6.2.1.1.2.1.3 Electrical Power

3.6.2.1.1.2.1.3.1 ISS electrical power shall provide the same capability to each RAM

3.6.2.1.1.2.1.3.2 The ISS shall provide 115 vdc power of up to 2.4 KW on a 24 hour average basis.

3.6.2.1.1.2.1.3.3 The ISS shall provide 115 vdc power of up to 3.6 kw on a one hour average basis.

3.6.2.1.1.2.1.3.4 The ISS shall provide 115/200 vac, 400 Hz power of up to 0.5 Kw on a 24-hour average basis.

3.6.2.1.1.2.1.3.5 The ISS shall provide 115/200 vac, 400 Hz power of up to 0.75 KW on a one hour average basis.

3.6.2.1.1.2.1.3.6 The combined loads of all RAM's and all integral experiments shall not exceed the combined power limits shown below. These allocations shall include power for experiments, RAM subsystems, and experiment support and integration equipment exclusive of the experiment support equipment function of the ISS.

ISS/RAM/INTEGRAL EXPERIMENT INTERFACE SERVICES
POWER ALLOCATIONS - KW

	Maximum 24-Hour Average (kw)	1-Hour Average (kw)	5-Minute Peak (kw)
115/200 vac, 400 Hz	--	2.4	2.8
Total, ac* plus dc	4.8	7.2	8.4

* Includes 115 vac 60 Hz and 400 Hz

3.6.2.1.1.2.1.4 Propulsion

None identified

3.6.2.1.1.2.1.5 Stabilization and Attitude Control

3.6.2.1.1.2.1.5.1 The ISS shall provide navigation parameters and attitude reference data to the attached RAM's via the data management subsystem to support pointing experiments. Attitude reference data shall define docking port coordinates relative to an inertial or earth centered reference frame. The standard docking port coordinates shall be defined as follows:

X-Axis — Nominally aligned with the longitudinal axis of the docked module. The positive direction is defined toward the centerline of the Space Station.

Y-Axis — Nominally aligned with the longitudinal axes of the Space Station. The positive direction is toward the right when viewing toward the positive X direction.

Z-Axis — Completes a right handed cartesian coordinate system.

The attitude reference data shall be accurate to within ±1.0 degree in each axis. Navigation parameters shall be accurate to ±1.8 km (±1.0 n.mi).

3.6.2.1.1.2.1.5.1 The ISS shall be designed to provide an environment in which the steady state disturbance level shall not exceed 10^{-5}g with application of operational procedures to reduce the effects of crew motion. During operations with normal crew motion, the ISS shall provide a disturbance level which shall not exceed 5×10^{-4}g. Activation of high thrust propulsion shall not be required during time periods which apply to either of these disturbance level requirements.

3.6.2.1.1.2.1.5.2 The ISS shall be capable of controlling the orientation of the cluster during all orbital operations for any combination up to five modules.

3.6.2.1.1.2.1.6 Communications

3.6.2.1.1.2.1.6.1 The ISS shall provide the reference signals required for the operations of the docked RAM audio terminal units via the analog data bus.

3.6.2.1.1.2.1.6.2 Emergency voice communications and public address information shall be provided on the analog data bus.

3.6.2.1.1.2.1.7 Data Management

3.6.2.1.1.2.1.7.1 Data management will interface with attached RAM's through an extension of the ISS data bus into the RAM's at each docking port for checkout and experiment operations.

3.6.2.1.1.2.1.8 Crew Habitability and Protection

3.6.2.1.1.2.1.8.1 Each attached RAM shall be capable of accommodating a 96 hour emergency pallet provided by the Modular Space Station Project.

3.6.2.1.1.2.8.2 The habitable compartment of the RAM shall be designed to provide a refuge for crewmen, utilizing the emergency pallet for critical supplies of oxygen, lithium hydroxide for CO_2 control, or water boiler for thermal control, food, water waste collection bags and a battery power supply.

3.6.2.1.1.2.1.9 Onboard Checkout and Fault Isolation

3.6.2.1.1.2.1.9.1 The ISS shall interface electrically with each attached RAM via the data management function for purposes of checkout and fault isolation. An additional hardwire interface between the local caution/warning system within each RAM and the ISS primary and secondary control centers shall be provided for purposes of transferring warning functions. These warning functions shall also be transferred via the previously noted data management function interface.

3.6.2.1.1.2.1.10 Experiment Support Equipment

3.6.2.1.1.2.1.10.1 The experiment support equipment shall interface with each RAM via the data management functions providing RAM and experiment control and support and experiment data processing.

3.6.2.1.1.2.2 Physical

3.6.2.1.1.2.2.1 The ISS shall be compatible with the requirement for crew access to docked RAM modules.

3.6.2.1.1.2.3 Not Applicable

3.6.2.1.1.2.4 Not Applicable

3.6.2.1.1.2.5 Not Applicable

3.6.2.1.1.2.6 Safety

None identified

3.6.2.1.1.2.7 Not Applicable

3.6.2.1.1.2.8 Not Applicable

3.6.2.1.1.2.9 Not Applicable

3.6.2.1.1.3 Design/Construction Standards

None identified

3.6.2.1.1.4 Logistics

None identified

3.6.2.1.1.5 Personnel and Training

None identified

3.6.2.1.2 Exchange Hardware and Delivery Dates

None identified

3.6.2.1.3 Exchange Services and Performance Periods

None identified

3.6.3 Not applicable

4. CONFIRMATION

This section contains agreements on the confirmation of Section 3 requirements. These agreements pertain to the assurance that each interfacing party has accomplished that to which he has agreed and do not specify the manner or method to be used in accomplishing that agreement. Any validation which necessitates verification shall be explicitly stated in the respective specification.

4.1 Responsibility for Confirmation

Each interfacing program/project shall provide the confirmation for which he has committed himself. Program managers shall review and approve project agreements and confirmation resulting from specific requirements.

4.2 Confirmation Methods

Within the guidelines of cost-effectivity, the method of establishing confirmation shall be subject to an agreement between the interfacing managers.

4.2.1 Management Reviews

At the respective management reviews (PRR, PDR, CDR, and CI) ICD's and other interface documentation shall be reviewed for compliance with I&SR requirements. In addition to requirements established in Section 4.1.3 of the project and CEI specifications, discrepancies shall be identified and bilaterally resolved prior to management review completion.

4.2.2 Data Transmittal (TBD)

4.2.3 TBD

5. PREPARATION FOR DELIVERY

None identified

6. NOTES

None identified

10. APPENDIX